THE DYNAMICS OF TOTAL QUALITY MANAGEMENT IMPLEMENTATION: A COMPUTER SIMULATION-SUPPORTED CASE STUDY

VOLUME 1

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ABSTRACT

The early 1990's saw the rapid increase in interest in quality initiatives as operational costs increased together with the stronger lobbying power of interest groups and environmentalists. Moreover, the stronger presence of the Japanese and other Asian economies in the world market, which is generally attributed to improved quality and lower costs, has threatened the traditional stronghold of Western countries. These developments, coupled with advances in technology and product development, has encouraged many organisations to adopt Total Quality Management (TQM), as they search for approaches to improve their competitive positions in the world market, and more importantly, their own survival in these highly competitive conditions.

However, attempts to implement TQM have not uniformly generated its promised benefits of improved quality, lower costs, customer satisfaction, and higher market shares. These mixed results have been attributed to a variety of reasons using theoretical and conceptual arguments, or empirical approaches such as surveys or case studies. Some of these attempts to explain the inconsistent performance of TQM have been criticised for failing to follow more rigorous methodologies, but more importantly, for pursuing objectives that do not necessarily lead to the better understanding of the TQM implementation process. Moreover, from the TQM perspective, some researchers have highlighted the weakness of this literature to address issues on definitions of quality, TQM and its related concepts; its underlying assumptions and conceptions; and, the contexts and contingencies that affect the implementation process. Furthermore, the generally prescriptive nature of TQM literature has overlooked the inherent complexity of the entire TQM implementation

system as its variables are intricately linked to each other to form feedback loops and as a result continuously adjust to each other. These weaknesses are addressed in this research through an extensive literature review, in-depth interviews and a computer simulation model with the goal of understanding the reasons for successes and failures of quality improvement efforts.

The empirical findings of the study identified financial and temporal resource-factors that affected the quality initiatives. These resources provide for top management visibility, middle management involvement and support, budget availability, training, facilitation, an incentive system, opportunities to participate and contribute, and acquisition and development of new skills and ability. Moreover, the interviews and case studies generally supported the initial proposal that the TQM process is indeed a dynamic process with complex interdependencies and contextual factors.

The theoretical findings from the computer simulation revealed the multiple mode behaviour patterns of the TQM implementation process. The tests showed that the same factors can lead to both improving or declining trends for levels of participation and total project generated, depending on the conditions prior to the launch of the TQM programme and to the level of resources that are made available throughout the implementation process. Furthermore, it was demonstrated that some dormant feedback loops that involved the complexity of the problems and improvement areas addressed by quality circles were activated in the long run, causing the outcomes of the programme to slide down and collapse. As more efforts to identify further improvement increases, the next set of problems become more difficult to identify and complex to solve. This leads to frustration, de-motivation and decreased interest to continue idea generation and solution activities.

This apparently inevitable collapse of a TQM programme in the long run was not resolved by the more traditional approaches of extending the life of the quality initiatives. Additional top management support and attention, more TQM staff and increased incentives were found to be largely ineffective in arresting the collapse of the programme. Indeed, these solutions only hastened the decline of participation and projects. More integrated solutions such as the control of frustration and difficulty through better training methods or TQM staff support also failed to prevent the eventual fall of the TQM programme. However, the approaches that were adopted by the Japanese, as they expanded the areas of operations of quality circles and the constantly improved products, equipment and processes, were found to be successful in sustaining participation efforts and improvement ideas generation.

The results of the study suggest that the traditional conception of top management commitment needs to be expanded to include more active tasks such as the search for new ways to sustain employee efforts to become involved in quality improvement. As the complexity of potential improvement areas increases, the time left for top management to act on this impending collapse decreases. Thus, inattention to this concern at the beginning of the programme can only let the reinforcing loops operate and aggravate the situation as to lead to a condition where it is difficult, if not impossible, to correct the situation.

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CHAPTER 1
INTRODUCTION

The recent years have seen an increased awareness and involvement in quality related activities. "Manufacturing to quality standards" was rated as the highest concern from among 32 choices by respondents from North American, Western European and Japanese companies in a Ferdows, et al. study in 1989. Dale and Cooper (1992) also found that a majority of Western Europe's top 500 corporations considered quality as critical to their operations. Indeed, the Scottish Enterprise (1991) reported an increasing number of firms that adopt the quality philosophy. Similarly, an Arthur D. Little (1992) survey showed that as much as 93 percent of America's largest 500 companies had adopted some form of a quality programme.

Mortiboys (1990) suggested that three developments motivated this shift in focus to quality. He opined that the emergence of consumerism as a commercial force in the United States, the rise of the environmentalist movement, and the entry of Japan and other Far Eastern economies in the Western dominated world market have influenced the change in management thinking. In addition, the increased costs of doing business and the blurring of the distinction between products and services helped in "fuelling the flames of the quality movement" (Seymour, 1992). Wilkinson, et al (1997:172) observed that in the recent years where product markets, technology and legislation have been changing, "enhanced quality is no longer seen as an option for management, but essential if market share is to be retained, let alone developed". Indeed, the British Deming Society recognises the necessity of transforming the traditional Western style of profit orientation "to halt the continued decline of industry" (Scottish Enterprise, 1991).

Kanji, et al (1992) observed that "many have insisted that quality be viewed as a competitive weapon and have treated it as an integral part of the value chain which enters into the process of long term strategic planning". Deming (1986) asserted that there is a chain reaction resulting from improved quality to customer satisfaction and continuance of the business. Moreover, the Scottish Enterprise (1991) views quality not only as an important factor in competition, and ultimately organisational survival, but also instrumental in achieving growth, prosperity and personal, corporate and social development.

Total Quality Management (TQM) provides the means to operationalise the quality concepts in the organisation (Seymour, 1992). TQM is seen as an integrated programme or a management philosophy (Ross, 1993) that involves a set of practices that, as claimed by its adherents, generates improved products and services, reduces costs, and leads to more satisfied customers and employees, and improved bottom line financial performance (Walton, 1986).

Nevertheless, the literature showed that the results derived from the programme have been mixed and rather inconsistent. Whilst a number of studies (Guimaraes, 1996; Harber, et al, 1993; Redman, et al, 1995; Ryan, 1992; Shiba, 1984; Zairi, et al, 1994) have shown the successful implementation of TQM with positive results and benefits, other writers have cited statistics that showed otherwise (Baatz, 1993; Kearney,1992; Poe and Courter, 1992). Cherkasky (1993) noted that

"TQM has come under attack for not living up to expectations". He suggested that although the programme worked well in Japan, it is not likely to work as well in the United States. Indeed, statistics from the American Electronic Association's survey (1992) showed that the percentage of their members with TQM programmes dropped from 86% in 1988 to 73% in 1991. In addition, the number of Malcolm Baldridge National Quality Award applications in the United States declined since 1990 (Jacobs, 1993).

1.1 Issues in TQM

The inconsistent results of quality initiatives suggest that there are certain limits that prevent full and successful realisation of the objectives of the TQM efforts. Two related issues explain these mixed results. On one hand, TQM has become a very popular management approach that offers managers a solution to many of their concerns. Its diverse concepts, initiatives and programmes make it a seductive philosophy of management (Pfeffer and Coote, 1991). Moreover, it holds out a promise of "a unified set of principles which can guide managers through the numerous choices [open to them] or might even make choosing unnecessary" (Huczynski, 1993: 289).

However, Gill and Whittle (1992) have noted that the attractiveness of TQM principles to managers is also partly attributed to consultants who are pressured into developing packages, products and services that will help their own companies through the more demanding and competitive consulting market. As a result, a number of quality principles are simplified and its underlying principles glossed over and not examined closely. Thus, it obscures the inherent difficulties of the programme and still encourages managers to adopt its simplified methodologies. Moreover, Powell (1995) observed that a number of earlier studies of TQM programmes were intended to show that TQM works. In this way, the interests of the sponsoring organisations, which were mainly consulting groups, were promoted. As a result of the widespread adoption of quality related activities and the failures and abandonment of many initiatives, TQM was dismissed as just another fad that will pass away (Jackson, 1995).

The second issue stems from the avoidance by management scholars to study TQM, partly as they may be seen as joining the ranks of "snake oil salesmen" (Abrahamson, 1996; Wilkinson and Willmott, 1995). Grant, et al (1995) also suggested that since TQM bypassed the leading management schools, management researchers have not been inclined to engage research in the area. One consequence of this disdain by academics is the virtual monopoly by quality gurus over definitions and discussions of this field (Wilkinson and Willmott, 1995). This is further complicated by leading advocates of quality management who are disinclined to refer to previous management literature, or, generally to any writings outside the quality management field.

Thus, Wilkinson and Willmott (1995) observed that whilst there are so many books that champion the cause of quality management (e.g. Dale and Cooper, 1992; Macdonald and Pigott, 1990; Oakland, 1989; Schroeder, 1994; Walton, 1986), there are so few studies that address quality and TQM's actual meaning, or reflect upon its practical implementation. Rees (1993: 2) noted that:

> There is usually very little discussion of the problems that managers may experience in applying the techniques, and little or no information about how TQM is perceived by employees. Moreover, the principles of TQM are assumed to be universally applicable, and one organisation is assumed to be much like any other."

Similarly, Morrison and Rahim (1993) report that literature "abounds with testimonies of the efficacy" of worker participation (which is a central tenet of TQM), however, information about successful participation is absent. They concluded that:

> "Perhaps the major shortcoming of the TQM literature is its failure to address substantially the barriers to implementation. In doing so, it depreciates the complexity of 'adopting a new philosophy' and limits its prescriptive value to managers it is intended to serve. What is needed are prescriptions informed by more rigorous examination of how the TQM approach is limited or supported by the existing culture of the organisation striving towards quality goals" (ibid. p. 148)

1.2 Research Aim

The foregoing issues suggest that TQM has not been fully understood nor appreciated. The popularisation and simplification of its concepts and techniques, the urgent need of managers for a 'cure-all' package and the disdain by academics to closely examine TQM principles all indicate that its underlying assumptions have not been properly investigated so that they can contribute to more successful adoption and implementation. Thus, this study aims to contribute to an effort to closely assess TQM from different perspectives and levels.

First, the concepts and principles of TQM are reviewed as it had been suggested that quality and TQM definitions have received scant attention in management research. A review of these definitions allows for the surfacing of the many of the underlying assumptions as well as hidden issues that may prove to be stumbling blocks to quality initiatives. Second, the factors that influence implementation efforts are also examined from the perspective of organisation theories as well as empirical and experimental literature. This may contribute to a better understanding of their criticality and the difficulty of managing these factors. Finally, this research investigates the TQM implementation efforts of some practitioners and their companies, and similarly analyses the critical factors that determine the performance of their TQM programmes.

This research takes the system dynamics approach and views the critical factors of TQM, as well as other organisational variables, from a dynamic perspective (as opposed to the implied static assumption of most studies). This research conceives the TQM variables as forming an information feed back system where the factors constantly interact and influence each other. This system perspective allows the analysis and inclusion of some underlying assumptions and hidden beliefs as they affect the more visible and concrete variables. Moreover, the system dynamics approach provides for a simulation facility that replicates the results of the factor interactions. Specifically, this study simulated the number of quality circles, the number of meetings and the participation rates and showed close relationship with the actual data from the company case. The simulation also generated the pattern of changes over the years of intangible variables such as perceived support from management and satisfaction with participation efforts. Furthermore, the simulation engine allows for extension of the behaviour into the future, as well as what-if experimentation and scenario analyses that would not be possible or practical in real systems. These experimentation and tests not only provide a facility to analyse current efforts as they impact on future trends (such as declining membership in quality circles) but also allow for the design and test of policies that aim to correct undesirable behaviour patterns. In system dynamic terms, this is known as policy design.

Ultimately, the research hopes to contribute to a better understanding of the processes inherent in, and underlying, the implementation of TQM.

1.3 Contributions of the Study

Eskildon (1994) suggests that one of the reasons why some companies are able to implement successful programmes whilst others derive little or no benefits is that implementers' TQM models are inadequate. Their knowledge and understanding of TQM is usually superficial. Furthermore, poor understanding of TQM "encourages simplistic process-improvement efforts that over treat symptoms and ignore or irritate root problems". Indeed, TQM programmes have been treated and promoted by consultants as simplified mechanistic processes to attract managers. This simplification obscures and neglects the more important underlying principles and processes (Gill and Whittle, 1992). Examining the details of the implementation process and including most of the important factors, and taking the dynamic perspective, can lead to a more comprehensive representative model. This resulting dynamic model of the current research overcomes the weaknesses of more prevalent static models.

Secondly, the present study can contribute to a growing literature that systematically and rigorously analyses TQM implementation processes. This growing literature, as evidenced by special editions of the California Management Review (1993), Systems Research (1994) and Academy of Management Review (1994), takes a more theoretically robust and objective perspective that correct the poorly designed and interest-biased TQM studies (Dean and Bowen, 1994; Powell, 1995).

Moreover, it has been pointed out that TQM lacks a solid theoretical foundation (Jackson, 1995). Academics such as Waldman (1994) and Sitkin and his colleagues (1994) have tried to propose theories for TQM. In the system dynamics field, theorising about TQM is being pioneered at the Massachusetts Institute of Technology (Sterman, et al, 1996). The present efforts hope to contribute to both areas of theory building.

1.4 Summary and Overview of the Thesis

The thesis is divided into two volumes. The first volume forms the essential reading the gives the reader an overview of the gaps and problems in TQM research, the findings from the study, the simulation model and the results of the simulation experiments. The second volume, on the other hand, provides the details of the tests conducted to verify the consistency of the model with its results.

The first chapter of Volume 1 introduced the general field of TQM by highlighting the main goals of the programme as it positions itself as a competitive strategy or weapon. It presents an broad overview of the studies that showed the mixed results of the performance of TQM in practice. Lastly, the chapter briefly described the system dynamics perspective of this study and how it can contribute to the better understanding of the TQM implementation process.

The thesis continues by providing a more comprehensive background of TQM: its historical roots, its main concepts and principles. Chapter 2 then concludes with some observations about issues and controversies of some TQM concepts as they affect the implementation process. Chapter 3 deals with a review of past TQM studies and identifies the more important factors in TQM implementation. In addition, these factors are discussed from organisation and management theory perspective. These factors are organised and integrated into a proposed dynamic model. Chapter 4 discusses the system dynamics approach focusing mainly on its main arguments and concepts based on feedback and simulation. Some relevant system dynamics studies are also reviewed in this chapter. Chapter 5 presents the research methodology.

Empirical data from the interviews and cases are presented in Chapters 6 and 7. Chapter 6 documents the results from the interviews with 14 academics, consultants and practitioners and indicates the interviewees' support for the proposed model. In addition, this chapter also presents two small cases that highlight the interactions of the proposed critical TQM variables. Some observations are made about the interviews and cases that provide further details for the model. Chapter 7 confirms the proposed model through the detailed experiences of Company C. This chapter prepares the ground for the development of a formal model in Chapter 8.

Chapter 8 integrates the information from the literature reviews and empirical observations into more specific relationships that are represented by non-linear differential equations. The output of this chapter is a formal simulation model. Chapter 9 presents an initialised model based on the data from Company C. The ability of the model to replicate the actual observed behaviour in the company case of the key indicators of number of quality circles, percentage participation, number of presentations and percentage meetings is tested in this chapter. Chapter 10 presents some experiments that show the reactions of the system to the more common measures and policies that have been implemented to support and sustain the TQM programme. Other possibilities to help improve the performance of TQM are also explored.

Chapter 11 concludes the thesis and the first volume with a summary of the observations from the literature, empirical and theoretical findings, theoretical and managerial implications, and possible extensions of the present work.

The second volume presents some of the technical details of the study. Chapter A2 reviews some system dynamics models of TQM programmes and compares their structures and logic. Chapter A3 presents the initial runs of the model developed in Chapter 8. This chapter shows 31 runs that involve different combinations of resource (factor) availability. These combinations, with varying presence of the factors, represent the different possibilities that TQM has been implemented in companies. Some companies provided for all the factors while others provided for only some of them. Chapter A4 tests the reaction of the system to changes in the availability of the resources (or factors). These are initial tests that aim to identify the criticality of factors in the success or failure of the programme.

CHAPTER 2
TOTAL QUALITY MANAGEMENT AND ITS CONCEPTS

The recent years have seen the rapid diffusion of quality issues in both manufacturing and service sectors and its growing importance has been well recognised. It has been referred to in various surveys as "critical" to their operations (Dale and Cooper, 1992; Ferdows, et al., 1989; Zeithaml, et al., 1990) and that its importance has significantly increased from its previous state in the 1970s (Dale and Cooper, 1992). Quality has also been described as "the single most important force leading to the economic growth of companies in international markets" (Feigenbaum, 1982:22). Together with quality, TQM has become a "ubiquitous organizational phenomena" (Dean and Bowen, 1994: 393) that has generated much interest from across different sectors of the economy, including public and non-profit organizations, and different countries. Krishnan, et al (1993) noted that in comparison to all other management innovations and initiatives, the quality movement has been the most influential or pervasive.

However, the recent years had raised some issues regarding its concepts. The meaning of quality and TQM has been characterised by ambiguity, haziness, inconsistency and lack of consensus (Dean and Bowen, 1994; Hackman and Wageman, 1995; Reeves and Bednar, 1994; Wilkinson and Willmott, 1995). Wilkinson and Willmott (1995) suggested that the various kinds of management techniques that have been identified with 'quality' generates an appeal that relates to its widespread adoption as "it can be used to legitimize all sorts of measures and changes in the name of a self-evident good" (p. 1). Moreover, they observed that the diverse and fluid meaning attached to quality also make it an elusive topic to study.

This chapter, thus, aims to review and examine some of these conceptual issues as they influence and affect the implementation process. The different conceptions of quality have diverse implications (Reeves and Bednar, 1994). Indeed, they suggest that "definitional difficulties account for the many of the inconsistent and often contradictory empirical results found in extant literature" (p. 436).

The second and third sections deal with TQM as a developing concept with a number of central principles and practices. The second section reviews the evolution of TQM and traces the roots of operational quality verification and maintenance practices. These activities, as they were influenced, refined and improved by theories, particularly, statistics, led to the development of what is presently known as TQM[1]. The chapter briefly mentions the ideas of Walter Shewhart, as well as the work of his protégés, W. Edwards Deming and Joseph Juran. The latter two persons proved to be influential in the introduction of quality management in Japan. The section also presents the development of quality management in the West, the final stage in the widespread use and practice of TQM in the world.

[1] According to Walton (1990), the name Total Quality Management was first suggested by Nancy Warren, a behavioral scientist in the United States Navy.

The third section deals with the core ideas and practices of TQM. It was observed that the theory and practice of TQM may not necessarily be the same and consistent. Indeed, Hackman and Wageman (1995) asked, "whether there really is such a thing as TQM" (p.309). The strategies for implementation are also examined in the fourth part of the chapter. It is recognised that the conceptualisation of the programme can have an effect on the strategy adopted to implement the programme. The fourth section thus reviews literature that reveals some of the issues and controversies about these concepts and the implementation strategies.

The chapter concludes with the impact of the concepts and principles on the operationalisation of TQM. The historical context and conceptual development provide some general insights and observations that can affect the implementation of TQM. Moreover, managerial perspective and concerns are observed to contribute to implementation decisions.

2.1 The Meaning of Quality

A review of the definitions of quality has yielded a diverse set that highlight different ideas and perspectives. These definitions have emphasised various features such as excellence (Tuckman, 1980), value (Abbott, 1955; Feigenbaum, 1951), loss avoidance (Taguchi, 1986), fitness for use (Juran, 1988), predictable degree of uniformity and dependability at low cost (Deming, 1986), conformance to specifications (Gilmore, 1974; Levitt, 1972), and, conformance to requirements

(Crosby, 1979). The more widely adopted definition in the present refers to quality as "meeting or exceeding customer expectation" (Buzell and Gale, 1987; Gitlow, et al., 1989; Gronroos, 1990; Zeithaml, et al., 1990). More lately, quality is being defined as "delighting the customer by continuous meeting and improving upon agreed requirements" (Macdonald and Piggott, 1990).

The various definitions of quality have been analysed by different writers to provide a better understanding and insight into their similarities and differences. For example, Garvin (1984) categorised the definitions of quality into the perspective taken by each. These five groups are transcendental quality, product-based quality, user-based quality, manufacturing-based quality and value-based quality. Later, Garvin (1988) proposed the seven dimensions of quality - performance, reliability, conformance, durability, serviceability, aesthetics and perceived quality - on which companies can choose to compete on.

On the other hand, Shiba, et al (1993) explained that the concept of quality in Japan evolved over the years. The meaning of quality in Japan changed with its practical considerations. The first definition referred to quality as '*fitness to standard*', highlighting the product's conformance to established standards and specifications. The weakness of this definition, particularly, the inadequate reflection of the needs of the customer, led to the second definition, '*fitness to use*', which assures that market needs are satisfied. The third development, '*fitness to cost*' built on the previous definitions by including another need of the customer, low costs. Finally, '*fitness to latent requirement*' anticipates changing customer needs and meets them even before the market are aware of these needs. Shiba, et al (1993) further noted that the evolution of the quality definitions reflected the historical context.

Reeves and Bednar (1994) reviewed the various definitions of quality in literature and found that the definitions are related to the context of the time period at which quality was examined. Thus, the roots of the customer-based definition can be traced in the marketing services literature. They suggested that the important catalyst for this shift in focus was the increased importance of the service sector in the US and other Western economies[2]. The second factor that contributed to the focus on customer satisfaction highlights the difficulty in applying the traditional concepts of quality in the services sector. These two factors together led to a new conceptualisation of quality as being governed by the extent to which a service met the expectations of the customers. They noted that the adoption of this new concept was reflected in the changes integrated into the definitions of quality in successive editions of books written by two acknowledged gurus of the quality movement, Joseph Juran and Armand Feigenbaum.

Analysing these definitions, Hardie and Walsh (1994) observed that the different definitions of quality are related but are not saying the same thing. They noted that possible contradictions are inherent in these definitions, observing that "it is possible to meet a specified requirement, but not satisfy the customer. It is

[2] Reeves and Bednar reported that in 1900 there were only 3 out of 10 workers in the US who were employed by the service sector. In 1990, the number was close to 8 in 10.

possible for something to be free of defects, but not fit for the purpose. A service may be of superior performance, but not conforming to requirements" (p. 54).

Nevertheless, by adopting a definition based on customer satisfaction, the other definitions are subsumed under its operations. Indeed, these customer expectations may involve established specifications and requirements as in many industrial products. Thus, in products and services that have specifications that reflect customer desires and requirements, customer satisfaction is directly related to conformance to specifications and requirements. Moreover, the focus on customer needs allows the inclusion of other attributes and weights in evaluating customer expectations. This can lead to competition among firms based on the different dimensions of quality (Garvin, 1988).

In reviewing the various definitions, Smith (1993) took a more philosophical approach. He argued that a concept's meaning is entirely different from its method or measurement or operationalisation. In particular, he criticised Crosby's advocacy of quality as "conformance to requirements", which, Crosby (1979) argues, is measurable, in contrast to "goodness" or "excellence". "Here, Crosby is making the mistake of equating the concept's meaning with its operationalisation or method of measurement ... What a concept means is one thing; how to measure it is another. ... more operational definitions like conformance to requirements run the risk of being exactly wrong" (p. 237). He noted that the definition as conformance to specifications also reflect a highly operational notion. Smith pointed out Juran's (1988) definition of quality as 'fitness for use' as having problems of operationalisation. He, however, favours Garvin's typology[3] (1984) as it bridges the gap between needs and product specifications. "The attributes (of Ishikawa (1990) and Garvin (1984)) identify what constitutes a quality product for users - what users want of a product - as well as performance measures and physical characteristics implied by those wants" (p. 239).

However, Reeves and Bednar (1994) found that quality defined as customer satisfaction when evaluated and compared with other definitions is the most complex definition. Whilst this definition allows for market responsiveness as it is externally focused, rather than establishing standards that are based on management judgements that may or may not be accurate (Wilkinson and Willmott, 1995), the measurement of customer expectations is very difficult. Indeed, Ackoff (1992) suggested that customers themselves do not know what they want. In addition, researchers do not agree on the causal order between customer service and customer satisfaction (Reeves and Bednar, 1994).

A second criticism against prevailing definitions of quality is the focus on the customer as the only relevant stakeholder (Smith, 1993). He noted that this notion of quality is founded solely on the customer/user as the stakeholder whose interest should be satisfied. He argues that both the producer's point of view of manufacturing should also be adopted with marketing's consumer perspective. This, he points out ensures that "they satisfy user needs as well as being profitable or otherwise beneficial to the firm" (p. 242). Considering the points on the abstract

[3] See Garvin's typology on page 14.

but relational nature of quality, and the importance of assessment to standards, he offered the following definition:

> "Quality is the goodness or excellence of any product, process, structure or other thing that an organisation consists of, or creates. It is assessed against accepted standards of merit for such things and against the interests/needs of producers and other stakeholders" (p. 240).

This definition, Smith (1993) pointed out, expands the notion of quality. It accommodates the concept of internal customers and other relevant organisational things, such as policies and structures, and, recognises other stakeholders other than the customer. Indeed, Juran (1988) earlier extended the notion of customer to include the internal customer, whose needs must also be met.

This extension of the concept further complicates the concept of quality. It opens up the topic of the various needs of employees. Ackoff (1992) brought the argument further by contending that the most important stakeholders in the organisation are the employees. He argued that:

> "If they are dissatisfied with the quality of their work lives, it doesn't make a difference what kind of quality program is imposed on them. Under such conditions they will not produce a quality product or service. On the other hand, if employees are provided with a very high quality of work life, one that is a challenge, exciting, fun, and offers

opportunities for advancement, managers don't have to worry about the quality of products or services; the employees will" (p. 69).

However, Wilkinson and Willmott (1995) noted that the pursuit of quality does not necessarily bring better working conditions and higher pay and benefits, even if improvement could have been generated by successful quality initiatives. They observed that "paradoxically, the very promotion of 'participation', 'teamworking', and 'empowerment' by quality management itself may prompt questions about the extent to which employees are treated and rewarded as full members of the organisational 'team', the extent to which they participate in key decision making, and the degree to which they are able to exercise control over their work" (p. 15).

The Japanese, on the other hand, do not seem to mind the complexity of customer-based definition of quality as they hold a still broader and more holistic perspective of quality. Ishikawa (1985, p.45) wrote: "Narrowly interpreted, quality means quality of product. Broadly interpreted, quality means quality of work, quality of service, quality of information, quality of process, quality of division, quality of people including workers, engineers, managers, and executives, quality of system, quality of company, quality of objectives, etc." Imai (1986, p. xxiii) offered a similarly broad definition that "quality is anything that can be improved".

Bounds et al (1994) noted that the Japanese definition of quality provides a total view that encompasses all the themes suggested by others. They argued that "managers who are committed to this view of quality have pragmatic solutions for translating the word "quality" into organizational realities" (p. 80). They noted further that these integrated themes provide a comprehensive approach to continuous improvement.

2.2 Historical Background of TQM

Quality is not a recent concept and quality practices have been recorded by ancient cultures (Juran, 1992). Quality was the traditional concern of the craftsman as he provided for the needs of his customers. Gehani (1993) noted that prior to the industrial revolution, the craftsman followed a highly integrated approach in producing goods in which he interacted directly with the customer to assess the needs and desires for the required goods. "The quality of a craftsman's output also embodied integration of creativity, managerial decision making, cost control and all other aspects of quality that modern organizations strive very hard to integrate" (p. 33). Wilkinson, et al, (1997) pointed out that the craft guilds of the Middle Ages functioned as standard setters as only those workers who proved capable of achieving the acceptable quality standards were admitted for membership.

However, the limited production capabilities of craftsmen did not match increased demand for their quality products and were forced to specialise operations and delegate functions and tasks to others. With the division of labour, the responsibility for maintaining quality was taken away from the workers. Workers were assigned simplified and standardised tasks whilst supervisors and managers planned and inspected their performance. Thus, the role of the worker was simply to ensure that the products were made according to specifications (Taylor, 1911).

The subsequent development of quality management can generally be grouped by the concentration of efforts in geographical locations. The first developments were undertaken in the United States. This can be traced to the publication of Walter Shewhart's book, *Economic Control of Quality of Manufactured Products,* in 1931. Shewhart argued that manufacturing processes involve inherent variability that is beyond the control of the worker. Moreover, such variability is random and as long as the variability can be computed as random, then the process may be said to be 'under control'. However, when the process variability moves beyond the limits that determine randomness, an investigation is necessary to identify its causes. These causes are not usually part of the process and must therefore be eliminated and prevented from occurring again. Shewhart, who worked for Bell Laboratories, developed some statistical techniques that would enable management to determine whether processes are within control or out of control.

Two other Bell Laboratories scientists, Harold Dodge and Harry Romig also made some advances in sampling techniques. Recognising that 100 percent inspection to sort good from defective was inefficient, Dodge and Romig developed sampling plans that provided for the number of items to be checked for each lot size. A reference-sampling table (based on probability) that determined whether a lot is acceptable or not was devised (Bounds et al, 1994).

These two statistical concepts helped Bell Systems to improve its telephone equipment and service for its customers, but found little impact outside the company. It was only during World War II when the US Army required large volumes of arms and ammunition from multiple suppliers that the War Department considered establishing a more systematic and efficient inspection system. A new set of sampling tables were developed using the concept of acceptable quality levels (AQL), which indicated the maximum percent defects allowable for a supplier to still be considered satisfactory. These techniques relieved the primary bottleneck, the understaffed inspection process, which was slowing down the production of war materials (Bounds et al, 1994).

The second set of developments in quality management was located in Japan. After the war, the Japanese Union of Scientists and Engineers (JUSE) invited W. Edwards Deming for a series of lectures. He taught executives and engineers to study and reduce variation through process control charts, and emphasised management's responsibility for continuous improvement of systems of production. Other concepts on quality such as the Plan-Do-Study-Act (PDCA, also known as the Deming cycle) and approaches to consumer research were also introduced by Deming (Bounds, et al, 1994; Walton, 1986).

The initial years of quality improvement in Japan were not an utter success. Senior management were not closely involved and the period saw an overemphasis on statistical methods, which many workers disliked because of their complexity (Ishikawa, 1985). The specifications and standards that were established often had limited influence on the workplace, and top and middle managers showed little interest (Wilkinson et al, 1998).

Ishikawa (1985) suggested that the turning point in Japan came with the arrival of Joseph Juran and Armand Feigenbaum in 1954, who encouraged management to make use of quality control. JUSE continued to support and promote quality. Indeed, JUSE facilitated the development of other quality innovations. These involved quality circles, problem solving work groups, which were originally conceived as study groups for foremen. Simple tools and techniques, such as cause and effect diagrams, that were easily understood and appreciated by workers, were introduced to support the use statistical process control in quality circle activities. Moreover, the quality circles evolved from a focus on small group operational tasks to a broader scope that involved company wide control - sometimes called Total Quality Control or Total Quality Management. Ishikawa (1985) observed that the development of this TQM has led to many managerial innovations such as supplier partnerships, cellular manufacturing, just-in-time manufacturing and hoshin planning.

Shiba et al (1993) traced the developments of TQM in Japan to parallel needs in the environment. In the 1950s, following the devastation from World War II, the primary aim of Japanese industry was to increase production. At this time, inspection, statistical techniques and standardisation facilitated the mass production goals of its industries and adopted the '*fitness to standard*' definition of quality. The 1960s, which saw the availability of most essential goods, required manufacturers to compete based on satisfying the customers through the variety of available products. This shift to market requirements involved the use of market research and cross- functional involvement. The oil crises of the 1970s suggested that quality must also reflect lower costs. To identify cost centres and to improve processes, techniques and tools such as quality circles (QC), the seven QC steps and the seven QC tools were developed. Finally, the trade surpluses of Japan with the rest of the world led to foreign currency exchange rates that made Japanese-made goods more expensive in the 1980s. Moreover, other Asian countries that adopted Japanese technologies were able to produce comparatively cheaper products at the same quality levels because of cheaper labour costs. In this period, there was a shift to the concepts of continuous change in the market needs that led to continuous shortening of product development cycles. To support this shift in focus, the quality deployment function (QFD) and management tools were developed and used.

The receptiveness of the Japanese to the quality message can be explained by three factors. First, the Japanese tradition for detail and fine craftsmanship matched the quality ideas of waste reduction and process reliability (Juran, 1993). Second, the statistical perspective of quality also matched the Japanese penchant for numbers (Crump, 1992). Third, Lillrank and Kano (1989) explained that quality was seen as a condition for survival for the nation.

The third set of developments in the quality movement was again centred in the United States and the West, in general, where the Japanese "economic miracle" began to attract managers and executives. Tuckman (1995) characterised this period of interest in the Japanese quality approach as involving four phases. The first phase, late 1970s to early 1980s, saw an increased adoption of quality circles (Collard and Dale, 1989) and the development of a huge 'Japanisation' literature in both academic and popular press. At the end of this period, the quality circles were largely seen as a failure. The second phase ushered in a wider programme of TQM. In this phase, TQM was seen as the means of organisational survival in a period of world recession. The quality activities were focused on the quality of suppliers and the adoption of quality accreditation standards. From the middle of the 1980s, there was a growing concern with customer service in the services sector. This third period saw the translation and application of TQM principles and practices to the services sector. The final phase in the re-introduction of quality management in the West occurred in the late 1980s. TQM began to be adopted by the public sector as quality management was seen as "possessing the potential to facilitate a programme that would address the criticisms of inefficiency, wastefulness and remoteness of public services" (Walsh, 1995).

In sum, the history of TQM may be viewed as a continued (continuing) refinement and extension of concepts and practices aimed at monitoring and maintaining quality. It steadily evolved from one form and complexity to another. Its roots can be traced to simple inspection procedures whose simple objective was to detect non-conforming products. This later developed to the concept of quality control wherein additional operational techniques such as product testing, basic quality planning and basic statistics were used to fulfil the requirements for quality.

The third stage in the evolution of quality management dealt with quality assurance. This level involved a more comprehensive set of activities to prevent the occurrence of quality defects through quality systems development, advanced quality planning, statistical process control and other techniques. Finally, the last stage of development is represented by TQM. In this stage, quality management principles are applied in all levels of the business, including suppliers and customers (Dale, et al., 1994).

Garvin (1988) offered slightly different labels as he focused on the emphasis, orientation and approach to quality at each stage of the quality evolution. Inspection emphasises product uniformity and "inspects in" quality. Quality control similarly emphasises product uniformity, but with reduced inspection, and "controls in" quality. Prevention of quality failures is the concern of quality assurance, and "builds in" quality. Finally, TQM (or strategic quality management) extends its emphasis to the market and consumer needs and "manages in" quality.

2.3 The Meaning of TQM

Seymour (1992) refers to TQM as the "means" to achieve the desired quality that ultimately leads to a competitive position in the market. A chain reaction results from quality improvement through reduced variations in output (Deming, 1986). He proposed the following relationship (p. 3): improve quality → costs decreases due to less rework, etc. → productivity improves → capture market with better quality and lower price → stay in business → provide more jobs.

Moreover, Deming (1986) explained that: "Improvement of quality envelops the entire production line, from incoming materials to the consumer, and the redesign of product and service for the future" (p. 4). He proposed 'The Fourteen Points' to embody the elements of his theory for management, suggesting that top management is responsible for maintaining quality in the organisation.

Anderson, et al (1994), on the other hand, proposed and articulated a theory of quality management to describe and explain the effects of adopting the Deming management method. They organised a panel of quality experts who identified 37 concepts underlying the Deming approach. By further analysis and clustering, they came up with seven concepts: visionary leadership, internal and external co-operation, learning, process management, continuous improvement, employee fulfilment, and customer satisfaction. A relational analysis of these concepts yielded to the following proposed theory of the Deming method:

> "The effectiveness of the Deming management method arises from leadership efforts toward the simultaneous creation of co-operative and learning organisation to facilitate the implementation of process-management practices, which, when implemented, support customer satisfaction and organisational survival through sustained employee fulfilment and continuous improvement of processes, products, and services" (p 479-80).

Other definitions of TQM similarly focus on quality as satisfying the customer through continuous improvement. Definitions of TQM also highlight its related concepts, methods and activities. An example of such a definition is given by BS 4778 Part 2 (1991):

> "A management philosophy embracing all activities through which the needs and expectations of the customer and the community, and the objectives of the organisation are satisfied in the most efficient and cost effective way by maximising the potential of all employees in a continuing drive for improvement."

Dean and Bowen (1994) proposed a more organised presentation of TQM's broad concepts. They viewed TQM as a philosophy or an approach that is characterised by principles, practices and techniques. Most of what has been written about TQM is explicitly or implicitly based on the principles of customer focus, continuous improvement and teamwork. Each of these principles is implemented through a set of practices such as customer information, process analysis, or formation of teams. Techniques such as customer surveys, quality function deployment (QFD), flowcharts and statistical process control (SPC), and team approaches in turn support the practices.

However, whilst there is general agreement on the general objective of TQM, Bounds et al (1994) observed that there is no complete agreement on the definition of TQM nor is there a consensus on how to put it in practice. Moreover, Wilkinson et al (1998) observed that TQM as an approach or philosophy of management is not self-evident. They further noted that despite the large literature on the subject, few studies have been made to address its actual meaning.

In general, TQM suffers from a number of conceptual and pragmatic definitional problems. One of the conceptual definitional difficulties involves the vague meaning of its central concept. The earlier literature review in Section 2.2 showed that quality is a "slippery" term (Garvin, 1988). The word quality "conveys notions of nebulous factors that are not readily measured or tied down" (Wilkinson, et al, 1998: 8). Thus, the ambiguous definition makes evaluation of the effects of quality management on business outcomes difficult (Reeves and Bednar, 1994).

Secondly, definitions of TQM have variously described or defined TQM as "a set of techniques and procedures" (Steingard and Fitzgibbons, 1993), "a system of means" (Brocka and Brocka, 1992), a "management system" (Rampey and Roberts, 1992), "programme"(Wilson, 1992), a "business discipline" (Hill, 1993), "a commitment and approach" (Schroeder, 1994), and "theory" (Anderson, et al, 1994) and "philosophy" (BS 4770). Other broader descriptions suggest that TQM represents a "paradigm shift" (Bounds, et al, 1994) referring to universal ideas that provides a model for solutions such as in a normal science that is being challenged by an alternative science (Khun, 1970). Each definition has its own implications on the understanding of what it exactly is. Moreover, each definition has its own focus that impacts on operationalisation concerns.

A third definitional problem of TQM lies in the variety of names and terms used to refer to TQM. It has been similarly known as total quality (TQ), total quality control (TQC), continuous improvement program (CIP), quality improvement (QI), quality management, strategic quality management, and some other names (Burr, 1993; Galgano, 1994; Hackman and Wageman, 1995; Schroeder, 1994; Seymour, 1992). Deming himself, Bounds et al (1994) noted, did not recognise the term TQM.

The history of TQM when it was adopted in Japan partly explains this multiplicity of TQM terms. Xu (1994) observed that when the Japanese adopted the concept of quality, quality control was translated into *Hinshitsu Kanri. Kanri*, however, literally translates to 'to manage' or 'supervise', and that the Japanese do not necessarily separate 'quality control' from 'quality management'. Later, the Japanese concept of Total Quality Control (TQC), which was originated by Feigenbaum (1951), was translated into English as Total Quality Management (TQM).

Fourth, a review of the main components of TQM shows that the number of features common among the quality experts can range from as few as four (Fine, 1985) to eight or more (e.g., Dale, et al, 1994; Macdonald and Pigott, 1990; Seymour, 1992). Schroeder (1994) proposed eight major premises of quality improvement: organisational mission, continuous improvement, customer orientation, leadership commitment, empowerment, collaboration/crossing boundaries, focus on processes and focus on data and statistical thinking. Powell (1995) combined the features promoted by Deming, Juran, Crosby and the American Baldridge Awards and came up with twelve factors: committed leadership, adoption and communication of TQM, closer customer relationships, closer supplier relationships, benchmarking, increased training, open organisation, employee empowerment, zero-defects mentality, flexible manufacturing, process improvement and measurement. Anderson and his colleagues (1994) identified as many as 37 key factors in Deming's management theory. Moreover, the differences in the focus of the various national quality awards (Ghobadian and Woo, 1996; Tummala and Tang, 1996) also similarly reflect the lack of consensus on the key features of TQM

The diverse interpretations on the core concepts of TQM stem from the number of leading proponents and practitioners who viewed and advocated quality improvement from various perspectives. Gehani (1993) summarised the work of some of the most influential persons in TQM and suggested that each had a different concept of how to address the quality issue (Table 2.1).

The ideas of the major quality proponents do not necessarily agree on certain issues. Some researchers (Cambridge Management Consultants (cited in Schroeder, 1994: p 6) listed the differences in the concepts advocated by Crosby, Deming and Juran. These differences lie in the use of slogans, the conception and effect of fear, the triviality of problems to be addressed to, the use of cost of quality, the definition of quality and the main thrust of TQM. However, when asked about the differences among the quality experts' differences in ideas, Crosby (1989: 79) pointed out that it is not possible to put Deming, Juran and him "in boxes with clear labels like in a zoo". He suggested that there are overlaps in their ideas. But nevertheless, he claimed that his approach focuses more on practical ways of dealing with the introduction of the quality improvement activities and the handling of organisational problems.

Table 2.1 Frontiers of the quality movement (Source: Gehani, 1993)

Frontier	**Main points**
Original Frontier (Taylor) Inspected Quality	simplified and standardised tasks for workers, whilst supervisors and managers planned and inspected their performance
Deming Frontier Process control Integrated Quality	process control and process variation reduction; active management participation and leadership necessary to reduce variations; stress on statistical training, constancy of purpose for continuous improvement, organisational pride and self esteem in workmanship
Juran Frontier Company wide integrated quality	hands-on leadership and involvement by senior management; quality trilogy of planning, control and improvements; quality breakthroughs; quality improvement as an integral and essential part of business plan, linked to each manager's performance review
Feigenbaum Frontier Total Quality Control	quality is determined by the customer; quality improvement lies in product design, basic production processes and scope of service.
Ishikawa Frontier Prevention Integrated quality	quality begins and ends with education, cause-and-effect diagrams; preventive aspects of quality; notion of internal customer; cross functional integration of quality
Taguchi Frontier Design Integrated Frontier	robust quality of design; design of experiments
Crosby Frontier Cost Integrated Quality	cost of quality; conformance to requirements; prevention of quality defects; zero defects performance standards
Kearns Frontier Market competition integrated quality	leadership through quality; meeting the requirements of the customers; benchmarking
Next Quality Frontier Innovation and market creation integrated quality	product personality dictates quality; new markets; product development not based on transitional market surveys

This last point leads to another definitional issue of TQM. The various versions of TQM, as advocated by the different quality experts, dealt with practical implementation considerations in different ways. First, the earlier review of the definitions of TQM's central concept, quality indicated varying concerns and foci. As previously indicated, each of these definitions of quality implied different levels of operationalisation. Indeed, Dale's (1991) found that managers typically favoured Crosby's approach mainly because of its ease of implementation.

Moreover, the expanded notion of quality that also involves internal customers proves to be an additional implementation difficulty. Indeed, Harber, et al. (1993) observed that "while TQM promotes the notion of internal and external customers and value of employees as a resource, many organizations adopting TQM appear to have some difficulty in translating this to employee equity. Employees seek equity for their involvement in and commitment to a TQM programme in a similar way to external customers expecting equity in exchange of money for products and services" (p. 24).

Secondly, the quality experts and consultants favour different practical approaches, tools and techniques that can be adopted to support quality improvement activities. Indeed, Hackman and Wageman (1995) observed a trend wherein a number of interventions, including some that are not related to TQM, are being proposed under the name of TQM. Thus, "the sharp and defining edges of a management program become blurred as more and more initiatives are launched in its name..." (p. 339). Hackman and Wageman (1995) explain that the introduction of various interventions is an attempt by practitioners and consultants to deal with implementation difficulties. Thus, these new ways of coping with implementation problems may bring TQM practice away from its original conception. Moreover, practitioners often mistake these tools and techniques for the entire concept of TQM (Bounds, et al, 1994).

Furthermore, Gill and Whittle (1993) observed attempts of consulting organisations[4] to make TQM more attractive and easily grasped by managers by obscuring of the subtleties lying under what is being proposed. Such developments on marketing of packaged approaches, coupled with the use of tales and stories "about the magic that the package has done for other managers" (p 290) contribute to a broadened and ambiguous definition of TQM.

Another implementation issue lies in the variations in the general approach that TQM takes in translating its concepts to reality. Xu (1993) categorises the practice of TQM into three manifestations. These different possibilities are also

[4] This development can be closely related to the marketing of OD and the increasing competition in consulting services. Krell (1981) wrote:

> Mainline OD consultants recognised that companies were "buying" OD to increase organizational effectiveness. ...Faced with increasing competition in a lucrative field, some OD consultants began to concentrate more upon the product as perceived by the customers - organizational effectiveness. ... Brand naming and packaging now give managers the opportunity to select the approach they like best" (p. 319).

Similarly, Darwent (1988) noted the intense competition among consulting firms and points that "differentiation is becoming more important ... the onus would seem to be on finding a product which is - or which can be marketed as being - as concrete as possible. The real politik of a falling market demands tangible results and quantifiability.... Today's nominalist consultancy catch-phrase is implementation" (pp 71-2). The results of such events are the development of seemingly different and more effective packages, and the use of simple packages devoid of theoretical, or academic terms.

reflected in the British Quality Association's (BQA) three alternative definitions of TQM (Wilkinson, et al, 1998).

Xu refers to the first manifestation as "programme-TQM". It is a new working framework that is dominated by an engineering mode of techniques. Moreover, it is characterised by a prescriptive package with a set of implementation steps or stages, supported by the tools and techniques. Programme-TQM highlights the structures and logic of TQM and assumed that participants are rational and co-operative. Moreover, the notion of a programme suggests that a new one with another set of assumptions and a promise of improvement and benefits can replace the old programme. Xu further noted that the "techniques and rules (in the programme) unwittingly turn out to be ends instead of means" (p17).

The BQA definition similar to this manifestation focuses on production aspects of quality. This involves systematic measurement and control of work, setting standards of performance and statistical procedures to evaluate quality. Wilkinson (1992) refers to technique-driven quality approaches as the 'hard approach' and involves less discretion for employees. A typical definition in this approach refers to TQM as "a set of techniques and procedures used to reduce or eliminate variation from a production process, or service delivery system in order to improve efficiency, reliability and quality" (Fitzgibbons, 1993).

In contrast to programme-TQM, the second manifestation, non-programme-TQM, "suggests an awareness that there is something fundamentally different about TQM" (Xu, 1994: 18). This, among others, includes the change of culture. She describes the culture change in TQM as a transformation of states of mind from the traditional rational scientific management. Galgano (1994) pointed to three elements of quality culture: mental mechanisms that involve critical thinking approaches; management rationales that provide the criteria or guidelines that drive managerial activities to continuously support TQM; and, a company wide mentality, shared beliefs that are consistent with TQM principles. Wilkinson et al (1998) suggested these 'soft' characteristics of TQM typically involve themes proposed by US consultants such as customer orientation, culture of excellence, removal of performance barriers, teamwork, training and employee participation. This manifestation views TQM as being consistent with open management styles, delegated responsibilities and increased autonomy to the staff. Evans and Lindsay (1993: 28) offer a definition that reflects all these concerns: TQM is an "integrative management concept for continuously improving the quality of goods and services delivered through the participation of all levels and function".

The third manifestation, holistic management, challenges the mentality of reductionist and functionalist thinking in management. This view represents a departure from the conventional management mental models and leads to a more philosophical framework (Xu, 1994). It is a mixture of 'hard' and 'soft' TQM and comprises three features: an obsession with quality; the need for scientific approach; and the view that all employees are to be involved in this process (Wilkinson, 1992).

Grant et al (1993) viewed TQM as representing a challenge to the prevailing paradigm of the economic model of the firm[5]. Bounds' et al (1994) suggestion that TQM can represent a 'paradigm shift' that involves a shift of the whole field of management. Following Khun's logic (1962), they suggested that the managerial stage of normalcy, which was dominated by Taylor's scientific management and Weber's theory of bureaucracy, was threatened by anomalies characterised by declining competitiveness of American industries. They observed that the emerging paradigm that is set to replace the old paradigm highlights three themes: customer value strategy that is supported by the cross-functional organisational systems and driven by the pursuit of continuous improvement. The shift in paradigm implies that TQM will become a "way of life" in organisations.

Hackman and Wageman (1995), in comparing the theory of the original gurus (Deming, Juran and Ishikawa) with the current TQM practice, found that some of the proponents' "sharpest and most distinctive ideas ... have been sanded down a bit"(p 318). However, they concluded that there is a substantial convergence of the TQM philosophy with its practice but cautiously concluded that "one can in 1995 still point with some confidence to the constellation of ideas and interventions that form the core of TQM, and one can, with less confidence, show how that constellation differs from others. At least for now, there is indeed a "there" there for TQM" (p 319).

[5] The main premises of the economic model of the firm are: the firm's objective is maximization of shareholder wealth; individuals are self-interested; rational decision makers driven primarily of economic goals; economic relationships between individuals are governed by contracts; and, cost efficiency determines the contractual form and institutional structures (Grant et al,1994).

On the other hand, other writers view such conflicts and issues in TQM definitions as rather transitory and necessary in the development of TQM. Wilkinson et al (1998) observed that the list of TQM features provides an ideal template that few organisations can match. Thus, Xu (1994), suggest that this holistic TQM is a direction towards which the current practice of TQM should be headed for.

2.4 Some Implementation Issues

The conceptual and practical issues in both quality and TQM are instrumental in the practice of TQM. The evolution of TQM in Japan (Shiba et al, 1993) revealed that quality management was dependent on the changing meaning of quality, which in turn, was determined by changing requirements of industry and the market. Thus, as the market shifted from product availability to more specific product features and requirements to cost efficiency, the appropriate tools and techniques were developed to support and facilitate quality management. This parallel development of quality and TQM implies an understanding of what quality comprises so that it can be exploited and developed to successfully compete in the market.

Indeed, Eskildon (1994) argued that successful implementation of TQM partly relies on the model that outlines what TQM is. However, the variety of combinations of the various conceptions of quality; the numerous elements and principles of TQM; and its diverse practices, tools and techniques can bewilder an organisation that embarks on a quality improvement programme (Krishnan, et al, 1993). In one case, after the training sessions on TQM were concluded, the middle managers of the facility were left wondering, "Where do we go from here?" (Hemphill, 1996).

The literature review showed that efforts by consultants to minimise the confusion and difficulty brought about by such great possibilities of concepts and techniques of TQM led to simplification of its basic tenets. This seeming improvement to address the problem perhaps led to a different problem of understanding – one of superficial knowledge and understanding of TQM (Eskildon 1994). In particular, he suggested that following any prescribed approach can lead to a very narrow and simplistic understanding of TQM. Flood (1993) added that slogans such as 'quality is free' create an impression that quality improvement efforts can realise its promised benefits without much effort. Some commentators have suggested that TQM is simple in theory, but proved difficult to implement (Giles and Williams, 1991). Indeed, the review of literature in Chapter 3 includes some empirical studies that indicated inadequate understanding of TQM among managers contributed to the limited success derived from TQM.

Furthermore, as the literature review revealed, a number of concepts and issues are not explicitly resolved by the definitions. One particular issue is employee participation. Wilkinson, et al (1991) observed that there seems to be a contradiction between employee involvement and TQM's emphasis on clearly laid down instructions. In addition, Morrison and Rahim (1993) pointed out that:

"A major shortcoming of the participation prescription is its simplified view of the worker. It uses the concept of participation as a social process to summarise the complex effects of human interaction. Clearly, 'participation' is not sufficiently comprehensive to capture the multi-dimensional and complex world of human interaction; the TQM prescriptions ignore such elements as interpretation, biography and impulse. While emphasising the criticality of employee participation to quality processes, the consideration of the role of employees - their perceptions, skills and interests - is remarkably neglected. The prescriptions widely assume that workers have both the skills and the desire to participate." (p 145)

Another implied assumption deals with organisational politics. Wilkinson and Witcher (1993) observed that TQM implicitly follows a management strategy that is seen as a rational and linear process. They argued that this neglects some management literature that emphasised management as a political process, where groups compete for influence and power. They pointed out that TQM needs to recognise the political reality of organisational life. However, "this does not mean TQM cannot get off the ground, but merely that an awareness of this is likely to lead to a clearer picture of the obstacles to implementation" (p. 55).

The model for implementing TQM is critical to the success of the change efforts (Eskildon, 1994). This echoes the common view in strategic management literature that "every failure of implementation is, by definition, also a failure of formulation" (Mintzberg, 1994).

These models for implementation are usually operationalised by programmes that specify the 'how' of change rather than the 'what' (Wilson, 1993). The quality experts or quality consultants typically provided organisations with a set of procedures or guidelines in implementing TQM. However, these procedures are not necessarily free from ambiguity. For example, Crosby (1979) proposed a 14-step programme, which involves carrying out a set of activities. Each step is intended at building on the preceding steps so that the shift to quality is systematically introduced in the organisation. However, Crosby (1989) himself pointed out that "the steps are taught in sequence only because they need to be discussed in some logical fashion" (p. 70). He specifically, suggested that step 8, which deals with education actually starts before step 1, which is management commitment. Moreover, he noted that the timing of the steps depends on the situation, such as management's readiness to commit itself to error cause removal or zero defect philosophy. He added, "the 14 steps of quality improvement were never intended to be a calendar".

Similarly, Deming's (1986) 14 points needed some clarification. He pointed out that "failure of top management to act on any of the fourteen points ... will impair efforts on the other thirteen". Thus, caution has been stressed against the interpretation of or embracing each point independent of the other points (Gitlow, et al, 1989).

Moreover, Eskildon (1994) noted that the typical activities that dominate a culture change approach involved widespread training on TQM concepts and tools, creating empowered teams, involving staff in complex planning processes; creating statements of mission, vision and values; and developing various Baldridge Award-endorsed activities. However, the value of these activities is "often undercut by a wide-spread tendency to implement them without clear, measurable goals for improving customer-valued outcomes or without a plan for objective activity assessment and improvement" (p. 62). Thus, some confusion, long implementation time frames, ineffectual and inadequate efforts, frustration and resistance usually follow.

Another implementation issue is suggested from the broader organisation change literature that claims that change programmes such as TQM do not work because they are guided by a theory of change that is "fundamentally flawed" (Beer, et al, 1990). "While senior managers understand the necessity of change to cope with new competitive realities, they often misunderstand what it takes to bring it about" (p. 158). The common belief is that the starting point of the change effort is with knowledge and attitudes of individuals as this will lead to changes in individual behaviour, and eventually the entire organisation. "Buzzwords like "quality," "participation," "excellence," "empowerment," and "leadership" become substitute for a detailed understanding of the business. They argued that the most effective approach to changing behaviours is through new organisational contexts that imposes new roles, responsibilities and relationships on people. They concluded that companies need a specific mind set for managing change: "one that emphasises process over content, recognises organisation change as a unit-by-unit learning process rather than a series of programs, and acknowledges the payoffs that result from persistence over the long period of time as opposed to quick fixes" (p. 166).

2.5 Discussion

There seems to be two important threads of thought that run through the issues suggested in this discussion. First, there is the underlying issue of functionalism and pragmatism against the more theoretically based conceptions of quality and quality improvement. This observation has been reflected in different ways: in Crosby's (1989) emphasis on his experience as a manager, in contrast to the teaching experience of Deming and Juran; in the importance of measurement implied by other definitions of quality as opposed to the real, albeit, abstract essence of quality (Smith, 1993); and, to the expanding yet simplified notion of TQM by consultants and other advocates, as compared to the more complex conceptualisation and interpretations (e.g. Bate (1993) chose to discuss culture change as a complex field).

Such points re-surfaces the old arguments between theory and practice, one that can be traced to the Platonic-Aristotelian view that knowledge was acquired for its own sake rather than for some use (Gill and Johnson, 1991). Academics charge the leading TQM advocates as being disinclined to refer to previous management literature, or indeed, refer to anything outside the TQM field (Wilkinson and Willmott, 1995; 1996). They further observe that other academics, "who are not busy promoting the quality revolution have been inclined to be contemptuous of its triviality, dismissing ideas about quality as merely the latest in a long line of management fads or 'snake oils'" (p 2). Thus, they conclude that the result led to a virtual monopoly of the definition and discussion of quality issues by the quality gurus.

Thus, it is interesting to note that discussions on TQM have leaned on the more practical positions, reflecting the consultants' biases and managers' preferences. The concern for practice and adoption of the more "common-sense" actions and techniques has, in turn, largely led to a second thread: the lack of awareness or ignorance, or the neglect, or the disregard, whether consciously of not, of many of the theoretical debates in the management and organisation fields. Hackman and Wageman (1995) observe that the implementation efforts face a number of dilemmas on employee motivation, commitment, continuous learning, and issues on empowerment and control. The interventions adopted to deal with these dilemmas do not necessarily reflect the use of theoretical considerations as proposed in management literature. Moreover, there has also been the common approach of learning and adopting the 'best practice', which to a very general extent, ignores the contingency theory wherein context in which change is introduced is considered an essential determinant of a successful implementation.

Thus, TQM literature generally seem to straddle both sides of these management and organisational debates, or at an extreme, take the less popular position, or one that is contrary to more accepted position. For instance, TQM emphasises interdepartmental co-operation. This stand reflects a disregard for the long-standing concepts of departmental specialisation. TQM also seem to take a stand against organisational control, and advocates autonomy and participation for its employees. This, needless to say, has been one of the long-standing discords among the rationalist school and the labour process school. On the issue of rewards, TQM has been rather ambivalent: gurus have generally emphasised intrinsic motivation, yet in practice, extrinsic monetary rewards have been used. Finally, TQM has focused on employee commitment to action whilst management and organisation research has been more concerned in employee commitment as reflected and indicated by turnover and absenteeism.

Overall, Grant et al, (1995) view this as the challenge posed by TQM to conventional management. They note that TQM is in the centre of the conflict between the broad rationalist schools typified by scientific management and the human relations school. Drucker (1990) positions TQM as the bridge between these two irreconcilable schools. However, Grant et al (1995) argue that the real conflict lies more in the contradictions of the more conventional practices of strategic change and restructuring and, not only the management practices of TQM, but also, more importantly, with its theoretical underpinnings.

Nevertheless, Dean and Bowen (1994) conclude that there is significant consistency between TQM and management theory. In particular, there are close correspondence between TQM and HRM prescriptions on practices such as employee involvement, the use of teams, training needs and evaluation, and career management. However, they also note that TQ should be informed by management theory in areas such as strategy formulation, as well as consideration of contingency theory. On the other hand, TQM suggests new research directions for management theory.

2.6 Conclusions

This chapter focused on the various definitions of quality and TQM. Its main objective is not only to provide an overview of these concepts but also to examine the diverse issues involved. The literature reviewed in this chapter showed that both quality and TQM are broad concepts that have been interpreted from different perspectives and that it lacks a general consensus on its meaning. The ambiguous meanings are further distorted by the different approaches, techniques and tools, including concurrent engineering and just-in-time, that have been used as part of TQM. It is made more complex by the use of unrelated techniques and tools to resolve some of its difficulties.

The ambiguities of the concepts are not exactly resolved but continue to develop and expand as theoretical definitional issues are left for managers and implementers to clarify. A number of writers have noted the evolving nature of quality and TQM was mainly the attempt by practitioners to deal with changing conditions, especially reflected in Shiba's, et al, (1993) account of the development of quality concepts in Japan. Indeed, Gehani (1993) observed that the Japanese have now shifted their concept of quality as they now consider the competition-based view of quality as traditional, obsolete and obvious. He reported that since the middle of the 1980s, Japanese manufacturers have concentrated on *mirhyoku-teki hinshitsu* or admirable quality and market-creating quality products and services. Shiba et al (1993), on the other hand, foresee that quality will be referred to as '*fitness to corporate culture*' to reflect the entire organisation, from production to the product's place in corporate strategy. They also noted that increasing pressure for environmental concerns can lead to a definition of quality as '*fitness for societal and global environment*'. These shifts in the meaning of quality are expected to lead to a new search for tools and techniques to promote quality improvement.

Taken together, each organisation is offered a vast number of possibilities of implementing a version of TQM that may cater to its own needs and requirements (Bounds et al, 1994; Gehani, 1993). It has a choice of a different conception of quality and TQM. Because of this, each organisation may develop its own brand of TQM, one that may not be exactly the same as the next organisation's programme. Because of this, TQM, indeed, becomes an elusive topic to study (Wilkinson and Willmott, 1995).

CHAPTER 3
LITERATURE REVIEW: THE PRACTICE OF TQM

The preceding chapter reviewed the theoretical conception of the related aspects of quality and TQM as they impact on the TQM implementation. In contrast, the first part of the present chapter deals with the real issues faced in the implementation process. These issues form much of the concern of TQM literature (Motwani et al, 1995). This chapter seeks to identify the weaknesses of this literature and its failure to satisfactorily explain the mixed results of TQM efforts. Secondly, it proposes a model that integrates these factors.

This chapter explores the empirical literature on the implementation of TQM and examines how organisational factors support the TQM process. These factors are also examined closely to find related issues that can account for the difficulties and problems of the practice of TQM. In addition, the results of these researches are viewed from the broader organisation and management theory literature to utilise the experience and understanding of these more developed fields of research.

The first issue that is raised in the literature deals with the benefits that are derived from TQM practice. The realisation of these expected gains impact on the satisfaction with the quality efforts, and thus determines the perceived success or failure of these implementation attempts. The second section focuses on the studies that identify the critical factors that support or hinder the successful implementation of TQM. The most common critical factors are derived from the comparison of ten empirical studies. These factors are discussed and supported by other surveys, case studies and commentaries.

Finally, the chapter proposes an integrated TQM implementation model and makes some concluding observations from these studies.

3.1 Benefits of TQM

As noted in Chapter 1, quality has been seen as an important, if not the most important, basis for competitive success (Ferdows et al, 1989; WIRS, 1990)). The argument suggests that business results will improve with efforts to improve quality (Deming, 1986). This section reviews some studies that investigated the impact of quality on profits and other business and organisational results.

Profit Impact Marketing Strategy Associates (PIMS) (Buzell and Gale, 1987), using its database of over 3,000 businesses in North America and Europe, found a positive correlation between quality and profit. The study revealed that the higher the customer perceived quality index, the higher both the average return on investment and sales. In addition, the PIMS database suggested that improvements in perceived quality led to higher capacity utilisation, higher employee productivity, reduced unit marketing expenses, and improved market share. However, Buzell and Gale (1987) noted that the impact of quality to increase profits came mainly from the ability to charge premium prices. They explained that the cost reduction derived from improved quality is offset by additional cost involved in enhancing product/service attributes and features.

On the other hand, Wilkinson et al (1998) cited some studies by Andersen Consulting (1993; 1994) and IBM (1995) that showed that lean production, which share similar characteristics with TQM, has considerably reduced costs. It was noted that non-world class plants pay a considerable penalty in terms of higher costs, particularly in higher direct labour costs and higher material costs, than world class plants.

A number of writers have reported that TQM programmes have achieved similar results. These companies achieved improvements in defects and yields (Kofman, et al, 1994), cost reduction and lead times (Dugan, 1993; Welch and Geissler, 1992), spoilage (American Printer, 1993) and sales and profits (Dugan, 1993).

Wider industry studies also showed that there have been improvements in organisation results with the implementation of TQM. The ASQC 1992 Gallup survey (Ryan, 1992) of 600 executives revealed that 73 percent of those pursuing quality improvement reported significant results or were pleased with the results. A survey of 30 TQM companies by Kendrick (1993) indicated that average revenues increased by 54.7 percent whilst new product development went up by 52 percent. Another study that analysed the five-year performance of 29 TQM organisations found that a majority (76 percent) had positive returns on total assets and had healthier profit margins than the industry mean (Zairi, et al, 1994). Ginnodo and Wellins (1993) surveyed 6,429 personnel in 84 North American companies, and reported that the majority believed that TQM had moderate to high success in improving operational outcomes, customer satisfaction and retention and organisational climate. A more recent survey of 880 UK managers (Redman, et al,

1995) reported improvements in quality awareness, customer satisfaction, teamwork, customer complaints, cost efficiency, employee morale and productivity.

Harber et al (1993) compared two sister companies and found that the 'experimental' company with a TQM programme in place had statistically significant positive results than its 'control' sister company. The TQM company, which shared its structure and history with the other company until TQM was implemented, had employees who believed their ideas were valued and that management was more likely to make improvements in jobs and workplace. Moreover, they were better informed, have greater involvement in decision making, are more committed, and are more likely to give their best performance. Another study (Guimaraes, 1996) which compared employee perceptions before and after a TQM programme was implemented showed that there were significant improvements in employee attitudes about the job and the company. Employees reported a significant reduction in role ambiguity, and higher job satisfaction, job involvement, commitment to the organisation, and intentions to stay in the company. A study, cited by Shiba (1984), of quality circle leaders in Japan indicated that the programme led to improvements in teamwork, human relations, morale, skills and personality of quality circle members.

However, these positive reports have been contradicted by other studies that showed otherwise. Arthur D. Little summarised findings from 500 American executives by stating that "only one-third believe their TQM efforts made them more competitive" (Poe and Courter, 1992). A.T. Kearney (1992) reported that 80 percent of the TQM companies they had surveyed had not yet demonstrated success. More specific results were indicated in the American Electronic Association (1992) survey of 458 of its members. The study showed that 63 percent of those with TQM programmes in place failed to reduce internal defects by 10 percent or more, despite the programmes being in effect an average of 2.8 years. Moreover, 80 percent failed to reduce supplier defects by 10 percent or more, despite the programme being in effect an average of 2.4 years. Eskildon (1994) cited a report from Electronic Business that showed that only 16 percent of 138 surveyed executives said their quality programmes brought higher market share and only 13 percent brought higher operating income and profits (Baatz, 1993). In examining statistics on unrealised benefits from TQM initiatives, Eskildon (1994) concluded that "typical TQM implementation is a practice that will probably fail" (p. 61).

A more methodologically rigorous research is the Fisher (1993) study of the performance of four Australian organisations during a five-year period. He concluded that TQM did not result in significant direct improvements in overall company performance. Although some improvements in internal and external quality factors and isolated cases of productivity improvement were observed, Fisher questioned the significance of these gains. He explained that the "impacts of the quality management processes are greatly overshadowed by effects of internal factors (such as the decision to invest in new capital equipment) and the generally uncontrollable external (economic and competitive) factors" (p. 51).

Moreover, the pursuit of quality initiatives does not necessarily bring back the organisation to financial health. Eskildon (1995) noted that of 52 TQM-like improvement programmes he studied, only one or two were successful in improving their financial conditions. The Wallace Corporation went bankrupt a year after it was awarded the Baldridge Award (Hill, 1993) whilst Analog Devices Inc.'s share prices and return on equity fell in the same period that they improved some of their operational indices (Kofman, et al, 1994).

Other studies revealed that organisations were finding it difficult to implement TQM. Cruise O'Brien and Voss (1992), in their self-evaluation of organisations against the Baldridge awards criteria, noted that the "over-riding picture is that most UK firms are a long way from TQM and finding it difficult to get there". They reported that whilst there is widespread use of quality systems (especially BS5750), most organisations were in the early stages of TQM and having problems developing it. Indeed, other studies confirm that a majority of TQM adopters are in their early stages of implementation (Ginnodo and Wellins, 1992; Van de Wielle et al, 1993; Witcher and Whyte, 1992).

Nevertheless, Witcher and Whyte (1992) noted that TQM appeared to be moving away from its narrow quality management origins to a fuller version of TQM. They suggested that the TQM experience is associated with greater long-term planning, a co-operative interpersonal climate, joint problem solving, enabling management style, dynamic attitude to change and market focus. Van de Wielle and his colleagues' (1993) study showed that building TQM principles into the company's culture can take at least ten years although A.T. Kearney (1992) argued that success should be demonstrated within six months.

Zairi et al (1994) suggested that whilst TQM was shown to have a positive relationship with tangible results, TQM was simply a "license to practice" and does not directly lead to improvements in bottom-line results. Success is also founded on right strategies, right products and services, the right commitment and right investment strategies. Moreover, "the seeds of success and failure lie in every company's experience with quality management" (Krishnan, et al, 1993). They argued that "signing up a 'quality guru', swearing devotion to Dr Deming's Fourteen Points, or rigorously following the series of steps and checklists that comprise some of the most popular and proven programs still cannot guarantee that the benefits of quality improvement will outweigh the uncertainties and dislocation that these programmes can stir up" (p. 8).

3.2 Critical Factors in TQM implementation

There is a large anecdotal literature describing the factors and characteristics that are needed to effectively implement TQM (Reeves and Bednar, 1993). However, there are fewer empirical studies that deal with these important factors. A content analysis of the findings of ten surveys revealed that a number of factors were commonly seen as critical to TQM implementation by the various groups of respondents, a large majority of which were managers. Table 2.1 shows the top ten most frequently mentioned factors in these surveys.

Authors	Sample	Top mgt commit-ment	Systems/ policies	Training	Resources	Employee participation	Rewards	Culture	Middle mgt	Long term view	Knowledge
Benson et al (1993)	152	*	*	*	*		*				*
Calupitan (1993)	26	*	*	*	*	*	*	*	*	*	
Coulson-Thomas and Coulson-Thomas (1991)	over 100	*	*	*	*	*					*
Ginnodo and Wellins (1993)	6429	*	*	*		*	*	*	*	*	
Lawler et al (1992)	313	*	*		*		*	*	*		
Longenecker and Scazzero (1996)	137	*	*	*	*	*			*		
Powell (1995)	36 and 18	*	*	*		*		*			
Redman,et al. (1995)	880	*	*	*	*	*			*		
Reeves & Bednar (1993)	79	*	*	*	*	*	*			*	*
Van de Wielle, et al (1993)	358	*	*	*	*		*	*		*	*
Totals	over 8528	10	10	9	8	7	6	5	5	4	4

Table 2.1 Key factors of successful TQM programmes identified by empirical studies.

The table shows that top management commitment and the supporting structure of the programme are the most common factors identified in these studies. These are then followed by other support functions provided by management: training, resources and rewards. The next three common factors, which are employee involvement, culture and middle management support, involve the rest of the organisation's role in the TQM initiative. The last two factors represent an understanding and appreciation of the concepts and principles of TQM. These factors are discussed in the following sub-sections.

The review of prescriptive TQM literature showed that these factors are not necessarily separate and mutually exclusive. Top management commitment and leadership can be viewed from a broader and more encompassing perspective as to include the other factors. Macdonald and Piggott (1990) suggested that the task of top management in the TQM programme involved defining a constant organisational purpose improvement principles; ensuring a continuous programme of training and education; removing barriers to quality performance; providing the necessary resources; and, ensuring actions that demonstrate the integrity of the improvement processes. Moreover, it requires active involvement in the quality programme. An extensive literature review by Kasul and Motwani (1995) indicated that top management support is demonstrated in four distinct ways: planning for change, allocating budgets and resources, control through visibility and monitoring progress. These activities are inherent parts of the other TQM factors.

The results of this content analysis are comparable to Reeves and Bednar's (1993) review of TQM literature. They similarly found that top managers' commitment is the most frequently cited factor in the papers they analysed, most of which were anecdotal writings. The other factors were also mentioned, albeit, not in the same order of frequency.

Table 2.1 was also found to be consistent with Sheffield and her colleagues' (1993) study that reviewed quality circle literature and identified eight core factors. These factors were ranked based on their perceived impact by quality circle members in their company case. In both lists, top management commitment emerged as the most critical factor. Training was cited second in the literature but was only ranked fourth by the respondents. Middle management commitment went from third in the literature to second in the survey results. A fourth factor common to both the Sheffield et al (1993 study and the present literature review is the rewards. However, rewards were rated least among the eight factors in both of the Sheffield et al lists. The other factors, which included clear QC objectives, following QC process, voluntary participation and feedback can be classified under the policies and guidelines of the programme.

Further support comes from the more extensive review of empirical literature on quality circles carried out by Fabi (1992). He reviewed 40 empirical studies and came up with the 17 most cited factors. The top 5 factors that were found to be instrumental to quality circles are commitment and support from top management, commitment and support from middle and first line management, training, involvement and support of employees and union and circle leaders' training. The other factors that were cited can be categorised in the core factors identified by the present study.

Each factor will now be considered in detail.

3.2.1 Top Management Commitment

Top management commitment is recognised by all quality 'gurus' as being an essential precondition for the success of quality management (Wilkinson, et al, 1998).

Van de Wielle et al (1993) found that lack of top management commitment was not seen as a major difficulty in their sample. However, they pointed out that their findings on executive commitment were not as positive as the earlier report from a McKinsey and Company research. They noted that this level could still be improved. In contrast, the Redman, et al (1995) study revealed that lack of commitment, particularly from senior management, was a key concern. The senior managers were criticised for failing to demonstrate personal commitment and were variously accused of being sceptical, unenthusiastic, unwilling to commit resources, and treating quality management with a 'short termist' perspective.

The data from the Ginnodo and Wellins (1993) study showed that corporate leaders either "feed" or "starve" the quality initiative. The data indicated that senior executive resistance was high where there was low overall success for the programme. Conversely, companies with higher overall success with their quality efforts had low resistance at their top management levels. Garvin (1986) reported that high levels of quality performance were always accompanied by an organisational commitment to that goal and that high product quality did not exist without strong top management commitment. Indeed, the statistical analysis of Powell's (1995) study found that executive commitment was one of three variables that produced significant partial correlations for TQM performance. Executive commitment had the second highest mean among twelve factors that they studied. Similarly, corporate management's support to quality as a context was also reported to have strong relationship with actual quality management (Benson, et al, 1991). Flynn et al (1994) also found that quality leadership had the strongest relationship to quality management.

However, the study of Indian organisations by Motwani, et al, (1994) do not support these observations. They did not find strong support for the importance of top management's role. They explained that top management in their sample manufacturing firms were involved in developing quality policy but that implementation of these policies were strictly accomplished by the efforts of the quality department personnel. In these companies, cost and schedule objectives took precedence over quality objectives at the top management level. They concluded that effective quality levels were obtained even in the absence of top management support.

This controversial role of top management commitment in supporting the TQM implementation process suggested by this latter study may be reflected in the broader literature on leadership. Some writers suggest that leadership is a redundant concept that can be replaced by aspects of individuals, tasks carried out and the organisation itself (Thompson and McHugh, 1990). Indeed, Wilson (1992) suggested that TQM advocates effective leadership as a substitute for organisational structure, hierarchy and controls. He noted that such insistence on effective leadership is "a case of blind faith" (p. 97) considering the paucity of knowledge, conceptual disagreement and apparent gaps in knowledge in the leadership theories.

The importance of leadership may be questioned as its relationship with predicting subordinate's responses is not fully established (Stoghill, 1974). In addition, the romanticised view of leadership "amounts to what might be considered a faith in the potential if not the actual efficacy of those individuals who occupy the elite positions of formal organizational authority" (---, 1985: 79). They suggested that such a romanticised conception of leadership allow complex causal organisational events that are ambiguous and difficult to understand, to be explained by the effectiveness or failure of leadership. This was borne out in their archival studies that indicated that emphasis on top management significantly varied with performance levels. They concluded that "because observers are prone to overestimate the amount of control that leaders exert, ... a subscription to a romanticised view could be dysfunctional to the goals of an "objective" or rational assessment of important but causally indeterminant events" (p 97).

Moreover, empirical studies suggest some contingency factors that determine the importance of leadership. Lynne (1966) found that the experience, ability, training, motivation and independence of individuals would determine whether they need leadership or will react positively to being led. Stodgill's (1974) findings suggested that the effects of leader behaviour might be moderated by the nature of the subordinate's task and the subordinate's personality. The extent to which the task is satisfying, entails variety, related to a specific technology and autonomous will also influence the reactions to leaders (Scarborough and Corbett, 1992). Thompson and McHugh (1990) also suggested that organisational structure and culture, selection processes and reward systems could effectively reduce the need for leadership.

Nevertheless, the empirical studies in Table 2.1 establish top management leadership as a very important factor in TQM implementation. Leadership is viewed from a behavioural perspective: that the leader's actions conform and support the TQM principles and concepts (Dale, 1994). He pointed out that the leadership style of the chief executive shapes the cultural environment of the organisation and his action signals positive or negative influences on the rest of the organisation. Harber et al (1993) noted that individuals observe the behaviour of the dominant role models such as the chief executive, and attempt to reconcile these behaviours with the values espoused within the organisation and their own beliefs and values. "Thus if TQM and its associated value system is espoused by top management but is not seen to be implemented then incongruence will result and the TQM programme itself will be seriously questioned" (p. 21).

Daft and Weick (1984) contended that the significance of leadership does not lie in its direct impact on substantive matters but in the ability to exert control over the meanings and interpretations important constituencies give to whatever events and occurrences are considered relevant to the organisation's functioning. Thus, Dale (1994) suggested that TQM is more compatible with transformational leadership, which was found to have a statistically significant relationship with organisational commitment (O'Reilly and Chatman, 1986).

3.2.2 Systems, Procedures and Policies

The respondents of the studies mentioned a variety of factors that collectively refer to the structure of the TQM programme. Among these systems, procedures and policies are communication and information systems, programme promotion, activity prioritisation, process improvement and documentation, measurement, and supplier involvement (Calupitan, 1993). More generally, an alignment of organisational systems to support TQM activities is seen as necessary (Ginnodo and Wellins, 1993).

Hill (1991) noted that TQM avoids the problem of parallel and dualistic structures by integrating quality management into existing hierarchies. Companies modified their operating systems and procedures to include quality management as part of the normal method of managing and as a component of every managerial job.

A comparison of Japanese and American supervisors revealed some important differences in their manufacturing objectives and policies (Garvin, 1986). The Japanese reported a consistent set of policies concerning quality throughout their organisation, with quality as their primary objective. Corresponding policies that focused on quality were being formulated and communicated throughout the organisation. On the other hand, US supervisors indicated less emphasis on quality than meeting production schedules although they were evaluated against goals of rework, scrap and defects. Moreover, quality was seldom observed to be a dominant theme, nor was it communicated uniformly on the shopfloor. It was also noted that although there were written quality policies, the American supervisors did not always read them.

Motwani, et al, (1994) noted that quality policies are "practical embodiments of an organisation's attitudes towards quality, and therefore help in improving the level of quality" (p. 46). Their study found significant statistical support for the claim that specific quality policies are related to the level of quality. Three specific practices were identified in their sample companies: well-documented customer-directed quality policies; clear objectives determined by government regulations, customer expectations, market share growth, company reputation and profitability; and, periodic review of these policies.

Reeves and Bednar (1994) reported that top managers feared that implementation problems could develop from unclear directions from the executive board regarding TQM goals, boundaries and authority. Van de Wielle et al (1993) maintained that planning is an essential element of TQM as it recognises the change from detection to a prevention system. In the absence of a plan, employees were reported to be concerned with the lack of objectives and strategies and uncertainty as to what was required of them. In addition, a TQM programme that does not identify the mission, vision and quality policies of the business can face three other obstacles: lack of cohesive forces which drive quality throughout the organisation; quality may be seen as being foreign to the business; and, missed opportunity to strengthen teamwork at senior level (Lu and Sohal, 1993).

In a case study of two District Health Authority offices that had TQM programmes with a "dim future", Debrah (1994) observed that they experienced considerable difficulty in developing clear quality policies and operational structures. They were not able to give a definition of quality and how it should be adapted to health care delivery. As a result, quality standards were not clear and the position of quality circles was not fully understood. Moreover, there were no systematic and planned quality control measures, and the absence of monitoring procedures hindered the evaluation of the success of the programme.

On the other hand, Boerstler (1996), in her study of TQM implementation in hospitals found some situations where a formal quality council of senior managers that guides and oversees the TQM programme, is not necessary. The first situation involved a senior management that is not committed to the quality initiative. They cited a case where a hospital consciously decided not to establish a quality council because they feared that the council would not function well without its members' commitment. The quick results that were gained without management commitment later encouraged top management to become involved in the programme. They also found that in a few small hospitals with a participative culture, a formal quality council was believed to be unnecessary. The council was not seen as important in demonstrating commitment to quality because there was ample opportunity to interact and observe the senior managers. However, they pointed out that the absence of a quality council might pose a problem in the long term, as it tends to limit interdepartmental activities.

Indeed, the problems of these health districts were similarly reflected in other surveys. Longenecker and Scazzero (1996) reported that their respondents experienced communication breakdowns, ineffective corrective action procedures, conflicting and unrealistic goals, poor planning/organising, ineffective measurement procedures and unrealistic quality standards. In addition, Redman's et al (1995) respondents also indicated problems with measuring quality, clash with other initiatives and the lack of infrastructure.

Kuei, et al (1997) suggested that quality management tendencies were related to the structure and policies of the organisation. In a study of 86 middle managers, they identified three clusters of quality management practices: high-quality tendency, medium-quality tendency and low-quality tendency. They found that high-quality tendency organisations tended to have loose and simple organisations in contrast to medium and low quality tendency organisations that emphasised bureaucratic structures. In particular, the medium and low-quality tendency organisations stressed rules, administrative details and red tape, and had confusing organisational structures.

3.2.3 Training

Training was ranked as the most important TQM factor in the study by Ginnodo and Wellins (1993), higher than top management commitment. This finding supports Ishikawa's (1985) admonition that "Quality begins with education and ends with education".

Van de Wielle et al (1993) revealed that 'definition of quality' was ranked by four of the five sample sets in their study as the first priority in current training. Other training topics include quality audits, quality systems, ISO 9000 guidelines and criteria and problem solving. Moreover, the study indicated that the aspect of TQM most urgently required from training programmes included TQM and marketing, quality costs and TQM cost effectiveness, top management leadership in TQM, integration of quality and business planning and employee involvement in TQM. They noted that European organisations have not allocated sufficient funds for TQM education and training. However, the trends show that there is an increased recognition for the need and importance of formal TQM training.

Powell (1995) found medium relationship between training and TQM performance, whilst the Motwani, et al (1994) findings showed stronger statistical support that training improves the level of quality. The latter study observed that their respondents employed effective and efficient training programmes that educate and communicate a focus on quality to managers and employees. The training programme involved on-the-job training and classroom lectures on special processes and advanced statistical methods. Despite comments that the training were academic exercises and were not understood by illiterate workers, most of their respondents indicated that training played an important role in quality improvement.

Contrary to conventional approach of having all members of the organisation trained at the launching of the quality initiative (e.g., Crosby, 1979), Boerstler (1996) suggested from her study that it was not necessary to train everyone at the outset of the TQM implementation. She found that in all her sample hospitals, training was conducted on a team basis instead of the conventional widespread approach. "Just-in-time training" proved more effective in these hospitals because it encouraged physicians to participate and offered the organisations to quickly demonstrate results. Moreover, team training incurred less expense and caused less strain on the quality improvement infrastructure.

The effectiveness of training programmes was shown to be directly related to the trainers. In the Van de Wielle et al (1993) study, the main resources for training were company personnel and external consultants. However, Lu and Sohal (1993) found that the use of consultants who conduct training did not always succeed because of several reasons. One possibility is that the use of off-the-shelf training material may not be appropriate for the organisation. Other respondents suggested the lack of transfer of expertise and ownership. A third reason was the lack of depth of knowledge of the consultant-trainer. They concluded that the choice of consultant is critical to the success of the TQM programme.

Indeed, Hemphill (1996) attributed the failure of the TQM programme in a health facility partly to the performance of inexperienced consultants and ineffective training. It was observed that the training methods were not compatible with the members of the organisation, which were consequently met with resistance. Moreover, the presenters were seen as ineffective in imparting the message, partly as they did not practice what they had advocated. Furthermore, the consultants' training and presentation methods failed in teaching the use of statistical tools and techniques. The topic was considered 'foreign' to the employees and triggered some fear in them.

A review of education and training in management literature shows common prescriptions with the TQM literature (Dean and Bowen, 1994). They noted that TQM practitioners appear to implement techniques such as evaluation and systematic needs analysis and comprehensive training in a broad range of skills. One common concern is in the design and content of training, two factors that Noe (1986) found critical in training effectiveness. Similarly, evaluation of TQM training typically utilise reaction and learning measures, two criteria that have been studied in training research (Alliger and Janak, 1989).

More recently, there has been an interest in transfer of training, that is, the degree to which trainees apply the knowledge, skills, behaviour, and attitudes gained in training to their jobs (Wexley and Latham, 1991). It was shown that transfer training is a function of factors within the formal training context and the work environment. Baldwin and Magjuka (1991) found that trainees had greater intentions to transfer learning back to their jobs (a) when trainees received relevant information before the training programme, (b) recognised that they would be held accountable for learning, and (c) perceived training as mandatory. Ford and his colleagues (1992) suggested that work environment may limit the employees' ability to transfer what they have learned. Their study showed that some trainees who performed similar jobs experienced significantly different opportunities to apply recently learned skills on the job. Moreover, Pentland (1989) found that trainees who are not able to transfer their new skills are more likely to exhibit greater skill decay than those who were given more opportunities to practice what they learned. Rouiller and Goldstein (1993) showed that aggregate perceptions of transfer climate were related to post-training behaviours. Extending this latter study, Tracey et al (1995) concluded that various training-related cues in the work environment can facilitate or hinder the application of newly trained behaviours. Moreover, a continuous learning culture was also found to have a direct effect on the transfer of training.

3.2.4 Resources

Reeves and Bednar's (1993) review of literature suggested that financial resources that are allocated for the TQM programme are critical to the quality efforts. These funds are necessary to implement the training programmes to develop skills and knowledge. Secondly, the budget allocation can create incentives and rewards that can motivate employee participation. Resource allocation also involved human and technical resources to enable the required work to be done.

Quality management in the UK generally suffers from resource limitations as 'lack of resources' and 'cost constraints' were reported as the two most important difficulties (Redman, et al, 1995). In the US, Lawler, et al (1992) reported that the importance of resources availability slightly decreased from 28 percent of the respondents in 1987 to 21 percent in 1990. They attribute the differences to the economic conditions prevailing during the late 1980s.

Some of the Australian respondents of Lu and Sohal (1993) expressed concern with the high costs involved in quality accreditation. These costs typically included staff resources allocated to the project, fees of the accreditation authority, documentation costs and consultants' fees.

Another important resource that is necessary to support the TQM programme is time. Ishikawa (1985) estimated that in a medium to large company, the chief executive needs to devote between 15 to 20 days a year to quality improvement activities. These activities, among others, include acquiring TQM concepts, methodologies and tools from training, chairing the quality executive committee, participating in periodic presentations of management plans, quality circle projects, suggestions and other quality promotion activities, and defining policies and guidelines to support continuous improvement (Galgano, 1994).

Takeuchi's (1981) survey of companies with high quality performance revealed that 89 percent had presidents who regularly attended company wide quality events such as quality circle contests, visited factory floor and participated in training programs. On the other hand, a study of automotive suppliers (Lascelles and Dale, 1988) showed that the chief executive was involved in actual introduction, steering and management of the improvement process in only 25 percent of the respondents, even as 75 percent of the companies with TQM programmes had been sanctioned at Board level.

However, Mintzberg's (1973, 1975) study of executives concluded that these company officials are constrained by time availability. The study showed that managers work at an unrelenting pace and that they are strongly orientated to action and dislike reflective activities. The chief executives in his study were found to have spent a majority of their activities in short tasks that lasted less than nine minutes, and that only 1- percent of the executives' time were spent in open ended observational tours. Mintzberg explained that the managers were "simply responding to the pressures of the job". In fact, the executives terminated many of their activities, and often left meetings before the end. Minztberg also observed that the managers seemed to jump from issue to issue, continually responding to the needs of the moment. Thus, these figures suggest that the executives may find it difficult to find time to devote to quality activities.

Other members of the organisation reported that they similarly had difficulty finding time to devote to quality activities. Dale (1991) reported that 51 of 88 respondents indicated that their main difficulty in sustaining TQM was related to time pressures and workloads. Similarly, Lillrank and Kano (1989) observed that Japanese quality circles were also pressed for time and found it difficult to arrange circle meetings.

3.2.5 Rewards and Recognition

Rewards and recognition are a form of employee motivation in which the company identifies and thanks employees who have made positive contributions to the company's success (Carder and Clark, 1992). Recognition can make a positive contribution to the worker's pride. Moreover, in large organisations where the impact on the overall business of a specific task is often difficult to see, recognition provides an immediate feedback on the results of individual or team effort.

However, the views of the respected authorities in quality management suggest that financial incentives have little to contribute towards the implementation of TQM, and that they can be counterproductive (Crosby, 1980; Deming, 1986). Oakland (1993: 437) pointed out that "... it (financial incentive) does not form part of the TQM culture, and would defeat many of the objectives. Recognition and the chance to participate are the only incentives".

Deming (1986) views the use of performance appraisal and management by objectives (MBO) as one of the "deadly diseases" of Western management that is characterised by "management by fear". In this situation, the staff is forced to look for short term individual achievements in attempts to meet their immediate appraisal objectives. Thus, employees are discouraged from criticising management and the system, and the emphasis is on avoiding risk. Moreover, Crosby (1980) argued that to reward an individual's commitment to quality is to risk demeaning them, by attaching a price tag to their efforts. He claimed that recognition is the key, and recommended that organisations present quality awards and prizes.

It was also noted that rewards and recognition may create an expectation among employees that they should receive increased pay in return for taking greater responsibility for quality, and that they should share in the financial benefits of quality improvement (Drummond and Chell, 1992). This implies a risk of being disillusioned with TQM when these expectations are not met. Moreover, Walker (1992) suggested that quality initiatives 'run out of steam' three to five years on, as employees begin to lose interest with token rewards and praise. This is further characterised by a growing expectation that they are due a share of the financial benefits of their quality improvement efforts.

Nevertheless, Lillrank and Kano (1989) did not find much evidence that recognition is a strong motivator for participation in quality circle activities in Japan. Of seven motivators in circle activities, quality circle leaders rated 'one will get recognition from the company' least. In the factor analysis of this data, recognition was clustered with factors that indicated that people participated because they are expected to do so. They explained that direct monetary rewards for quality circle activities are so small that they cannot account for their participation. Their respondents rejected money as a motivator.

On the other hand, it was noted that systems rewards such as wages based on total corporate performance, corporate welfare, seniority-based salary increases, may serve as "lubrication" (p. 184) to participation in quality circle activities. Such rewards are seen from a broader system's perspective so that they believe that their efforts shall be rewarded in the due course. Okuno (1984) also suggested that system rewards are seen as motivators by inflicting a sense of fairness.

Despite the concerns of the quality gurus against monetary rewards, a number of managers still believe in the efficacy of rewards in supporting employee motivation. Indeed, six of the cited empirical studies indicated rewards as an important factor in TQM implementation. Other empirical studies have supported the use of rewards as being conducive to quality management. Ebrahimpour and Lee (1988) found that the way in which performance was measured and rewarded was key to high quality levels achieved by Japanese plants.

More recently, a comprehensive empirical study of performance-related pay and other financial incentives was done by Snape, et al (1996). They found that managers tended to rate their TQM programmes more successful in cases where formal quality indicators were linked to performance-related pay and formal appraisal of employees' performance. However, the relationship was not statistically significant. In addition, the comparison of organisations that had and did not have other forms of financial incentives showed no statistically significant difference in TQM success ratings.

Furthermore, the study found no evidence that that the use of financial incentives undermined the perceived effectiveness of the TQM programme, and that if anything, there may be a positive impact. The manager respondents indicated that linking of pay and bonuses to quality management indicators is associated with greater success in terms of improving quality awareness, teamwork, labour turnover, productivity, customer satisfaction and complaints, sales and profitability. The respondents were also compared based on a composite index of overall success from these fourteen criteria. The statistical analysis showed that the index of success was significantly higher for those organisations that had formal quality management indicators in their pay or bonuses. Testing the impact of various forms of incentives and appraisals by using the success index showed that the relationship was not significant or significantly positive. In sum, TQM appeared to coexist with financial incentives and appraisal practices.

Snape and his colleagues (1996) explained that role of the bonus was to highlight key quality improvement goals and to focus employee attention on these goals. "There was no question of attempting simply to 'buy' commitment to quality. Managers emphasised that the development of a 'quality attitude' was a gradual process and that pay alone was unlikely to bring about the attitudinal and behavioural changes required by TQM" (p. 15).

Carder and Clark (1992) argued that the importance of recognition (which includes financial rewards) does not lie in improving work by providing incentives for achievement. Rather, the system makes a statement about what is important to the company. They suggested that the recognition system provides an insight into the company's values in action. Indeed, a study of rewards system of Baldridge Award winners showed that dimensions such as involvement in continuous improvement initiatives and contributions to teamwork were emphasised (Blackburn and Rosen, 1993). It is argued that appraisals may contribute towards quality improvement by ensuring that employees are aware of the behaviours which contribute to high quality (Schuler and Harris, 1992).

3.2.6 Employee Participation

The objective of building quality into processes rather than simply inspecting the quality of the end product places the responsibility for quality directly to operators. The organisation is conceptualised as a chain of workers, each contributing to the final quality of the product or service. Performance failure of a single individual denotes a break in the chain and the failure to meet quality standards. Thus, all members of the organisation are enjoined to participate and become involved in the TQM programme (Oakland, 1993). The programme allows all employees to use their specialised knowledge and skills as well as their creativity to identify and resolve problems within their sphere of influence (Harber, et al, 1991). Thus, it needs to permeate all aspects of organisational functioning (Morrison and Rahim, 1993).

Empowering employees was ranked fifth among thirteen important variables of TQM by the respondents of the Ginnodo and Wellins (1993) study. Similarly, Coulson-Thomas and Coulson-Thomas (1991) found that employee involvement and commitment is very important to the management of change. High and medium quality tendency organisations in the study by Kuei et al (1997) had a high rating in the people dimension. Their practice of TQM dealt with an emphasis on empowerment, people skills and relaxed working climate. Morrison and Rahim (1993) suggested that the positive relationship found between quality and productivity may be largely due the use of worker participation schemes to execute the quality agenda.

However, Motwani, et al, (1994) did not find any significant relationship between employee involvement in quality efforts and the level of quality. They explained that in their sample organisations employee participation, particularly quality circles, failed because employee promotions were not solely based on quality performance and that rewards for quality work were done on a random basis. In both cases, workers were not motivated to participate. In another company study that compared participation levels before and after full TQM implementation, Harber et al (1991) found that there was no significant increase in perceived participation. They suggested that the measurement period may have been too short for the effects of TQM to be felt or that employee expectations may have changed in the intervening period. However, the research indicated that TQM may indeed require a lengthy time span to be properly consolidated.

On the other hand, some reports suggested that employee participation and involvement are dependent on other issues. In a manufacturing facility that De Cieri et al (1991) studied, the importance of employee involvement was recognised at the outset of the programme. Consequently, the company spent twelve months conducting meetings with employees to explain the needed changes to gain general consensus and understanding. Despite these preparations, other problems arose during implementation. Issues on car parking, clothing, time clocks and canteens took longer time to resolve, causing dissatisfaction among the employees. Similarly, Wynne and Lancaster (1992) reported that their respondents with quality circles and problem solving teams indicated problems with management commitment and lack of training. Perceptions of organisational efforts and support were also noted to influence employee participation.

From a broader perspective, Morrison and Rahim (1993) suggested that the limitations of participation processes pose a significant threat to successful implementation of the TQM approach. Indeed, the participation process is more complex than what has been generally suggested in the TQM prescriptive literature. This literature widely assumes that workers have both the skills and desire to participate. Organisation literature has suggested that factors such as nature of the task (House, 1971), locus of control (Mitchell, 1973), work values (Wanous, 1974), perceptions of self-efficacy (Bandura, 1982), and maturity (Hershey and Blanchard, 1989) could affect the degree to which employees are able and willing to participate.

Reviewing a wide range of empirical and experimental literature, Ferris and Wagner (1985) closely examined the underlying assumption of quality circles that all workers want, seek and profit from participation. They cited two Hackman and Oldham studies (1976, 1980) that found American workers who resist taking enriched tasks that involve increased autonomy because they were not accustomed to participative decision making. Another cited study by Katz (1980) suggested that workers might be more motivated by clearly defined tasks than by jobs high in novelty or autonomy. Moreover, some workers who view participation as lacking in real impact are not likely to participate (Kanter, 1982). Ferris and Wagner (1985) concluded that quality circles programme are not necessarily effective in all cases, partly because not all workers equally desire to become involved in participation programmes.

The research conducted by Miller and Pritchard (1992) revealed that employees who expressed interest in participating in an employee involvement programme were younger, less senior in their jobs, better educated (as measured in years of school completed), and more interested in job advancement than non-interested employees. Further statistical analysis showed that the most important difference among the two groups of employees is due to the interest in job advancement. This group of interested employees was found to be more positive in their expectations that the planned employee involvement programme would lead to benefits for both employees and the organisation. Miller and Pritchard suggested that the interested workers were also generally satisfied with their jobs. Thus, this study supports the view that workers' interest in participation programmes tends to reflect their search for self-expression and personal achievement.

Dean (1985) specifically studied the decision to participate in quality circles and considered the factors that are involved in such decisions. He similarly found that people who desire greater involvement in an organisation and people who believe that circles will be making improvements are more likely to join quality circles. Three factors that can explain the perceived instrumentality of quality circles are the success and failure of previous programmes; belief in the credibility of the organisation's management; and the degree of difficulty of problems confronting the group. In addition, socialisation with friends, family and co-workers and satisfaction in their current jobs are likely to influence the desire for greater involvement in the organisation.

Allen at al (1997) used expectancy theory (Vroom, 1964) to model the decision to participate in an employee involvement programme. Expectancy theory postulates three variables that determine the decision to undertake a given task: expectancy, which is the perceived likelihood that the tasks can be carried out; instrumentality, the belief that the outcomes from carrying out the tasks can be realised and gained; and, valence, the attractiveness or preference for the outcomes. In the Allen et al study, the likelihood that the employee involvement programme can be joined if the individual decides to do so is the expectancy for the decision to participate. The likelihood that the programme can lead to certain outcomes is the instrumentality, whilst the attractiveness of these outcomes represent the valence. The results of the study supported the hypothesis that the motivation-force score, which is the product of these three variables, is higher for volunteers in the programme than non-volunteers. The study found that volunteers appear to view their social environment (that is, friends and family) as being more supportive and have greater confidence in their ability to be effective participants in the programme. Moreover, the analysis showed that individuals with high growth needs evaluate the more intrinsic outcomes (such as enhanced feelings of self-respect, pride and esteem and the company will be more competitive) more favourably and expressed greater willingness to participate than others in the sample. They concluded that the findings that not all employees will uniformly be interested to participate will inevitably lead to low participation rates in some programmes.

3.2.7 Culture

Hames (1991) pointed out that TQM is "nothing less than a revolution in management culture - a paradigm shift". Thus, it is argued that with the adoption of TQM a cultural change is necessary for its successful implementation. Harber et al (1993) specifically suggested that a significant change in values and leadership style is necessary when the organisation shifts its focus to product and service quality.

Prescriptive literature suggests that the two of the building blocks of TQM are basic assumptions and a quality culture (Galgano, 1994). The basic assumptions involve basic values and an operational strategy that incorporates the new meaning of quality, continuous improvement, involvement of all employees and the concept of breakthrough. The quality culture includes mental mechanisms that deal with problem solving skills and techniques; management rationales that set the criteria and guidelines that constantly drive TQM activities; and, a companywide mentality that places priority on quality, teamwork and critical thinking.

Grant et al (1994) suggested that the "long TQM road takes companies into a new landscape where authority, decisions, and innovation are much more widely shared. ... TQM's revolutionary impact goes deeper. TQM represents a challenge not only to conventional management practices but also to assumptions and theories on which those practices are based. The theories underlying TQM and the economic model of the firm are incompatible" (p. 34). Sinclair and Collins (1994) pointed out that current cultural forms can hinder the changes required in moving towards TQM.

Indeed, high-quality tendency companies were found to emphasise top management leadership, role of the quality department, training, product design, supplier quality management, quality-data reporting and employee relations more than any of the other quality tendency groups (Kuei et al, 1997). Powell (1995) concluded in his study that "most features generally associated with TQM - such as quality training, process improvement, and benchmarking - do not generally produce advantage, but that certain tacit, behavioural, imperfectly imitable features - such as open culture, employee empowerment, and executive commitment - can produce advantage".

In synthesising previous research and experience, Dale (1994) suggested that fear of change is one of the main barriers to quality improvement. He pointed out that this fear involves the labour unions and their members, as they are concerned with loss of earnings and jobs, the formality of the new system, skills and the general worry about the unknown.

However, whilst it is suggested that much depends on the relationship that exists between management and unions, some surveys show otherwise. Hayward et al (1985) reported that trade unions were not a significant factor in quality circle failures: only 5 out of 14 companies had unions that opposed quality circle introductions, 5 out of 32 companies had unions that caused the suspension of the programme, and, 13 of 370 quality circle failures could be attributed to unions withdrawing their support. A more recent survey (Wilkinson et al, 1998) showed that trade union resistance was not considered a difficulty by the respondents. Only 4 percent of the respondents indicated that union commitment was a major difficulty, in contrast to the 18 percent and 11 percent response for top and middle management, respectively.

Dale (1994) also noted that resistance to change was not only confined to the lower levels of the organisations. Top and middle management similarly resist change because the degrees of freedom at the top are higher. Indeed, the survey results of Ginnodo and Wellins (1993) found that top management resistance was highest at the least performing organisations. Dale (1994) explained that managerial fear of change is caused by two beliefs. Change is perceived as a threat to authority and that there is a belief that there is nothing wrong with the present quality systems, procedures or performance. Thus, he suggested that the organisation's traditional environment and individual experience may have bred, over the years, a directive, dogmatic and non-participative management style that is not compatible to those required in the practice of TQM.

A five-year study of quality circles in France (Chevalier, 1991) reported that after some time, many managers even openly showed their opposition to the circles programme as it affected their long-standing influence in the organisation. The managers felt threatened as the quality circles began to question manufacturing procedures and their effectiveness. Middle managers began to fear releasing information that the circles needed as this action gives away the managers' prerogatives and expertise. Those in the line positions were afraid of weakening their decision-making status, whilst others in the staff positions dreaded losing some of their influence linked to the information they possess.

Kekäle and Kekäle (1996) pointed out that there can be a "clash" of two different cultures: that of the prevailing assumptions of the organisation and those of the TQM philosophy, and finding the route of "least-resistance" is an important task for management. They proposed and tested a theoretical model that linked three basic assumptions about man (behaviouristic, humanistic and cognitive) to the three TQM versions offered by the British Quality Association (Wilkinson, 1992). Their findings showed that the best results were gained in the situations where there was a match between the basic assumptions that act as a base of the organisation's culture and the assumptions that are included in the approach. They suggested that choosing other quality approaches will entail extensive "cultural re-engineering" and are not likely to succeed without a large investment of time and a suitable external threat such as from demanding customers.

Another important aspect of culture that impacts on the TQM implementation process deals with perceptions of organisational support. Gardner and Carlopio (1996) found statistical support for the relationship between employee perceptions of organisational quality efforts and employee affective reactions. Those perceiving greater organisational efforts exhibited more positive reactions in satisfaction, commitment and turnover intentions. They found that the impact for perceptions of quality efforts was largest for organisational commitment.

On the other hand, Hill (1993) found that quality circle participation did not have a significant positive influence on work-related attitudes and behaviours. This was explained by the current dissatisfaction with the work environment. In the second company, dissatisfaction was expressed with regard to authority, company policies and practices, supervision, human relations, compensation, working conditions and advancement. Hill noted that in these two company cases, that the quality circles programme appeared a little more than peripheral activities and that commitment of management was questionable.

3.2.8 Middle Management Involvement

Harrison (1994) suggested that the importance of middle managers lie in their operational functions and their contact with the majority of the organisation. It is necessary that their vision and perspective of quality be congruent with that of top management. Incongruence between these two perspectives can derail the improvement initiatives.

A longitudinal study of quality circles by Hill (1989) showed that the main cause of individual circle termination was lack of support from middle management.

Ginnodo and Wellins (1993) revealed that middle managers' and first line supervisor's resistance was highest in organisations with high overall success as opposed to those with low to moderate success. However, more recent empirical data in the UK (Wilkinson et al, 1998) showed that lack of commitment from middle managers and supervisors was seen as at least a 'minor difficulty'.

Hill's (1991) study of quality circles support earlier researches that there are difficulties encountered with the middle management level. "In essence, circles disrupted managers' lives for small returns and created an organisational complexity that confused existing structures, and middle management had no reason to make them work" (p. 548). The disruption came from the formal procedures that implemented the quality circles: regular meetings of the circles during working time, and spending time to listen to circle presentations, assessing, and at times implementing, their projects. The organisational complexity, on the other hand, was due to the parallel structure to the present organisational hierarchy, so that middle managers found themselves in two structures which resulted in a confusion of authority. Moreover, middle managers were given a responsibility for overseeing circles but were not given the corresponding authority: the voluntary nature of circles prevented middle managers from choosing the composition of the groups and that these circles were free to choose their agenda and not obliged to heed middle management's priorities and concerns. A third issue was the separation of problem identification and solving by the circles, and implementation of problems which was the responsibility of middle managers. A fourth concern of middle managers was that these circle activities were not integrated into the organisation's rewards system.

Giordano (1992) also observed that resistance by managers to quality circles stems from their exposure as inept leaders to upper management. She also reported that management manipulated the process to address management issues, which led to feelings of co-optation. She noted that the loose structure of quality circles enabled managers to use different types of coercive strategies to impose their ideas on the circles. Managers were observed to lack enthusiasm for ideas, persuasive discourse and active intervention to influence the direction of discussions. Moreover, workers found their ideas consistently subjected to review and interpretation. Management usually took no action on approved proposals, proposals were reorganised to suit the management's agenda, and upper management voted down approvals of lower management.

Hill (1993) suggested that supervisors involved in quality circle activities needed to be properly trained to cope with their QC duties and responsibilities. In cases where the supervisor fails to understand and undertake his responsibilities, QC members will quickly become disenchanted. Furthermore, she pointed out that the role of the first-line supervisor has only been recently recognised in British industry. Hutchins (1980) originally considered that participation in quality circle activities could possibly help redefine the role of the British supervisors, providing them with greater responsibilities for training subordinates and more scope for genuine leadership.

3.2.9 Long Term View

One of the more specific aspects of top management commitment is a long term view of quality improvement efforts (Deming, 1986; Ginnodo and Wellins, 1993; Van de Wielle et al, 1993; Wynne and Lancaster, 1992). Most TQM advocates agree that TQM cannot produce consistent performance advantage until after the third year of implementation (e.g. Schmidt and Finnigan, 1992) This is consistent with the 'soft' aspect of TQM. According to Witcher and Whyte (1992), "the results (of their study) indicate that pessimism about whether TQM is delivering has been overdone and that 'quick fix' expectations are misplaced. TQM is, after all, a radical new approach to business management. The true benefits will be longer term."

Indeed, Powell (1995) reported better performance for long-time TQM adopters than shorter-term adopters. His findings indicated higher correlation between years since adoption and TQM performance, although there was no significant relationship with total performance. He added that long time TQM adopters were more satisfied with their TQM programmes than short time adopters. In addition, long and short-term adopters differed significantly on six TQM variables, with extent of training and process improvement being highly significant.

Wilkinson et al (1994) reported that quality management may be constrained by short termist attitudes, with over 60 percent of the sample organisations seeing the 'emphasis on short term goals' as a difficulty. They observed that there is a concern for a quantifiable impact on cost savings. Another respondent pointed out that his company was interested in short term goals such as "surviving, invoicing, shipping goods to try and not go past delivery deadlines" (p. 402).

3.2.10 Knowledge

A second important aspect is that top management commitment is founded on an awareness and understanding of quality and TQM concepts and principles.

Grant et al (1994) claimed that mixed results in the implementation of TQM is due to top management's deep understanding of its ideology and consequences. They argued that the TQM's origins and dissemination patterns had bypassed the leading business schools. Consequently, many companies misunderstood and misapplied TQM. Indeed, Wynne and Lancaster (1992) observed from their survey that there was a wide divergence of understanding the concepts of TQM.

Galgano (1994) noted that it is not sufficient to understand the concepts underlying TQM. It is important that members of the organisation are able to apply its concepts. He argued that considering that the majority of TQM implementation has had only 4 to 5 years of experience and the estimated introduction for TQM was about 6 to 10 years, the problem for learning to apply TQM principles becomes more complex. Moreover, he pointed out that since managers need at least 2 to 3 years to fully appreciate the meaning of TQM and its associated concepts, then it is not surprising that most TQM implementation in the US and Europe are still at an early stage.

3.3 Causes of TQM failures

The implementation of TQM promises a number of tangible and intangible benefits. Chapter 2 showed that TQM aims to establish better competitive market position and improved financial status for the adopting organisations. These market objectives are gained through gains in employee motivation, co-operation, employee satisfaction and increased employee responsibility. However, surveys indicate that the more important drivers of the quality efforts lean to the more tangible results in product and service quality improvement and cost reduction (Lascelles and Dale, 1989; Redman, et al, 1995).

The mixed and inconsistent results on improving these bottomline figures indicate the difficulty of gaining these benefits. The relationship among quality improvement, cost reduction and market share proposed by Deming (1986) may not be as simple nor as direct as originally argued. External and internal organisational factors impact on the attainment of the market objectives.

One of the stronger forces that affect the realisation of these benefits is the general condition of the economy. Redman et al (1995) reported that more than a majority of their respondents indicated that the recession was at least a minor difficulty affecting their TQM programme. They explained that the recession increased the pressures on costs whilst re-organisation and redundancy undermined staff morale and commitment.

Moreover, Kordupleski et al (1995) pointed out that lag effects in the market share improvements complicate the process of gaining the desired benefits of TQM. Their model, shown in Figure 3.1, highlights the location of these time delays. First, customer retention is determined by the purchase cycle, that is, the time between purchases. Lag effects are also located in the word of mouth interactions as the diffusion of information to new customers takes some time. These writers found that the average lag time is between four to six months, that is, the greatest impact of the improvement activities on the market share is after at least four months. Thus, the short-term perspective of managers and their demands for immediate or early payback of the TQM programme (Cole, 1995) is unrealistic to realise the dramatic changes in product quality. They implied that a number of TQM failures may be due to the early withdrawal of the TQM before the intended results have been realised.

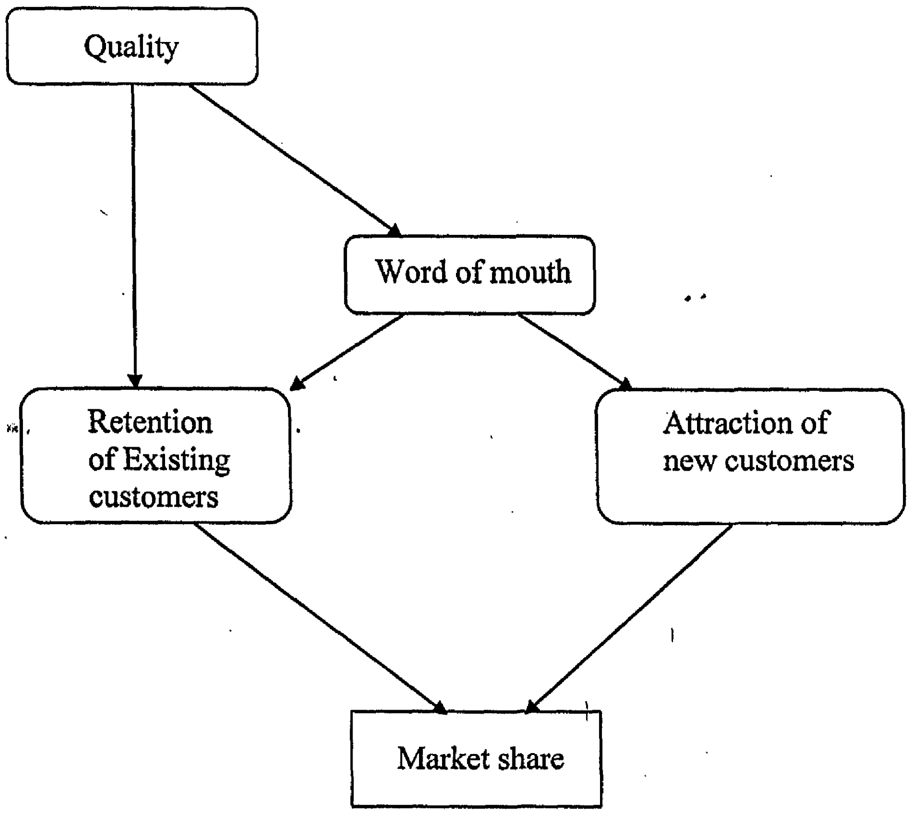

Figure 3.1 Quality and market share interactions. (Source: Kordupleski, et al, 1995)

The failure of TQM to create market impact also lie on the internal organisational factors as discussed in the earlier sections. TQM argues that the satisfaction of the external customers can be accomplished through the satisfaction of the internal customers who are responsible for all the production and other processes. Thus, the factors discussed in Section 3.2 become critical in satisfying these internal customers through ceaseless provisions of managerial and organisational support. Typically, these factors comprise the list of essential requirements to the successful implementation of TQM and that also suggests the best practices in industry.

This list represents the prescriptive nature of TQM literature. This literature, which is dominated by consulting agents, simplifies the installation of TQM in largely mechanistic procedural approaches and "make use of parables and stories about what magic the (TQM) package has performed for other managers" (Gill and Whittle, 1992: 290). Gill and Whittle suggested that these simplified (if not simplistic) approaches to TQM implementation obscure and gloss over its underlying assumptions and other subtleties. They represent attempts by consulting companies to make TQM attractive and easily grasped by managers. This situation is a result of increasing competition in the consulting industry with greater pressures to come up with "turnkey" products and managers who also come under pressure from their superiors to find new ways of dealing with organisational problems with minimal risk and investment. Hodgson (1987) suggested that TQM is another example of a management fashion that will soon fade "not because people won't work hard for quality but because we will end up trying to install the techniques of quality management and not understanding it" (p 40).

A comparison of the list of critical factors and difficulties faced by implementing organisations shows a close reflection of the steps that the gurus have advocated. The important factors that the quality gurus have deemed important are almost the same problems that companies experience in their quality efforts (Table 2.2). Invariably the first step in these packages deals with top management commitment. Crosby's (1979) first of the fourteen step programme explicitly states "Establish top management commitment". Deming (1986) focuses on the creation of a constancy purpose and the adoption of a new philosophy based on quality as the initial points of his management method. Thus, it is ironic that concepts and factors identified and expounded a piori by the gurus, which may be considered as fair warnings, are the same difficulties experienced by practitioners.

It is suggested that the mechanical step-by-step approach to TQM implementation overlook the less apparent processes and inherent interactions within the organisation. The generally positive approach of prescriptive literature does not capture the essence of the TQM principles. Wilkinson and Witcher (1993) suggested that the literature of other fields of study could contribute to the better understanding of the issues of TQM implementation. To address this criticism, the present study reviewed some of the relevant literature and showed that TQM prescriptions and procedures are overly optimistic and simplified. The review showed that there are a number of contingency factors and moderating variables that impact on the TQM factors so that the operationalisation of a step or concept will not necessarily lead to the desired outcome or effect. The realisation of the outcomes will depend on the organisational contexts upon which the programme was launched.

Morrison and Rahim (1993) pointed out that the TQM literature "depreciates the complexity of 'adopting a new philosophy'" because it does not take into account the contingent factors, especially those that deal with participation. There is a failure to address TQM from a more holistic perspective, particularly from human resource management field (Hammermeyr, 1991). Moreover, the TQM implementation based on a piecemeal approach is unlikely to succeed (Porter and Parker, 1993). These authors suggest a more comprehensive and integrated model of TQM. A holistic systems model that considers the complexity of TQM is proposed in the next section.

3.4 The Proposed TQM Integrated Model

The literature review of the factors that determine the performance of the TQM implementation process suggested that these factors are not independent of each other. A further examination of these variables indicates some overlaps.

The essence of TQM implementation is the interaction between management and the employees or workers. There is a constant flow of information between these two sectors. Formal systems deal with policies, directives, instructions, responsibilities and other information that plan, direct, control and regulate the TQM activities whilst informal communication systems are based on perceptions and observations that spread through the organisation. Formal systems also involve structures that delegate responsibilities and authority, allocate resources, establish rewards and recognition, training staff and programmes, and promotion staff and activities. On the other hand, the less formal system is based on daily interactions of the employees and management.

In both cases, the information that is sent to the lower levels of the organisation becomes the basis for action and reaction. The formal system establishes the role of worker and other employees in organisational processes whilst the informal system determines the deeper aspects of behaviour: motivation, attitudes, values, beliefs and other underlying assumptions about management and the organisation. These latter abstract effects of communication generally comprise the culture[1] of the organisation. Apparently, management also holds some subjective judgement of the work force that influences their own actions.

However, a more rational view assumes that top management acts based on data such as market and financial conditions, as well as organisational measures such as defects and yield rates, cycle times and participation levels. Thus, the formal structure is set up to establish a pattern of activities that will ensure the achievement of the promised benefits of TQM. The informal system, on the other hand, is less subject to changes as it is mainly determined by influences of past experiences. Mental processes, biases and other beliefs are not as easily modified. These interactions are integrated in the model as shown in Figure 3.2[2].

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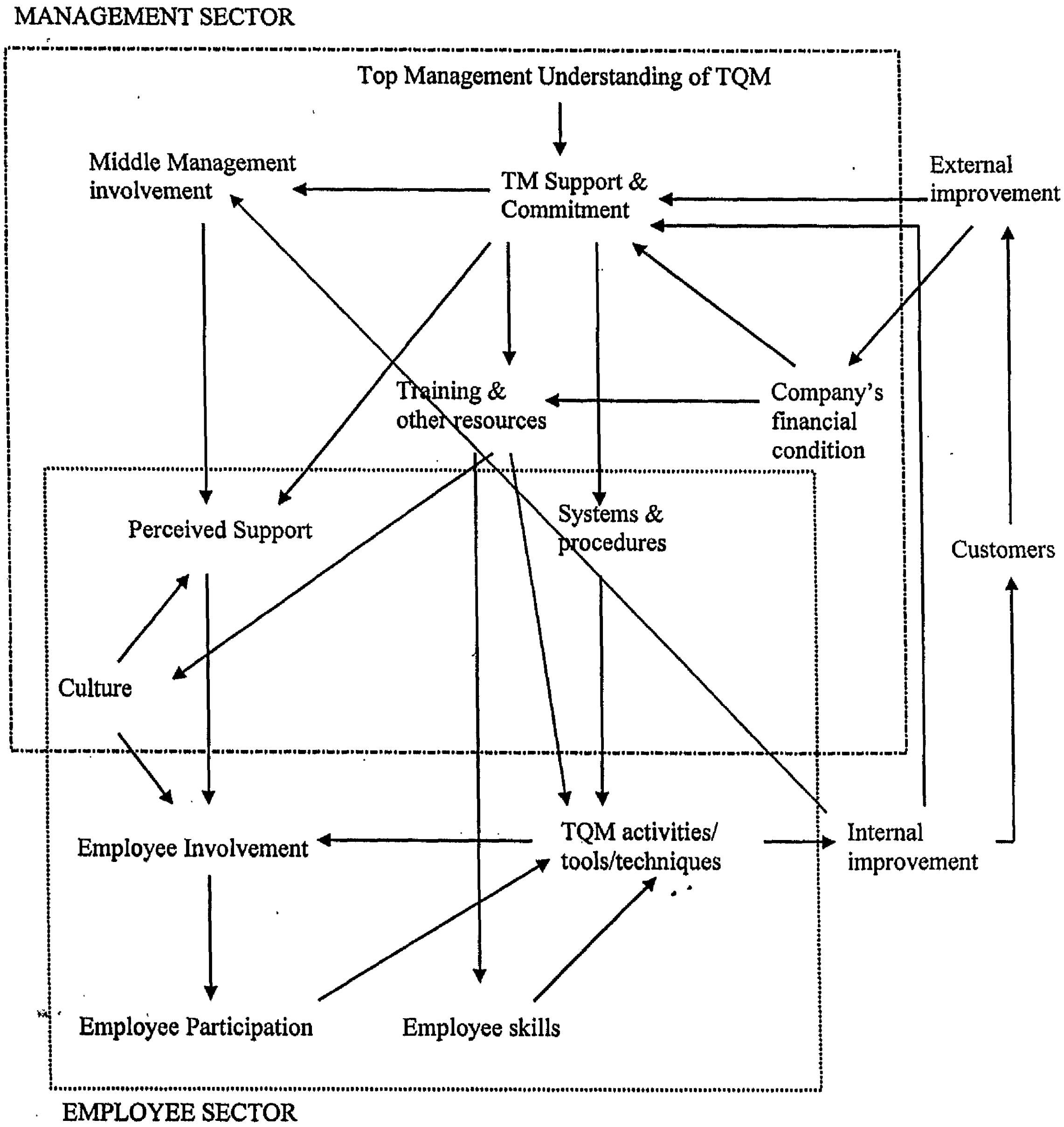
[1]In their review of literature, Tracey et al (1995) individual perceptions about the salient characteristics of the organisational context can be referred to as organisational climate. It is based on the interaction between observable, objective elements of the organisational settings and the perceptual processes of organisational members. These organisational characteristics which include policies, reward systems, and managerial behaviours, are interpreted and meanings attached to them based on the personal values, beliefs and needs of the individuals.
[2]This model focuses more on the organisational factors of TQM and omits the other factors that will influence customer preferences and other external forces, such as market, industry, economy and government. Other studies that have considered these factors will be reviewed in Chapter 4.

Figure 3.2. The Integrated TQM model framework



The model shows that top management support and commitment is influenced by understanding and appreciation of the TQM concepts, principles and techniques. Top management then allocates resources - financial and human - to develop employee skills as well as develop an understanding of the TQM programme and associated concepts. Structures such as TQM promotion and support offices, quality policies, and procedures, such as those that govern project identification, presentation and implementation, and rewards and recognition schemes are also put in placed. Top management also places some responsibilities on middle managers and delegates, or sometimes empowers them.

Employees and workers perceive top management support through their formal and informal contacts as well as through information that are passed through the organisation's grapevine. Perceived management support is also seen from the more frequent contacts with their immediate superiors. Finally, the company's past experiences and more generally, the culture also influences the perceived support of management.

Perceptions of support engender employee involvement, an affective response that can be translated into actual participation in the programme. These programmes can include quality circles or teams, suggestion schemes and housekeeping activities. These activities, as they use the systematic techniques of problem solving, are expected to generate some internal improvement. Tangible results include improvements in yield and defect rates, cycles times, delivery times and general cost reduction and quality improvement actions. Improvement in morale, teamwork, co-ordination and responsibility are some of the more intangible internal improvements.

These internal outcomes can affect customers' perceptions of the company's products and services. They can also impact on middle managers support as these justify the time investments on TQM activities. More satisfied customers can lead to external improvements such as higher market shares and higher profit margins (from lower costs or higher sales), which in turn can improve the company's financial status. These external improvements can encourage top management to generate more support and commitment for the TQM programme.

The central thesis of the model lies in the feedback loops. It is suggested that the interactions form loops that either support or hinder the influenced variable or factor. This initial influence and its corresponding response will cascade to the other related factors and feedback into the original variable. There is a series of chain reactions that eventually returns to the original variable, and which starts off another cycle of reactions. Thus, there is an unending effect of the initial reaction. Moreover, as factors affect more than one variable or are connected to related variables, other parts of the entire system are at some time, or the other, influenced by the initial responses. Furthermore, the contexts in which the variables act, which may be referred to as initial conditions, determine the magnitude of the responses.

These interactions among the factors are hypothesised to represent the actual interdependencies in the organisations that implement TQM. It is suggested that changes in reactions in variables are due to interactions with other organisational variables rather than independent variables that simply change on their own, or have simple dependency relationship with other variables. Thus, top management commitment, which may be very high at the outset of the programme, may decline or grow depending on external improvement and financial gains that the TQM activities engender. TQM activities, on the other hand, are dependent on the resources allocated implemented quality policies and procedures as well as the development of employee involvement. All these variables are directly or indirectly influenced by top management commitment. Higher top management commitment may encourage employee involvement that can generate internal and external improvements and more commitment and support. On the other hand, low commitment and support may not provide for the resources that can develop new skills required for improvement activities, or may not generate the proper attitude among employees that can generate improvement that justifies the programme to top management. This latter case of insufficient outcomes and benefits typically lead to dissatisfaction and abandonment of the programme.

These important feedback loops are further complicated by two situations. The other factors that moderate between top management may be the source of distorted information that can hinder the positive responses from top management. For instance, a company culture characterised by distrust and suspicion with top management will find it difficult to positively influence employee involvement despite great efforts and support from management. Such cultural contexts will not likely lead to positive results at the outset.

A second possibility that complicates the system interactions is the lag time between variables. There will be inherent delays before employees who initially distrust their superiors until they become convinced that management is truly supportive and committed to TQM. Also, there are time lags before TQM participants can successfully identify and implement projects, before the implemented improvement projects can realise the benefits, before customers recognise the internal improvement, and before customer satisfaction can bring financial improvements. As noted by Kordupleski et al (1995), when top management does not recognise these inherent time delays, the TQM programme may be abandoned before the benefits can have an actual impact on the bottom line figures.

The lag time effects highlight the role of culture change in generating the expected outcomes. The model suggests the interaction between contexts and lag time in culture change. In cases where there is a favourable management-labour relations, the adjustment process for workers to become involved may be short. On the other hand, in less favourable situations, a longer time adjustment may be necessary to convince the lower levels of the organisation of management's sincerity.

3.5 Conclusions

This review of the literature that dealt with the practice of TQM remarkably indicated a consensus on the more frequently-faced problems. Whilst such approach of identifying the most common problems or implementation factors has its limitations as it may identify the more obvious problems rather than the most important ones (Fabi, 1993), the resulting list of these factors served as a starting point for further analysis and examination of the TQM implementation process. The brief review of relevant organisation and management literature revealed other contingency factors that can affect the TQM implementation process. This broader literature suggested that establishing the factors of TQM are dependent on other organisational and individual contexts, and these contribute to the difficulty of implementing TQM.

Moreover, this review of factors from both TQM and organisation and management literature showed that these factors are rather interdependent and form feedback loops. Four observations (Mutuc, 1995) were established in this chapter. First, TQM touches on the dynamic relationships of the organisation. TQM variables such as commitment, involvement, participation rates and market shares are often subject to various influences so that they are not likely to remain unchanged over time.

Second, TQM may involve competing, if not conflicting goals. As TQM aims to involve every member of the organisation, the existing conflicts between individuals' and groups' goals may extend into the TQM programme. The 'them and us' mentality (Kelly and Kelly, 1991) between management and labour and the conflict between marketing and production are likely to be reflected in the TQM implementation process. Moreover, the case of the Wallace Company, the Baldridge awardee (Hill, 1993) that went bankrupt, illustrates the competition for limited financial resources between TQM requirements and other organisational investments.

A third observation points to the dependence of TQM success on the initial conditions of the organisation prior to the TQM programme implementation. Wilson (1992) observed that the financial health of the organisation at the outset of the programme could be critical as in the case of the Wallace Company. Cultural aspects and management-labour relations can also be factored into the implementation process. Indeed, Jacob (1993) suggested that the uniqueness of the company have to be taken into account in the quality initiatives.

Lastly, the implementation process is time dependent. The lag times between the variable interactions highlight the importance of time in TQM. Apparently, the benefits that will be derived from the programme are not achievable in the short term because of these inherent delays.

In sum, these observations point to the complexity of the TQM process. The degree of complexity that is based on the number of elements of TQM and their ambiguous conceptions, as discussed in Chapter 2, is further increased in the present chapter by interdependent relationships among variables and the influences of contexts, conflicting/competing goals and lag times.

These observations on the complexity of the TQM change process indicate the limitations of many traditional research approaches. These studies, usually surveys, do not account for these changes of the important variables over time. Essentially, these studies take a static perspective and take "snapshots" of the organisation at particular points in time which describe the organisation only at that point in time. The static view does not take into account the lag times that strongly affect the results of the quality efforts. As this review suggested, a more dynamic view is necessary to understand why TQM succeeds or fails to achieve its objectives.

On the other hand, case studies and longitudinal studies can account for the changes that have occurred over the years and can explore the various aspects of these factors. However, most of these analyses deal with factors as separate from each other, or at best, simply imply relationships among these critical factors. The model presented in this chapter explicitly shows the relationships among these variables and contributes to further understanding of the TQM process.

Moreover, many studies on TQM end with a list of critical factors and corresponding prescriptions, instructions and guidelines. These papers imply that the failure of TQM is dependent on the proper application of concepts and strict adherence to the prescription and instructions. Failure to follow these guidelines will lead to failure of the quality efforts. On the other hand, the proposed integrated TQM model is able to show the reasons why some organisations are successful and others fail in gaining the desired benefits of TQM. In contrast to other studies that conclude with a list of factors, the proposed model showed that the interactions, contexts and lag times are the critical but inherent part of the system that can affect efforts to improve quality and competitiveness.

Nevertheless, despite the advantages and benefits that can be derived from the proposed model, it is still limited by its inability to show *when* the quality initiatives are successful or failures. Senge and Sterman (1994: 200) observed that:

> Experienced managers frequently have accurate perceptions of the causal structure and decision-making process but draw erroneous conclusions about what happens when different parts of the system interact. Challenging models, thus, requires an inference engine to deduce the consequences of interactions among the elements of the map. Simulation provides that map.

Simulation refers to the computer replication or reproduction of observed interactions. Senge and Sterman (1994) argued that the simulation could provide better and deeper insights than causal maps. The concept of simulation, and more generally system dynamics, is discussed in the next chapter. Some system dynamics studies are also reviewed.

CHAPTER 4
A DYNAMIC VIEW OF TQM

The preceding chapter suggested some of the limitations of the more common approaches in studying the implementation of TQM. The system dynamics approach offers an alternative to the understanding of the complex TQM adoption process as it particularly accommodates a holistic and dynamic perspective of a situation.

System dynamics deals with the study of the behaviour[1] of any system through the use of representative models. In particular, it is concerned with improving system performance. It is a methodology for understanding certain kinds of complex problems. It shares its history with systems theory and is closely related to cybernetics and control theory (Coyle, 1977; Wolstenholme, 1990). Richardson's (1991) review, however, places system dynamics under the servomechanism thread instead of the cybernetics thread. It traces its roots to the study of industrial systems (Forrester, 1961), which focused on the management of instabilities in inventory systems and employment, inconsistent corporate growth and declining sales and market shares. Later, its principles were used in diverse types of applications including urban development problems, managing research and development, and even to testing theories related to diabetes (Richardson and Pugh, 1981).

More formally, Wolstenholme (1990: 3) defines system dynamics as:

[1] The behaviour that is referred to in system dynamics is the pattern of changes of particular system variables over time. The changes are based on the values of the variable and the patterns are typically reflected in time graphs.

"A rigorous method for qualitative description, exploration and analysis of complex systems in terms of their processes, information, organizational boundaries and strategies; which facilitates quantitative simulation modelling and analysis for the design of system structure and control."

The purpose of this chapter is to provide some basic background on the field of system dynamics (referred to as SD hereon). While it surveys the more general areas of concern in the field, it is not intended to be an exhaustive review. It is hoped that it provides a sufficient overview to support the understanding of the entire thesis. It covers a brief review of its concepts and philosophies, its methodology and some validation issues.

The second part of the chapter reviews some literature following the concepts of SD. Section 4.2 discusses TQM literature that suggests the dynamic nature of the employee participation programmes and quality improvement initiatives.

4.1 System dynamics concepts

The term "system" in SD recognises the diverse possible applications of the methodology as the field moved from its initial concern with industrial systems to other various areas. It indicates the perspective of a system, or a holistic view of a problem, which is the main focus of SD (Richardson and Pugh, 1981). It is a systems approach to understanding and solving the problem through the identification and explicit relations of the causes and sub-causes of the problem (causes of the causes).

A result of the constant search of causes and sub-causes is a closed loop(s) of causes and effects, as eventually, the initial variable becomes a cause in itself.

SD views the problem that is addressed through its two main features: dynamism and feedback. Dynamism refers to the dynamic characteristics that involve variables that change over time, whilst feedback deals with the "transmission and return of information" (Richardson and Pugh, 1981: 3). The dynamics affects the information in the system, which in turn also govern the dynamics. Indeed, Forrester (1961: 13) defined industrial dynamics as:

> "The study of the information-feedback characteristics of industrial activity to show how organizational structure, amplification (in policies), and time delays (in decisions and actions) interact to influence the success of the enterprise."

The closed loop formed by these variables (causes) indicates the continuous feedback on the decision process. This suggests that there is a constant interaction among the variables, which, moreover, indicates the dynamism over time. The feedback structure, made up of causes and effects forming a network of loops, in conjunction with time delays, which are implicit in decision making and action, was seen to play a key role in the response and description of a variety of systems. Forrester (1968) noted later:

> "Feedback processes emerged as universal in social systems and seemed to hold the key to structuring and clarifying relationships that had remained baffling and contradictory."

Thus, SD may be viewed as a theory of structure wherein one can systematically construct and analyse dynamic feedback models of social systems (Starr, 1980). He also pointed out that "the fundamental attitude of SD consists of an interest in affecting, if not solving, real problems and a willingness to create, define or abandon causal theories of behavior as necessary for model construction" (p. 47).

As previously indicated, time delay, although an implicit part of structure, is an important element. This recognizes that information about actions is not readily available and may have to be collected; that decisions do not immediately respond to information; and, that it may take some time before decisions are executed or implemented into actions. Furthermore, the output from these variables may be amplified, that is, they may be greater or lesser, and not necessarily equal to the input, as it can be distorted or affected by noise. That is, information about the actions may not be accurate or may be incomplete, thus influencing the related decisions (Forrester, 1961). These delays may add complications to the interactions between variables, decisions and actions.

The result of such interactions is a pattern of actions over time that are directly attributable to such decision processes, which are, in turn, influenced by the input information from the different relevant actions. But as there is a complex network of information flows, understanding such patterns of actions, or the behaviour of the variables over time, may prove to be a difficult task. SD addresses this problem by the study of the underlying feedback processes. The main premise is that the dynamic behaviour is a consequence of system structure (Richardson and Pugh, 1981). Moreover, problem events are viewed as symptoms as they occur at certain points in time and they represent instantaneous reactions of the system. Taken together and plotted on a time graph, they are part of a bigger behaviour pattern that is governed by the systems structure. Thus, problems are not seen as being caused by external agents outside of the system, rather, SD views the occurrence of problems as being due to internal reasons, that is, its structure.

In sum, the purpose of the SD model is understanding, and the goal of the modelling effort is to improve understanding of the relationships between feedback structure and dynamic behaviour of the system (Richardson and Pugh, 1981). The model, as a slice of reality, facilitates such understanding as it recognises its dynamic nature due to its feedback structure. The study of such problems follows the framework discussed in the next section.

4.2 Basic SD approach

An SD study begins with the identification of a problem (Barlas, 1996; Forrester, 1961; Richardson and Pugh, 1981; Starr, 1980). The problem is defined based on the time-graphs of the variables under investigation. Whilst this suggests the need for explicit numerical data plotted on a graph, some variables of concern may not be traditionally measured nor quantified. In the absence of such hard data, some members of the real system, particularly managers, may have a rough estimate of the behaviour of such variables. This can be used as a basis for identifying the problem because "what is required is the tendency to focus on patterns over time: periods of increase and decrease, phase relationships among variables, peaks and valleys" (Richardson and Pugh, 1981: 19) and not specific and accurate values of the variables. These graphs of the variables over time are referred to as reference modes, and the resulting SD model will be tested on its ability to reproduce this behaviour pattern.

The second SD task is model conceptualisation and model building. The objectives of this activity is to create and examine the feedback loop structures and to provide a qualitative assessment of the relationship between system processes, information, organisational boundaries and strategy (Wolstenholme, 1990). System conceptualisation involves isolating the factors that appear to interact to create the observed symptoms by tracing the cause and effect loops that link decision processes and actions (Forrester, 1961). Conceptualisation is aided by the building of an influence map (or causal diagram) which explicitly shows the relationships among the important variables: resources, processes, information and strategy.

Model building involves the mathematical formulation of the identified relationships in the conceptualisation stage. Whilst numbers are attached to variables, the formal model is not aimed at generating point-by-point estimation of the historical data. Rather, this formal model aims at generating points that when plotted will replicate the general behaviour patterns or trends of the variables of interest (Forrester, 1961; Richardson and Pugh, 1981). Moreover, after the reference mode has been reproduced, parameter and other possible changes are made to determine the possible reactions of the system. Ultimately, the objective of these tests is to identify policies and other leverages so that the problem behaviour pattern is corrected or at least improved on.

The SD approach is summarised by a graphical presentation (Figure 4.1). The model shows two loops: the model structure which represents the network of decisions, processes and information flows, and the behaviour loop, that represents the interaction of variables and graphically illustrated by the simulation results. There is a continuous effort to compare the model structure and behaviour with empirical evidence in order that the model is assured to be consistent with the real system. It is only when this condition is satisfied that analysis of the model can proceed. In this way, the model is found to be useful for the real system.

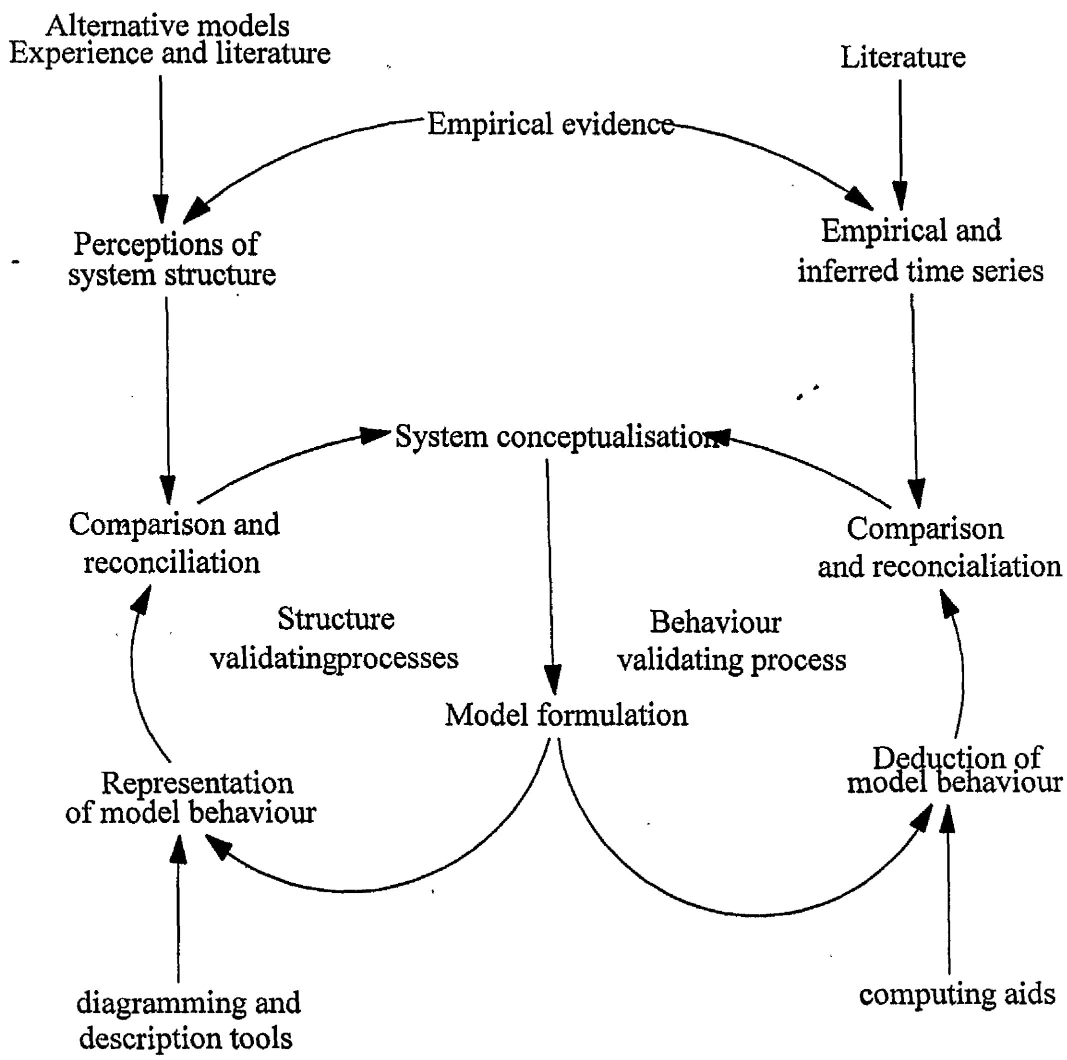


Figure 4.1 System dynamics modelling procedure (Source: Saeed, 1992).

4.3 Some reference modes and dynamic hypotheses about TQM

As suggested above, the identification of a problem is founded on an observed behaviour pattern. The review of TQM literature in Chapter 3 indicated that some TQM programmes fail to achieve their objectives and desired benefits. This could mean that TQM had no effect on these figures, or that TQM was gaining some decreasing benefits. This may be contrasted with those that were able to gain some improvements in quantifiable aspects of the business but also the intangible aspects such as increased teamwork and better relations among workers, and higher worker morale. In any case, a further review of TQM and organisation behaviour literature identified studies that observed or theorised more specific dynamic behaviour patterns that represent the behaviour of TQM or participation programmes.

The general organisation behaviour literature revealed two theories on the behaviour of participation programmes. Ramsay (1977) postulated that employee involvement programmes followed cycles of fluctuating management's interest in encouraging and supporting employee participation programmes. Ackers et al (1992: 281) noted that in this theory "history does not stand still or evolve upwards or downwards, but it does tend to repeat itself, if not in exact detail, by playing 'variations' on a fixed 'theme', according to the deep structural logic of capitalism." Known as the cycle of control theory, it is suggested that during periods of crisis where managerial authority and legitimacy is felt to be challenged by labour, management initiates employee participation schemes. However, when the crisis has passed, management loses its interest in the scheme, and the participation activities fade until the next crisis, when management becomes involved and interested again.

In this theory, participation is "best understood as a means of attempting to secure labour's compliance" (Ramsay, 1977: 481).

The findings of Marchington et al (1992) and Ackers et al (1992) challenged Ramsay's cycles of control theory based on their own studies, and suggested an alternative view which they referred to as 'waves of interest'. They found that different organisations had their own, sometimes unique, motivations for introducing employee involvement programmes rather than the single motivation founded on the conflict between management and the trade unions. Their case studies revealed that organisations adopted various employee involvement techniques, usually implementing more than one at any time (Figure 4.2). However, management places varying degrees of centrality or importance on these employee involvement techniques within the organisation. They observed that as the technique becomes older, it loses its centrality, as another scheme becomes more prominent. In some cases, the first techniques may or may not disappear, but if it endures, it takes less importance as attention and resources are then focused on the new and more central technique. However, some older techniques may be revived from time to time.

A number of reasons have been cited for the decline in centrality of specific techniques (Marchington, et al, 1992). First, initial enthusiasm for the technique fades as other issues become important, as some of the objectives and aspirations fail to be met, or as operational difficulties occur. Secondly, the technique's weaknesses are discovered or the context within which the organisation operates may change due to the environment, new products or new organisational structures. A third and more apparent reason for the decline of technique's importance lies on the principal

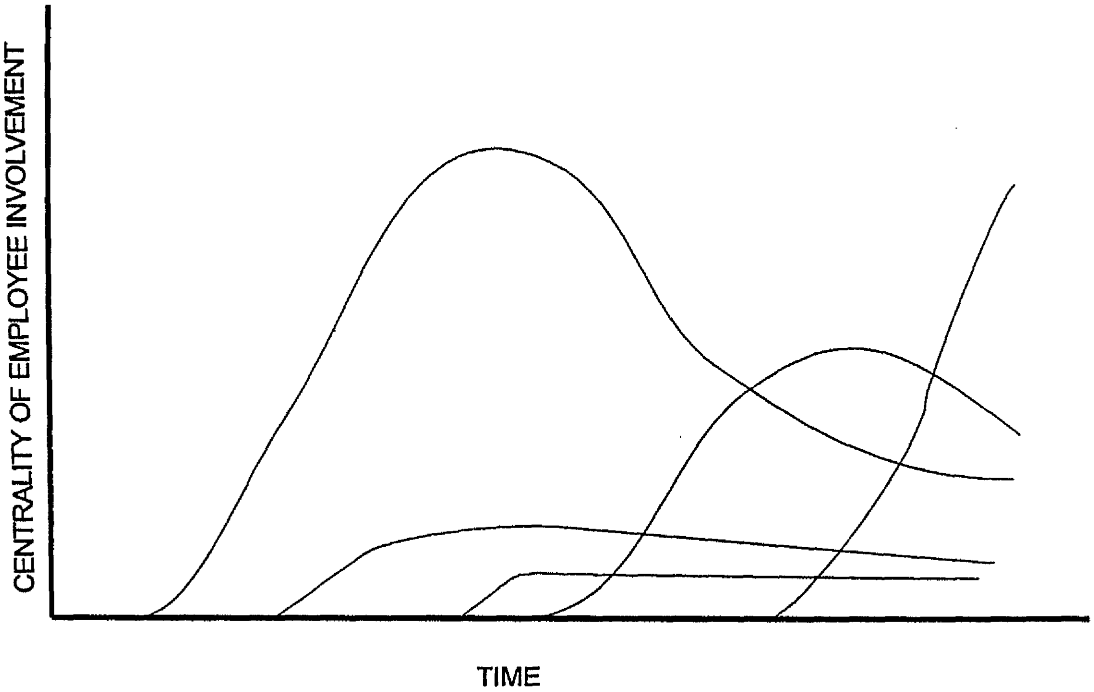


Figure 4.2. Waves of interest (Source: Marchington, et al, 1992)

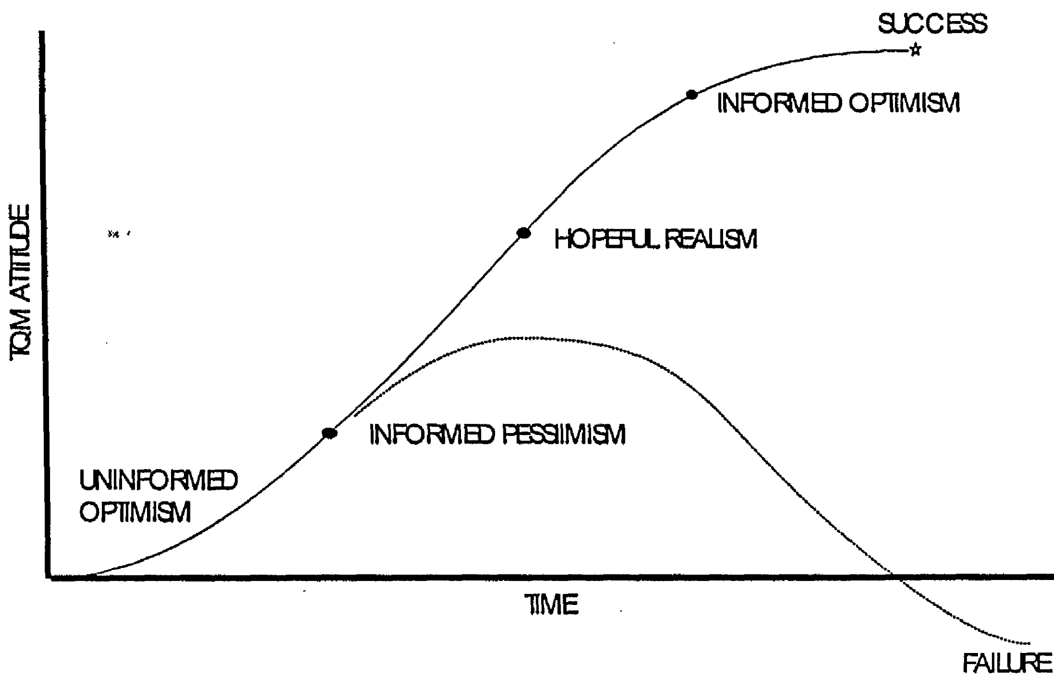


Figure 4.3. Development of TQM. (Source: Pasternak and Berry, 1994)

initiator and champion who leaves the organisation, leaving no one behind with the same commitment for the scheme.

Some studies that focused specifically on the behaviour of TQM programmes similarly highlighted the changes occurring over time. Paternak and Berry (1994) suggested that TQM follows a slow growth movement toward a peak, which represents success. A decline, indicating some difficulties, may lead to the failure and abandonment of the programme (Figure 4.3). More successful efforts that are able to overcome the difficulties are suppose to continue in their upward trend.

Lawler and Mohrman (1985, 1987) described a similar behaviour pattern for quality circles. The programme begins with a few circles, which are highly motivated and often realises significant gains. This period of success is usually followed by widespread dissemination of the quality circles, as others become motivated to participate with the initial gains. With the expansion of the programme, a number of problems set in: middle manager resistance, failure to implement the generated ideas, non-productive groups, extra cost of operating support systems, and failure of some ideas to produce the level of savings projected. Because of the increased number of circles and limited management time, the groups compete for management attention. At this stage, some organisations decide it was an error to implement the programme and abandon them. Others recognise the positive value of circles and find ways to sustain them. Thus, there are an increasing number of circles that peaks to maturity and declines (Lawler and Mohrman, 1987).

Atkinson (1990) proposed a more complex behaviour pattern involving peaks and troughs (Figure 4.4). Comparing the adoption of TQM to the emotions felt by patients, he suggested seven stages of emotions in the adoption of TQM: shock, denial, strong emotion, acceptance, experimentation, fuller understanding and integration. Managers initially experience shock and feel their competence fall as TQM is seen as another attempt to correct their incompetence. After some time, managers and other members of the organisation recover in their initial shock and then perceive an increase in their competence, and ability to cope with ambiguity. Atkinson explains that this 'false competence is fuelled by the belief that nothing is ever going to happen" (p. 77). This false competence during the denial stage is soon replaced by fear as it is realised that TQM will happen soon and it will entail changes with uncertain consequences. Thus, there is a need for support and understanding from superiors and peers. With support, help and realistic visions, the fears and the initial frustrations with the practice of TQM, members of the organisation will progress to the experimental stage. At this time, employees begin to learn new ways and behaviours. Atkinson also noted that at this stage, organisations must provide resources, training programmes, even counselling for staff who find it difficult to make the transition. With success in learning, and through trial and error, the organisation progresses to fuller understanding and integration.

Other researchers have recognised that the interdependent nature of TQM variables may be represented by mathematical relationships. In particualar, Lakhe and Mohanty (1995) suggested that total service quality measurement (TSQME),

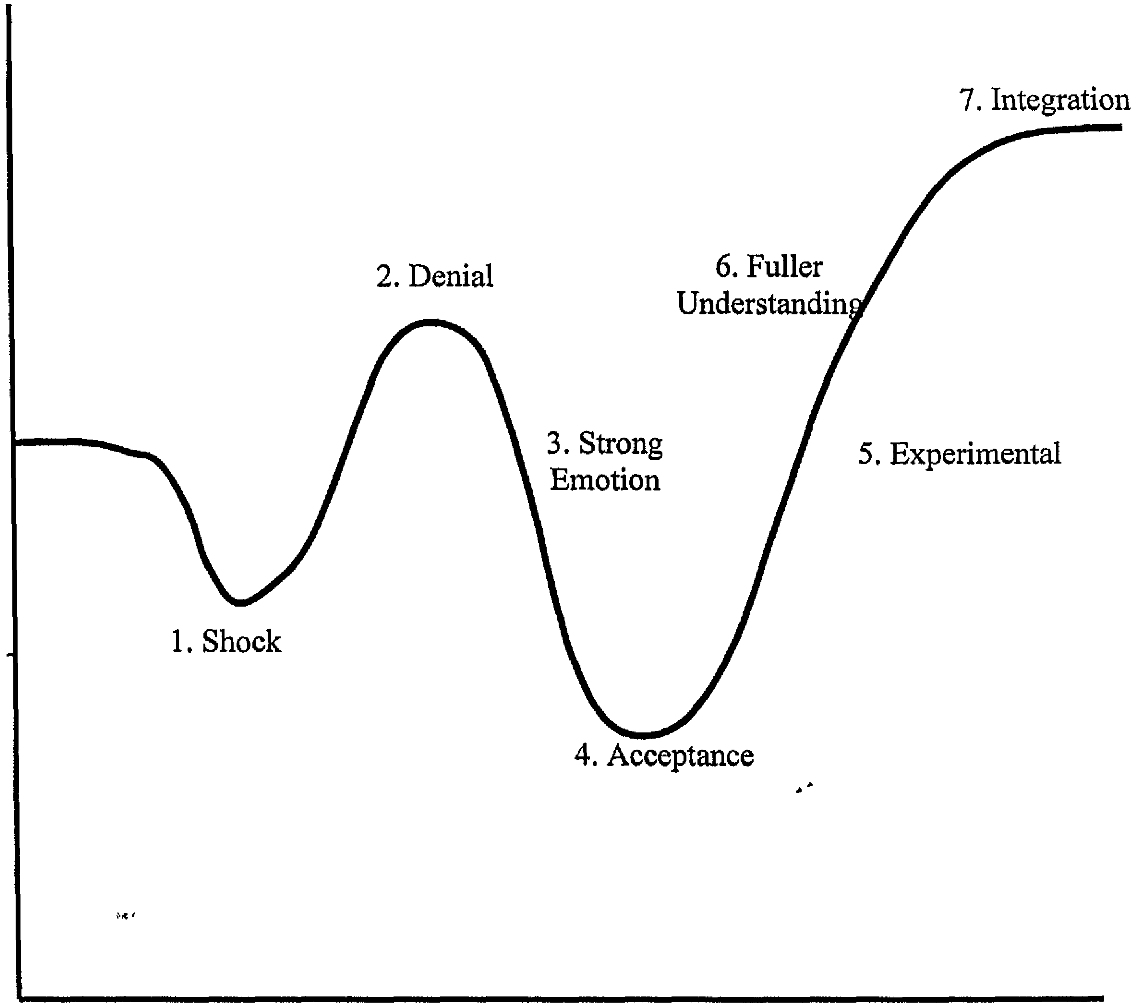


Figure 4.4. Changes in attitude and feelings in a TQM programme. (Source: Atkinson, 1990)

which is the extent to which the programme meets its desired objectives, is a dependent variable of some independent variables that include top management commitment response (CR), product and process improvement (PPI), customer orientation response (COR), human resource excellence (HRE) and economic advantage (EA). He represented this relationship mathematically as :

$$\text{TSQME} = f(\text{CR, PPI, HRE, COR, EA})$$

He further related these variables to other variables. For example, top management commitment response (CR), which he defined as the extent to which top management is satisfied with the progress of the programme and has increased its involvement in it, is suggested to be dependent on time devoted (TD), resources allocated (RA), and personal efforts (PE). This can be expressed as:

$$\text{CR} = f(\text{TD, RA, PE})$$

Human resource excellence (HRE) is an assessment of the human resources based on attributes such as improvement in communication, training, information and accountability. That is,

$$\text{HRE} = f(\text{C, T, I, A})$$

A theory based on feedback loops to explain successes and failures of gaining the desired effects from quality improvement programmes was developed by Repenning and Sterman (1997). Three first-order feedback loops were identified as typical approaches to increasing net output (defect-free output, that is, total output minus rejects) from a process. Two loops deal with increasing gross output: one through the increase in capital and workforce, and the other through increased worker effort. Thus, as the actual net output falls below expected or desired net output, these two loops operate to correct the imbalance. The third option deals with effort to correct the defects. As the gap between expected and actual output increases, more time and resources are spent to correct and rework defects to increase net output and therefore, move closer to production standards.

Process improvement through training and experimentation represents a fourth alternative to increasing net output. When the standards are not met, resources are allocated to process improvement so that training and experimentation can be carried out. These studies can correct process problems, which in turn controls defects and thereby increase net process output.

Repenning and Sterman noted that these approaches to improvement are not independent but strongly coupled. One of the most basic connections is the firm's finite resources. For example, when workers are pressured to work harder, they will not have time for defect-prevention training and experimentation. Likewise, when resources to defect correction rises, resources to process improvement will fall. They also noted that improvement activity disrupts production, which further discourages the use of training and experimentation. These interdependencies suggest the conflicts on the use of resources, and the resolution of these conflicts determine the successful adoption of the process improvement alternative.

4.4 Conclusion

The aim of this chapter is to acquaint the reader with the system dynamics approach. Thus, the first part described the basic concepts of dynamism and feedback as they reflect and represent many social systems including organisations. It is noted and argued that the organisation implementing TQM is characterised by many feedback loops that causes the dynamism, and to a certain extent the unpredictability of TQM efforts.

This particular point on the unpredictability of TQM initiatives lie mainly in the linear thinking that characterises many analyses, particularly those of consultants who tended to simplify TQM principles. Thus, as shown in the earlier literature review, failure to achieve the programme's desired outcomes are explained to be due to improper or careless implementation procedures. Such linear thinking do not consider the dynamism of the system as actors related and interact with each other. What this chapter showed is that these programme performances should be viewed from a complex interaction of factors or forces such as those generally proposed in Chapter 3.

Moreover, the second part of this chapter showed that there are some non-system dynamics studies that indeed recognised these interactions and interdependencies albeit not in the form of a system dynamics study or concepts. Perhaps, this is the weakness of these studies and anlayses: that they do not follow a structured approach as to how conduct and continue their results and analyses. More particularly, there is no recognition of the relationship between behaviour patterns and system structure. Pasternak and Berry (1994) proposed a behaviour pattern but did not explore the structure that creates the pattern. On the other hand, Lawler and Mohrman (1985, 1987) acknowledged the dynamics involving the factors within the organisation and implied but did not specifically proposed behaviour patterns. A third non system dynamics paper, (Lakhe and Mohanti, 1995) recognised the basic interdependencies of organisational variables but did not go as far as to simulate and test the validity or relevance of their proposed equations.

The Ramsay (1977) and Marchington, et al, (1992) differ from the aforementioned papers in that they explored the interactions of variables and proposed general behaviour patterns. Still system dynamics favours the testing of these relationships. As noted earlier, experienced managers are able to accurately identify the causal structure of systems but fail to draw similarly accurate behaviour patterns when the structure operate. Thus, a more quantitative approach is suggested to show the more reliable patterns of the proposed system structure.

The system dynamics approach provides a very comprehensive and structured approach to understanding and analysing complex systems such as the implementation of TQM. It integrates many of the strengths of these non-system dynamics studies into its methodology. Moreover, the quantitative part of the approach also provides a facility to test different scenarios and later develop new policies that will improve the system performance.

For the interested reader, a review of some system dynamics studies that entail some technical discussions are presented in Chapter A2 in the second volume. The next chapter discusses the detailed research methodology.

CHAPTER 5
RESEARCH METHODOLOGY

The preceding chapters have examined the nature of TQM and quality, and their implications on implementation. The broad coverage of both quality and TQM has not helped organisations in appreciating the deeper underlying principles, such as those of implicit interactions between variables and activities, underlying goals and decisions, and tacit assumptions and information. It is suggested that this limited understanding by implementing organisations can contribute to difficulties in implementing TQM. Indeed, researchers (Duncalf and Dale, 1990; Caudron, 1993) have noted that managers had a low understanding of their roles in TQM, and did not know what quality meant.

The propagation by consultants of TQM has not helped these organisations either. As noted earlier, marketing concerns have simplified many of the TQM concepts, which have been translated to a number of simple prescriptions and mechanical steps and procedures. Moreover, practitioners have introduced many interventions that further blurred the TQM concept. Furthermore, they have not acknowledged the more established management theories and thus isolated themselves from the academic field. The academics, on the other hand, have not involved themselves with the research on TQM (until recently) lest they are labelled "snake-oil salesman" by colleagues (Abrahamson, 1996). Some have viewed TQM to be superficial and not worthy of sustained research (Wilkinson and Willmott, 1995; 1996). This gap between consultants and academics may reflect the age-old debate about difference between theory and practice. Gradually this gap may be resolved with the acknowledgement by researchers of the importance of TQM in management and organisation theory research (Dean and Bowen, 1994).

5.1 Importance of TQM Research

Grant, et al (1994) have shown the effects of TQM on management practices and the focus on integration and co-operation. They further argue that TQM goes beyond practice as it poses a challenge to prevailing systems of thought and principles. TQM questions the accepted and conventional theories of the economic theory of the firm that places economic and financial goals as priorities, in contrast to TQM's focus on the customer's needs. Thus, they argue that TQM confronts the conventional management techniques and the theories that support them. This echoes Bounds, et al (1994: 29) points on the management paradigm shift.

Despite such optimistic view of TQM, its effects and benefits have yet to be fully felt in all the sectors that have applied it. Many of the failed implementation attempts indicate many problems and difficulties (refer to Chapter 3 for details). Hackman and Wageman (1995) suggest that there is a lot of room for additional learning, and that research can provide the corrective function for TQM.

The importance of TQM in research has been suggested by Dean and Bowen's (1994) review. First, TQM is a pervasive phenomena and management research's continued dissociation from it has been questioned (Dean and Bowen, 1994; Krishnan, et al, 1993; Robinson et al, 1991). As TQM is considered important in practice, Dean and Bowen (1994) contends that "we risk losing our credibility as management theorists by ignoring TQ in our research" (p393). Secondly, they observe that TQM covers the same ground as management theory. Indeed, there is much correspondence between HRM prescriptions and TQM practice. The third reason for devoting research to TQM is the benefits that can be derived by both researchers and practitioners. They note, for example, that there is a "high premium" on TQM as existing theories are unlikely to be sufficiently broad to support TQM research, and thus offers many research possibilities. On the other hand, research can contribute to improving success rates of implementation efforts as they observe that TQM practices are organisationally and politically naive.

It is in this latter reason that this research hopes to contribute: the understanding of the TQM implementation process. By examining this process, this research can help in shedding more light on the paradox of why some companies seem successful with their TQM efforts while others are not. This analysis tries to overcome some of the weaknesses that previous studies have had as suggested in the previous chapter. The present study also amply recognises theoretical developments in management research by applying some of their postulates to the analysis of TQM, and thereby contributing to expanding the areas where TQM as practice can communicate with the more theoretical fields of inquiry.

Secondly, the research can contribute to the System Dynamics field as it tries to find new applications of its principles and methodology. Specifically, this can contribute to the present efforts at the MIT Sloan School of Management that embarked on a joint project with industry to analyse quality improvement programmes (Sterman, et al, 1994).

Thirdly, the results can still be helpful to TQM practitioners. As this research tries to integrate theory with practice, it is hoped that its analysis can contribute to better application of TQM.

5.2 Objectives of the Research

The preceding section has broadly outlined the intentions of this research as it aims to contribute to the growing management research field in TQM, and as it hopes to contribute to the better understanding of the TQM processes.

The main objectives of this research highlight the need to take a broad perspective in the study of the TQM implementation process. As has been indicated, the research takes a bias towards the systems approach and adopts the System Dynamics methodology. Briefly, the choice for SD depended on the acknowledgment that TQM involves many interdependent relationships of actions, decisions and information, the existence of competing and conflicting goals, the effect of initial conditions, and the importance of time as a factor influencing many of these dynamic relationships. SD allows for the integration of the many elements of TQM (Chapter 2), the intended and unintended consequences, and contexts of many of its variables (Chapter 3) and the interactions among these factors (Chapter 4). More specifically, this thesis conceives the TQM implementation process as a function of its structure, that is, the variables and their interactions. The interaction of the organisational variables is exhibited in the observable patterns of behaviour (Chapter 4) and which indicate the success of failure of the programme.

Thus, the main objectives of this research are:

1. To develop a System Dynamics model to represent the interactions in the TQM implementation process; and,
2. To determine the critical factors and feedback loops that influence the sustainability of TQM in a company, by using this System Dynamics model.

The specific objectives are:

1. To identify the more important factors in TQM implementation process based on literature and interviews with practitioners, consultants and academics;
2. To examine these factors and propose the relationships among these factors;
3. To identify the more specific factors that influence the implementation process in the company case;
4. To examine these detailed factors and propose a qualitative model that represents the company cases TQM experience;
5. To develop a simulation model and study the effects of the feedback structure; and,
6. To formulate policies and structural modifications to help sustain TQM efforts.

5.3 Research Methodology

This research generally follows the System Dynamics approach (Barlas, 1996; Coyle, 1977; 1996; Forrester, 1961; 1994; Richardson and Pugh, 1981; Saeed, 1992; Wolstenholme, 1990). The major steps typically involve identification of a problem, model conceptualisation, model formulation, model analysis and validation, policy analysis and design, and implementation (Barlas, 1996). These basic steps involve examining relevant variables, establishing influence relationships among them, developing the feedback structure, and finally analysing the structure.

Wolstenholme (1990: 3-6) suggests that there are two phases in the System dynamics methodology: qualitative and quantitative system dynamics. The qualitative phase is based on creating influence or system maps (also known as cause and effect diagrams, causal loop diagrams) following some precise and rigorous rules and using them to analyse the system. The activities involved in this aspect are:

1. creating and examining feedback loop structures using resource and information flows;
2. qualitatively assessing system processes, information, organisational boundaries and strategy; and,
3. estimating system behaviour and to postulate strategy design changes to improve behaviour.

The second phase entails initially a behaviour replication and analysis, and validation and sensitivity tests. The second stage of the quantitative phase focuses on the design of alternative system structures and control strategies.

Following the major steps in the system dynamics approach, this research was conducted following five broad activities, which are organised in three phases. These are shown in Figure 5.1.

Figure 5.1. Research Methodology

Phase 1: Preparatory phase

1. Content analysis of TQM literature

2. Interviews with consultants, practitioners and academics

Phase 2: Field research

3. Data gathering in company cases

4. Qualitative analysis and models

Phase 3: Simulation and Analysis

5. Quantitative model and analysis

5.3.1 The Preparatory Phase

The first phase represents the preparation of the foundations of the conceptual model. The objective of the phase is to create a general view of the TQM implementation processes by reviewing and examining published empirical studies, cases and analytical papers. By content analysis, the most common, if not the most important, difficulties, barriers and problems in TQM implementation are identified. This generally follows Fabi's (1993) methodology in integrating empirical studies of quality circles problems and critical factors. By examining these further, relationships among the factors are established and a preliminary qualitative model is created. The results of this content analysis and comparison of empirical literature was presented in Chapter 3. Moreover, the chapter developed the integrated TQM model framework from the resulting list of most common factors (Figure 3.2; p. 97).

The second step attempts to verify the preliminary TQM model by interviewing consultants, practitioners and academics. This represents an external validity exercise to increase the validity of the results of the preceding step (Weber, 1985). It is also recognised that published reports and literature have many limitations and weaknesses: vested interests (Powell, 1995) can affect the validity of results and conclusions; space allocation can also limit the depth of discussions of some articles; and, other general contingency conditions may have been overlooked. Furthermore, published literature does not allow for a two-way communication that is necessary in the initial analysis and proposal for a qualitative model. All these weaknesses are overcome by interviews with the "experts". In addition, the varied experiences of consultants, practitioners and academics can provide a wider system perspective.

Fourteen persons were interviewed in this phase: two consultants, four academics, and eight practitioners. The interviews lasted at least one hour. The interviews were conducted in two parts. In the first part, the interviewees were asked what they thought were the most important factors in TQM implementation, and if these factors were in anyway influential on the others. If the interviewee did not suggest the same factors as identified in the preliminary TQM model, or if the interviewee did not the see any connection between the identified factors, the interview continued to explore his ideas. If they did generally support the proposed model, the model was shown to the interviewee. The second part of the interview encouraged the interviewee to analyse and examine the model as it conforms to his own ideas. He was encouraged to support, object, modify, and clarify the model. The results of the interviews showed that all seventeen supported the proposed model. They all believed that it reflected the TQM implementation process. Thus, the preliminary model arguably passed the first test and was used for the second phase.

Moreover, the model presented in Figure 3.2 was also presented at the British Academy of Management Conference (Mutuc, 1995) where comments, suggestions and objections were solicited from those present in the presentation. The absence of any direct objections to any part of the model nor its assumptions were taken to mean support for the model.

Table 5.1. Schedule of Interviews.

Interviewee	Position and Organisation	Length of Interview (hours)
Academics W. McEwan	Professor, University of Paisley	1.0
U. Bittici	Senior Lecturer, University of Strathclyde	1.0
R. Livingstone	Senior Lecturer, University of Strathclyde	1.0
A. Manalang	Associate Professor, De La Salle University	1.0
Consultants G. Sneddon	QualScot Associates	4.0
R. Atienza	Freelance consultant	1.0
Practitioners B. Alexander	Assistant Manager Quality Department Wyman-Gordon Limited	1.0
O. Demano	Industrial Engineer Quality Department 3M, Philippines	2.0
B. Espino	Coordinator Quality Improvement Department Motorola, Philippines	2.0
A. Lindsay	Manager Quality Department Kone Carruthers	1.0
	OKI	1.0
J. Macmillan	Mackays	2.0
B. Reid	Manager Quality Department Wyman-Gordon Limited	1.0
	Manager Quality Department RFK Carbon Fibres	1.0

5.3.2 The Field Research

The verified TQM model provided the framework for the data gathering stage. The questions and information necessary followed that framework, and thus organised much of the data gathering and subsequent interviews. The following general questions were the backbone of the field research:

1. How are TQM activities sustained? What factors contribute to employee commitment to the programme? Has employee commitment been the same all throughout the implementation history? What were the changes and how do you account for such changes?
2. How are these factors related to each other? Or are they independent?
3. How important is top management commitment? How does top management show its commitment? Can you give examples of top management's involvement to the programme?
4. How does top management evaluate or assess the programme's success? What are top management's problems in dealing with the programme?

These questions reflect the need to take the various perspectives of the problem. Stakeholder analysis (Burgoyne, 1994) provides an approach at dealing with the different views of the implementation process. The field research involved data gathering in three companies. However, for reasons of accessibility and availability, the data gathering and interview were not exactly the same for all three cases. In the first two companies, interviews were limited to the main implementers of the TQM programme as other interviewees were not available during the data-gathering period. Moreover, in the first company, the decision to provide access to all personnel to be interviewed was postponed until the new plant manager arrived. The decision was further delayed as the new manager had to attend to more pressing matters as well as adjusts to his new role. The data gathering phase had been concluded before the new plant manager was able to allow access to other personnel and staff. In the second company, the reorganisation and the impending collective bargaining agreement caused the shelving of interviews with other managers and union officials. Thus, the interviews were limited to the quality manager and TQM manager in the first case, and the senior and deputy manager for TQM in the second case.

However, it may be pointed out that unlimited access to company documents and other records was provided for by these interviewees. Moreover, the interviewees spoke freely on their personal reflections of the important events in their company's TQM efforts. In addition, attendance to TQM activities such as quality team presentations and meetings were also accommodated. The interviews totaled to around 30 hours for four interviewees, while attendance in TQM activities was around 16 hours. Overall, the data gathering proved fruitful and led to a detailed conceptualisation of top management commitment (Chapter 6) and focused on the central role of facilitators and TQM staff. Moreover, the unique relationships between facilitators and the rest of the organisation were highlighted in these interviews.

In the third case, the company allowed interviews with top management, middle management, supervisors, TQM staff, union officers, and quality circle leaders. The various interviews served several purposes. First, the problems of implementation are viewed from different perspectives, and as actors and stakeholders in the system, their actions are guided by these perceptions. Especially true in TQM, where voluntarism is one of its fundamental features (Hill, 1991; 1995), employees are generally given a freehand in deciding to participate or not. Thus, their actions are as strongly governed by their own personal perceptions as organisational structures and processes.

Furthermore, top management may have limited, if not incomplete, information about all the organisational actors. Thus, information from top management may be partial, distorted, or even misleading. Thirdly, interviews with different actors in different levels function as a validation mechanism of information through cross-referencing.

The interviews involved a total of 24 people in third company case, involving a total of around 120 hours of interview. It must be noted that a large proportion of time was spent interviewing the TQM staff, as they had a lot of 'insider information' from both top management and lower ranked people. The information they had provided formed part of the structure for the interviews with the other people.

The interviews were supported by other research activities. Observation and attendance to company TQM activities provided rich information. These activities included project presentations, annual report meetings, quality circles leaders meetings, management and staff meetings and the like. These activities revealed some information that otherwise did not come up in interviews as they reflected very specific concerns of the employees. These activities may be seen as a reflection of the perceptions of employees "in action". They also afforded some unplanned interviews with other employees. Opportunities were taken to inquire about details of these problems, about their perceptions of the TQM programme and their relationship with top management. In all, the researcher spent a total of around fifty hours in these activities.

The last source of information is documents, reports, minutes of meetings and other written data sources. This was particularly true for the second case as it had a regular annual employee survey that covered around fifty- percent of its people. The studies involved survey questionnaires and in-depth interviews from all levels of the organisation. It is a very useful source of information as they more accurately (relative to recollections in interviews) reflected the prevailing feeling and perceptions during those past years. These documents showed the events and other intangibles underlying the more measurable data sets.

The output of these interviews is a more detailed picture of the relationships among the variables modelled in the TQM integrated model framework of Figure 3.2. This model goes deeper than the preliminary model of phase 1. The initial insights from three company cases showed details into the development and expression of top management commitment. The access of the interviewees to top management, as well as contact with the rest of the organisation, provided opportunities to reflect on the relationships between management and the organisation. These observations are presented in the second part of Chapter 6, which also provide support for the development of the qualitative model in Chapter 8.

It is a comprehensive qualitative model that integrates the more important variables that the various members of the organisation felt contributed or influenced the TQM process. The parts of this model were presented to the interviewees to solicit their comments and if the model reflected what they perceive to be important feedback structures. The submodels were also shown to top management and their confirmation was also solicited. Indeed, the preliminary models were confirmed and even presented at their management committee annual review meeting. These submodels are shown and discussed in Chapter 8.

A second output of this field research are the data sets that were used as reference modes, the time graphs that are used as the bases for comparison with the simulated runs. However, the only data sets that were found to be useful as reference modes for the simulation were those from the third case. The data sets include the number of Excel circles (quality circles), total number of persons registered under the Excel circles programme, percentage to total manpower of circles participants, and projects generated by circles. The behaviour reflected in these time graphs would be reproduced by the simulation model as presented in Chapter 9. Some qualitative measures have been solicited from the interviewees in view of the limited indicators that are being measured by the company cases.

5.3.3 Simulation and Analysis

The preceding phase involved much analysis as the conceptual models are built. It involved continuous comparison between model and observed and interview information (see Figure 4.1, p.112). The analysis from phase 2 is continued in phase

3 using the quantitative approach of simulation. Simulation provides a powerful tool for examining the effects of the interaction of factors and organisational elements. It is recognised that time plays a very important role in TQM systems (Bong, 1993; Kofman, et al, 1994) as in most other feedback systems (Forrester, 1961; Wolstenholme, 1990). TQM is characterised by many time delays that are not necessarily of the same length, and determines many of the benefits to be derived from the programme. In general, therefore, the study of TQM requires acknowledgement of this resource. Whilst conventional studies would have resorted to the use of longitudinal studies, a simulation study can represent these changes and allow other advantages such as examining alternative scenarios (Kofman et al, 1994). Simulating results also overcomes the frequently observed phenomena of people not being able to see the consequences of their actions even as they are aware of the corresponding causal maps (Sterman, 1989; 1994).

This phase involves the translation of the conceptual model into "stocks and flows" and the formulation of a system of simultaneous difference equations. The graphical solution of these equations is compared with the observed patterns in the company case. As noted earlier, there are two parts of this phase. Firstly, the formal model is tested both for validity and for deriving some preliminary understanding of the system. The second part involves the continuous comparison, revision and calibration of the formal model against the case until it is able to satisfactorily represent the cases. The pattern matching logic (Trochim, 1989) indicates some similarities with the System Dynamics methodology of comparing simulated patterns with historical data. A number of statistical tests have been designed to support this part of system dynamics (Forrester and Senge, 1980; Peterson and Eberlein, 1994; Senge, 1977; Sterman, 1984)

Finally policy analysis is conducted to identify critical factors and determine policy sets that shall contribute to a more sustained TQM programme. The software Powersim is used in this phase. The results of this phase are presented in Chapters 9 to 10 in the first volume and Chapters A3 and A4 in the second volume.

To sum up, the research approach taken in this research allows each phase to present an output that becomes an input into the next phase. This methodology allows for simultaneous verification and validation during the data gathering. The collected data is constantly compared with reality, with other sources of information, with various interviewees, and finally presented to the interviewees for final verification. Secondly, the methodology facilitates the next phase of the research by the use of an already verified model. Thus it can be argued that the last phase of the research represents a verified and valid model. Nevertheless, some statistical tests are further conducted to establish more confidence on the simulation results. These are discussed in Chapter 9.

5.4 Model Boundaries

As pointed out in the previous chapters, TQM covers a variety of principles, practices, and techniques and tools (Dean and Bowen, 1994). These result in vast possible combinations of applications, thus requiring the establishment of boundaries for the research. As this research was generally utilising the grounded theory approach, the boundary was mainly established through the company cases' own focus of their programme. Thus, the TQM programme of company case A leaned towards Improvement Action Teams (Corrective Action Teams, Crosby, 1979), while case B was more concerned with suggestions. The third case focused on quality circles.

Part of the reason for choosing to set the boundaries on circles and suggestions lie on their voluntary nature, a feature that partly distinguishes TQM from other management initiated approaches[1]. Moreover, circles and suggestions indicated an arguably good indicator of employee involvement to the programme. As such, it is an attractive measure that can be graphically plotted and compared with simulated figures.

Whilst most analyses (Barlas and Özgökmen, 1996: Bong, 1993; Özgökmen, 1995; Kofman, et al, 1994) relate the TQM efforts to other quantifiables and tangibles such as sales and revenues, the company cases studied in this research did not relate their overall company performance to the TQM programme. The interviewees from top management hesitate, or refuse, to acknowledge that their current performance is solely due to TQM activities. Moreover, in contrast with the above mentioned studies where the programme is based on the profit or market share improvement, the companies in this research do not assess programme success based on this external economic measures, but rather on the activities themselves.

The position taken in this research highlights only some of TQM's main features. This research equally views TQM as a philosophy and a programme, perhaps, a philosophy that drives the programme. This means that the philosophy becomes a change in the mental models and thinking patterns of management while the programme provides the channel to which these new thinking patterns are communicated to influence other members of the organisation. The programme provides activities that shall embody the change in top management's thinking process. It is to be acknowledged that too often, TQM implementation process concerns itself with the activities so that the "means become an end to itself" (Wilson, 1992: 102). On the other hand, philosophical approaches do not offer much of practical approaches so that it will leave their managers with confusion and not knowing what to do (Dale, 1994; Atienza, 1996).

Thus, this research focuses on one operational concept of TQM: continuous improvement. While this term may also cover vast possibilities, this research will narrow down these areas by highlighting the role of quality circles in identifying and proposing new improvement areas or projects. Thus, supporting and sustaining the programme is viewed as sustaining the quality circles (or suggestion scheme). Furthermore, the commitment that is engendered by the change in philosophy shall be manifested through several channels in the organisation and influences the motivation to organise quality circles or propose new projects. In other words, the TQM implementation process is viewed as a virtuous circle (Masuch,1985) This can be illustrated in Figure 5.2. Management commitment encourages participation in

[1] Hill (1995) suggests the voluntary nature of participation in TQM whilst Wilkinson et al (1998) point out that quality circles were voluntary but that in TQM participation is mandatory. Nevertheless,

quality circles and suggestion schemes, and this results into some improvement. Such improvement can encourage or induce top management to be more committed to the TQM programme. Thus, when the circle continues to operate, then there is continuous improvement.

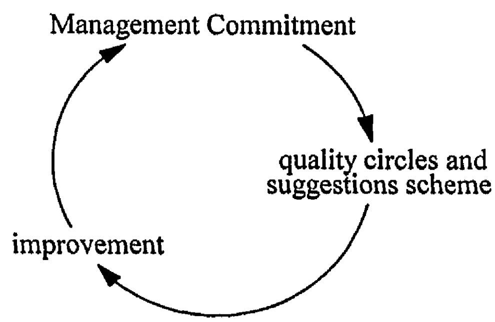


Figure 5.2. The cycle of improvement and commitment

Improvement is a rather general term. It may involve internal improvement, external improvement, improvement in customer satisfaction, improvement in profits and improvement in market share. However, this research shall not try to measure improvement and include these in the developed model because of two main reasons. First, is the availability of the information. The cases used in this research did not provide any of these information either because of confidentiality or because of it was not collected. Secondly, the management in the cases did not relate their success in the market with these external measures of improvement. Besides, the top management commitment to the programme was not based on these external indicators but much more influenced by the number of registered circles or generated suggestions.

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in the companies that were investigation, participation was voluntary.

Thus, this research differs with the previous system dynamics studies in that it focuses on the internal operations of the programme, and highlighting the interactions of management and employees, rather than concerning itself with the interactions with the market and the satisfaction of the external customers. In essence, the research deals with an often-neglected area in TQM research, that is, the internal customer. As noted by Ackoff (1992), if the internal customers are satisfied, then they can be motivated to satisfy their external customers as well. This contention is explicitly taken in this study to mean that improvement will not be achieved if employees do not participate in this scheme.

It must be noted that the implicit assumption is that continuous improvement is based on voluntary participation. While other TQM techniques provides for less voluntary activities such as management initiated projects, this study views that such approaches do not represent a change in philosophy. Although it is debatable, this study takes the position that one of the other important aspects of TQM is in pushing power down to its rank and file, and that voluntarism is a real step from gaining such power and moving away from the management dominated concept of Taylorism.

5.5 Conclusion and summary

Research is usually intended to help clarify much of the ambiguity in TQM concepts and practice. Unfortunately, the first researches conducted have been those conducted by consulting groups, but which are now viewed with suspicion (Powell, 1995) because of their self-interests. It is only in the more recent years that more informed and theoretically founded analyses have been conducted to shed light on these issues. In this regard, this research aims to contribute towards this growing literature of more rigorous and informed analyses of TQM implementation.

The next chapter presents the findings from the interviews with academics, consultants and practitioners. The case studies are also presented in both Chapters 6 and 7.

CHAPTER 6
CONFIRMING THE FRAMEWORK
EMPIRICAL RESULTS FROM THE INTERVIEWS AND CASES

This chapter presents the results of the interviews. The chapter is divided into two parts: the first part discusses the experiences and ideas of some 14 academics, practitioners and consultants; and the second part explores the detailed experiences of four interviewees in the context of their respective companies.

The first section deals with the definition and conception of TQM from the interviewee's perspective and experience. The interviews revealed that the interviewees had varying definitions and understanding of the term TQM. These differences in conceptions partly explain some of the differences in their emphasis on the types of problems or difficulties that hinder the implementation of TQM. Nevertheless, there are common threads that run through these experiences. Indeed, these interviews confirmed that the factors identified in Chapter 3 were also experienced in their own TQM efforts, albeit, in varying degrees. More importantly, the interviewees had no objections to the interactions among these variables proposed by the Integrated TQM model framework (Figure 3.2, p. 97).

The second part delves deeper into the factors and their interactions by presenting the in-depth interviews with TQM implementers in two companies. These interviews provided more information on the dependencies of the factors in the model and gave anecdotes and experiences that justified connectedness of the factors. This second set of interviews, backed up by secondary data sources from company documents, similarly supports the Integrated TQM Model of Chapter 3.

The chapter ends with some general observations and conclusions.

6.1 TQM Critical Factors: Interviews

The interviewees were made up of four academics, two consultants, and eight practitioners. Three of the academics - Bittici (1995), Manalang (1996), and McEwan (1995) - have engineering backgrounds and were involved either in actual research of TQM, or were consulted on the implementation of TQM and related projects, or both. The interviews showed that these three academics had similar perceptions of what TQM is. All three interviewees echoed the definitions of TQM as a way of managing organisations. They support the idea that management should be viewed from an integrated perspective of parts that are efficiently contributing to the whole. They agree that problems typically occur because of the lack of synergy among the parts of the organisation, and that optimisation of the organisation's performance will not be achieved by maximising the performance of the parts.

However, McEwan (1995) argues further that the failure of organisations in competing in the global market is mainly rooted in traditional values that do not necessarily place foremost priority on delivering quality and promoting customer satisfaction. He contends that changing these values is necessary to implement TQM. This can be achieved by placing more emphasis on training and education. He admits that while organisations have established training programs, the educational system still provides the foundation to learning. McEwan maintains that the educational system, including primary and secondary schools, should mould the young in the 'right manner'. In this way, the output of the educational system will provide right input to industry.

Similarly, Manalang (1996), highlights that strategic position of values in implementing TQM. Values, she pointed out, are the cornerstones on which the entire TQM programme rests. As such, TQM is becoming more than a practice, and a way of managing. She suggested that "There must be more than a mechanical application of the TQM principles. Instead, there must be a deeper understanding and appreciation of the principles of TQM which must be translated into acceptance." She believes that TQM must be a religion that should be practised with willingness and total commitment.

The fourth academic, R. Livingston (1995), viewed the TQM movement from a more specific perspective of accreditation of the university. Being involved with the accreditation process of his department, he views quality, specifically, that of education, as defined from the Ministry of Education agenda and standards. The quality of education within the department is evaluated based on specific criteria and minimum performance standards. He points out that a good rating in these evaluation processes is necessary for competing not only for prospective students but also for government funding and support. The typical criteria for assessment are involvement not only in teaching but also excellence in research.

The two consultants who were interviewed also showed an identical systems perspective of the TQM programme. Sneddon (1995) developed a model for TQM, which he uses for his training seminars. The model focuses on the need to establish top management commitment, which involves the establishment of a vision and mission statement. He argues that these visions and missions should encourage employee participation in the TQM programme. He contends that "employees want to contribute to the management of the company by suggestions and ideas for quality improvement. However, these ideas are lost simply because there is no opportunity for them to bring these suggestions to management." Thus, new systems and procedures provide this opportunity to participate in quality improvement.

Both consultants similarly imply that the entire TQM programme can be focused to one set of activities, or mini-programmes. It is possible to focus all efforts on these activities and still claim to have a TQM programme. Both admit that it is difficult to implement all the possible activities that promote quality as it diffuses the efforts, spreading the limited resources too thinly within the organisation.

Both also agree that the implementation of TQM begins with top management providing all the necessary foundation for the programme, including their own personal support and commitment. This must be supported by deeper understanding of quality and its implication on organisational processes and activities. Training and education is a fundamental task at this stage.

Atienza (1995) observed that top management understanding and commitment is not sufficient to begin and launch the programme. He cited an example from one of his projects where the initial efforts of the company to launch quality circles failed. Despite the commitment and interest of the organisation's top management and the initial training seminars that were conducted, the quality circles waned after a few months. The main reason for the failure to keep the quality circles was linked to the consultant who left the circles on their own after the training seminars for all personnel were completed. Without proper guidance, the initial quality circles lost their direction, and failed to successfully identify and implement improvement projects. Moreover, he noted that, in other cases, company management terminated the services of the consultant earlier, to save on consultant fees or when the managers felt they have gained sufficient knowledge that is necessary for the programme. In these instances, the programme also failed to take off. Thus, Atienza (1995) stressed that consultants should not leave the organisation until the participants have been gained sufficient experience. He observed that, "like most things, quality improvement programmes are learned after some continued experience."

Of the eight practitioners, five practitioner interviewees (from four companies) implemented a quality programme that followed textbook programmes. Wyman Gordon Limited (Reid, 1997 and Alexander, 1997) implemented a TQM programme based on Crosby's 14-step quality improvement programme. The programme was centred on Corrective Action Teams (CAT) to identify quality improvement projects. The activities of the quality department are more focused on operational quality control, which occasionally required teams to resolve problems. Nevertheless, both interviewees found the model representative of their own experiences in quality improvement.

At Motorola Philippines (Espino, 1996), the programme is focused on the use of quality circles, which had been considered very successful. Espino (1996) proudly declares that these circles have developed teamwork in the workforce as well as commitment to the organisation. She says that participation and involvement is high in their company. As for the factors that explained their success, Espino (1996) pointed out that top management leadership and involvement was the most important factor for the implementation of their TQM programme. She believes that such leadership is a product of an organisational culture that prepares leaders who uniformly imbibe practices that can be applied in any country.

Demano (1996) suggested that training and process improvement is similarly the concern at Amkor Anam, a semiconductor joint venture between a Korean and an American company. However, he singled out middle management as a critical factor in the TQM programme. It was observed that quality improvement activities of the rank and file employees could create a sense of insecurity among the supervisory and middle management levels. It was recognised that this can lead to derailing of the TQM programme. To address this potential issue, Amkor Anam management drew up a career path for the supervisors and middle managers that clearly show that their subordinates will not be able to overtake their position through active involvement in the programme. The career path for middle management eliminates the perception that the TQM programme is a threat to them and thus, assures their co-operation and support for the quality initiatives of their subordinates.

The current company of the fifth practitioner interviewee (Lindsay, 1995) did not implement any special quality programme. Their quality systems are mainly based on quality measuring technology. But they were reported to be planning to apply for ISO or BS5750 accreditation. However, he presented his views on TQM based on his previous job where he had worked for a number of years. He believed that TQM is more than the application and practice of quality improvement techniques and tools. He maintained that TQM has to extend to other organisational processes, in fact, become embedded in the entire organisation. In particular, he was concerned with performance appraisal and tenure of services. In his personal experience, he felt that the company did not consider his long tenure and excellent performance for the company when his services were terminated. He believed that this was a clear contradiction of the principles of TQM.

Two practitioner interviewees, Macmillan (1995) and --(1995) said that quality efforts in their companies were limited to ISO 9000 accreditation. Quality is seen to be a main area for competing in a more demanding market. However, quality is seen as connected to an accreditation process that certifies the level of quality of products and services. The certification process argues that the organisation's systems and procedures determine the end quality. Undocumented processes allow for lack of standards and standard processes that can lead to non-uniform quality output. As such, the certification programme is mainly focused on documenting all procedures and policies.

It was a common experience of these two interviewees that the accreditation process is characterised by some stages of interest among the management and employees. It began with a gradual increase in interest in the documentation activities. Later, more interest and enthusiasm developed. When the actual part of documentation of processes reached the more tedious review and revision activities, the members of the organisation started to slowly lose interest and felt that "this is an extra job to be completed". In a few instances, some members actually stopped contributing and avoided altogether all the documentation activities. The completion of the documentation, and finally the actual certification revived some interest, but soon faded again after the novelty of the award had sank in. In many instances, the employees, including managers, went back to the old ways of doing things without regard to the new work manual. Interest came back again only in the following audit.

Macmillan (1995), as the main person in charge for the accreditation process in her organisation, made further observations on the preparation and documentation process. The company-wide nature of the accreditation process required the participation and co-operation of all the members of the organisation. She felt additional workload and pressure during the downside part of the 'enthusiasm curve'. Moreover, regular work was given priority over accreditation activities and requirements by members of the organisation. The secondary role of these certification activities therefore contributed some delay in the process.

She pointed out that top management commitment and leadership is necessary to "tow the members in line" to keep the accreditation process on schedule. However, her experience showed that even top management commitment is not uniform among the top managers. While there were those who clearly understood and supported the programme, there were those who were not as supportive. These latter group tended to give least priority to certification and documentation tasks, and "would avoid it totally if they can get away with it". The result is the diffused support for her activities. These situations are the main obstacles she encountered in her experience.

When he was asked whether their organization had some form of TQM in place, the last practitioner interviewee (,1995) asked to qualify the meaning of TQM. When informed that TQM involved the principles of customer focus, continuous improvement and team work and practices such as problem solving teams, training, quality systems and certification, and supplier management, he admitted that they had all these activities in place, but that they do not have a TQM programme. He pointed out that they believe in providing quality to satisfy their customers but that they consider it to be inherently part of their management practice and does not have to comprise a separate programme.

The final part of each interview involved the presentation of the model to the interviewees to summarise their main points and ideas. Invariably, the interviewees accepted the model and its proposed relationships. They said that they were able to explain their experiences based on the conceptual model. Moreover, they recognised the dependencies of the factors on each other. They also agreed that the factors indeed were present and had some influence but noted that the strength of the influence could have varied. That is, the strength of some factors in influencing the programme simply dominates the observed effects but does not necessarily eliminate the effects of other factors. Furthermore, the model explicitly indicated the relationships of the factors, a fact which was not as apparent when they implemented the TQM programme (Reid, 1997).

6.2 Discussion

The results from the interviews revealed some insights into the TQM implementation programme. The more apparent observation from the interviews was the variety of versions of TQM implemented by their organisations. Although the programmes are founded on the same principles of quality excellence, the approaches and emphasis seem to differ from case to case. The instruments through which quality improvement can be achieved ranged from the very personal level of involving the individuals through suggestion schemes (Demano, 1995) to a more socially-founded motivational approach using teams and quality circles (Atienza, 1995; Alexander, 1997; Espino, 1996; Reid, 1997; Sneddon, 1995). A third variation is relatively less personal, perhaps a traditional bureaucratic approach, of documenting and entrenching systems and procedures (Livingston, 1995; Macmillan, 1995; --). The seventh practitioner, in contrast, viewed the principles of TQM not from a programme approach but from a strategic perspective that is embedded in the entire organisation, which does not require any additional promotional efforts or new structures.

These differences in versions highlight the varied possibilities of implementing the TQM programme, or more specifically, promoting and undertaking continuous improvement to satisfy the customers. The interviewees did not have any specific reasons for adopting a particular technique. From their comments, there seemed to be no explicit decision as to how the programme was to be implemented. Apparently, the technique was suggested either by the consultant they had hired at the start of the programme (Atienza, 1996; Demano, 1995; Sneddon, 1996), or, the off-the-shelf package that they followed (Reid, 1997;

Alexander, 1996). Alternatively, the company followed the programme of its home office (Espino, 1996). As for companies that pursue accreditation activities, the decision to undertake such approach was initiated by their management (Livingston, 1995; Lindsay, 1995; Macmillan, 1995). This variety of approaches to improving quality is rather similar to Dale's (1991) survey of 148 companies that reported that developing a quality management system, quality system certification and adopting the teachings of a guru are the three most frequently used approaches to quality. The seeming absence of an actual selection criteria and decision making on the approach to TQM reflects the Dale (1991) study that organisations tended to follow the simplest option.

Moreover, there was a unanimous concern for top management's role in the programme, albeit, varying emphasis on the different top management-related factors and middle management support. The emphasis ranged from more concrete actions of overlooking performance and loyalty (Lindsay, 1995) or lack of co-operation (Macmillan, 1995) or open support (Espino, 1996), to more abstract expectations of commitment and support (Sneddon, 1995) and leadership and support (Atienza, 1995). Although there were differences in focus, the interviewees all supported the notion that top management plays a central role in the programme.

The three academics, Bittici, Manalang and McEwan viewed the TQM programme from a wider perspective and did not focus on any specific application technique. Rather, they saw beyond the application techniques and highlighted the basics of value formation, training and education, and the inter-relatedness of factors and organisational functions. They seem to imply that success of the implementation of the programme would necessarily follow if the principles have been properly understood.

The differences of the focus of the systemic academics and the more pragmatic practitioners reflect their immediate concerns. On one hand, academics have the time to step back and assess implementation difficulties. They can afford to look at these obstacles with a more objective perspective without pressure from their organisations. They are able to see beyond the events without being unnecessarily troubled by details and reactions from employees and management. All these allow the academic a more ideal conceptualisation of the organisation and the implementation of TQM.

The practitioners and consultants, on the other hand, are tasked with operationalising the TQM concepts. They are faced with the reality of organising, co-ordinating and directing all TQM activities and tasks. The idea that all employees be involved in the programme, coupled with possible resistance to the required changes in responsibilities, skills and behaviour patterns, further complicates the task of the practitioners and consultants. Moreover, there is a need to justify the implementation of the programme through its impact on the bottom line figures of costs, revenues and profits in the shortest possible time. Such pressures, therefore, encourages managers to adopt off-the shelf packages or recommended programmes by consultants as these schemes are claimed to have been tested and found to be effective and efficient.

These points, however, lead to the question of how much the organisation, in particular, its top management, understands about the principles and requirements of TQM. The experiences of Lindsay (1995), where his organisation did not seem to recognise his efforts and loyalty to the company, and Macmillan (1995), whose top manager was not co-operative and supportive to her ISO documentation efforts, seem to show that top management does not fully know the meaning and implication of TQM. In these two situations, the interviewees had questioned management's commitment to the implementation of the programme.

The TQM framework postulated that management commitment is directly related to understanding and appreciation of TQM. Some studies revealed that managers did not understand TQM and were not able to adjust to their new roles (Duncalf and Dale, 1990; Caudron, 1993). This proved to be a barrier to successfully implementing the programme. However, Atienza (1995), pointed to the limits of training and education. He maintained that these are not sufficient to support the programme (Atienza, 1995) as there are other events that occur after that may support or hinder the programme (Stratton, 1993). Events that occurred after initial training and gaining understanding are investigated in the two cases of the next section. The section addresses the role of learning and understanding on top management by focusing on the development and shaping of top management commitment and other factor interactions.

6.3 Factor Interactions: In depth Interviews

This section presents the results from two sets of interviews that delved deeper into the implementation of TQM in their respective companies. The interviewees were asked not only about their own interpretations and understanding of TQM, and the corresponding the critical factors, but were also asked to reflect on their experiences as TQM implementers and relate situations and conditions that affected the success of their programme. These experiences were also supported by secondary data from company documents. The companies are subsidiaries of foreign firms that have been established in the Philippines for a relatively long period of time.

6.3.1 Company A

Company A is involved in the production of electrical lighting and was established in 1959. Its sister company handles marketing and sales of these products. It was producing mainly for the local market until around the 1980s when it began to export into the United States. It has approximately 600 workers operating on two shifts.

In 1985, through the initiatives of its mother company abroad, the Company-Wide Quality Improvement Program (CWQIP) was launched. Following the quality programmes of its sister companies in the United States, the company began promoting quality improvement using the 14-step Crosby programme (Crosby, 1979). Seminars, called Quality Colleges, were conducted beginning with top and middle managers and senior supervisors. Selected management staff were given special training to conduct the subsequent seminars for all workers, office staff and rest of the organisation. The Challenge Sheet programme based on Crosby's Error Cause Removal (ECR) was launched together with the corrective action teams, called IMPACT for Improvement Action Teams.

The factors that are important to the TQM implementation process appeared to be reflected in the fluctuations of the number of Challenge Sheets and IMPACTs (Ordonez, 1995). The number of Challenge Sheets and IMPACTs fluctuated over the years. Ordonez (1995) explained that these peaks and troughs represent certain events that encouraged (or discouraged, as the case may be) workers and other employees to participate in the TQM programme.

The interviews revealed that the direct factor that encouraged participation and involvement in the Challenge Sheet and IMPACT schemes was facilitator effort. The TQM group was tasked with co-ordinating all TQM training, performance indicator collection and monitoring, and promotion and information dissemination activities. In all these activities, there was direct contact between the facilitator and all the members of the organisation. During these regular monitoring and promotion activities, problems and difficulties were invariably suggested or discussed with the facilitator. In such instances, the facilitator encouraged, or suggested the filling up of a Challenge Sheet or the formation of a new IMPACT.

The workers received the support efforts of the facilitator with much enthusiasm, and returned the favour by becoming involved in the programme. Ordonez (1995) pointed out that there are two possible explanations for worker enthusiasm. First, the facilitator is seen as top management's representative on the shop floor. The TQM programme has afforded the workers with a channel to air their own concerns to top management, a system, which was not available in the past. The recognition given to outstanding participants and the corresponding publication of such awards were seen as indications of top management's changed attitude to the rank and file. Moreover, the speedy resolution of the problems identified in the Challenge Sheets and the implementation of IMPACT recommendations served to reinforce involvement in the TQM programme.

A second explanation to the high levels of participation is the peculiar relationship that evolved between facilitator and worker. This relationship developed into a more personal concern for each other's welfare: "the facilitator and workers were taking care of each other's back" (Ordonez, 1996). The facilitator took personal interest in seeing to it that all suggestions (Challenge Sheets) were properly evaluated by management and facilitated their early resolution. She also saw to the efficient functioning of the IMPACTs so that their recommendations were in the proper form and content that were acceptable to management. Thus, the number of Challenge Sheets and IMPACTs rose when the facilitator appealed for more participation.

These two explanations accounted for the peaks and troughs of the number of teams and suggestions. The initial positive slopes were mainly due to the new opportunity to solve existing problems and difficulties. The later rises in the numbers may be credited to the efforts of the facilitator to encourage participation, even when top management's concern for workers was not as apparent or visible.

This latter lack of visibility of top management in TQM affairs was identified as one cause of diminished worker interest in TQM participation. The changes in top managers who had different ideas and perspectives of TQM concepts and implementation process affected the perceptions of commitment of top management to the programme.

Ordonez (1995), however, observed that in many instances, the facilitator failed to offset such negative perceptions of the workers as she had less time to visit the production lines. In fact, it seems that her absence on the shop floor may have contributed to the lower perception of top management sincerity. Further interviews, however, showed that less contact and less active monitoring of the workers was initially due to work overload. Time had to be allocated to other priority activities such as the ISO accreditation activities. The facilitator confides that "There wasn't enough time to accomplish all my responsibilities. I often had to go home late at night, and all my activities for the entire day were all related to the ISO accreditation. If there were TQM reports that were needed, I would have to do them on weekends!"

A more critical problem that reduced the facilitator's time on the lines was the plan by the new plant manager to transfer the TQM section from the quality department to the personnel department. The ensuing controversy on which department should take this responsibility slowed down all TQM activities. The uncertainty that characterised that period proved to be discouraging to the facilitator herself, as she could be relieved of her responsibilities if TQM were transferred to the personnel department. There was some uncertainty on whether she will be retained by the company as she did not have skills to stay in the personnel department. Moreover, the possibility that changes in policies due to the pending change in authority created doubt about her performance and the system they had introduced, as well, as the present need to perform her current functions. These disrupted all TQM facilitation efforts on the shop floor at this time.

Upon reflection of the past events, Ordonez (1996) concludes that the central factor in TQM implementation is top management commitment and their corresponding actions. She says, "Commitment may only be a rhetoric without content. Commitment must be translated into real actions as people read actions more than words. Despite the centrality of the facilitator's task as a direct channel to the lower ranks, top management is still more strategic. Top managers are responsible for the facilitator, for the facilitator acts only upon top management's instructions and policies. Besides, facilitators are simply doing their assigned jobs. Facilitators are only an instrument and the real actors are management."

6.3.2 Company B

Company B is a consumer goods manufacturer. It has a longer company history than Company A, having been established around the late 1920s. It has around 1200 workers.

Their TQM programme, which was simply called TQ, began in the late 1980s when increasing competition was becoming more apparent. Lessons from abroad indicated that improved quality and cost reduction could be achieved through a more integrated programme. A corresponding TQ seminar was conducted, visits by its top executives were made to sister companies who had similar programmes, and later a foreign consultant was hired to guide the programme. By 1991, all members of the organisation from management to shop floor workers have undergone training for Total Quality.

The initial years of TQ in the company were focused on three main areas: training, communications and improvement activities (Macapagal, 1996). The TQ concepts and practices were first introduced to its top management, and followed by a select group from middle management, who later acted as facilitators and trainers. Later, training was extended to all members of the organisation from senior and middle management to the office staff and shop floor workers. The training programme also included newly hired personnel, and later offered to external suppliers and even customers.

Good communication as a second foundation of Company B's TQ programme highlighted "the need to develop a common language to promote understanding". The communications campaign was aimed at maintaining awareness, commitment, motivation and enthusiasm of management and staff towards Total Quality. It was also intended to provide the necessary information to help individuals tackle their tasks. In addition, an employee survey, called the Organisational Climate Survey (OCS), was conducted annually to determine the impact of the programmes of the company on its members. The OCS became an input to top management's plans for the following year.

The improvement activities were centred on a suggestion scheme called OFI (Opportunities for Improvement). It was introduced in April of 1991 and since then has accumulated around 9,000 suggestions. Figure 6.1 shows the annual generation of OFIs.

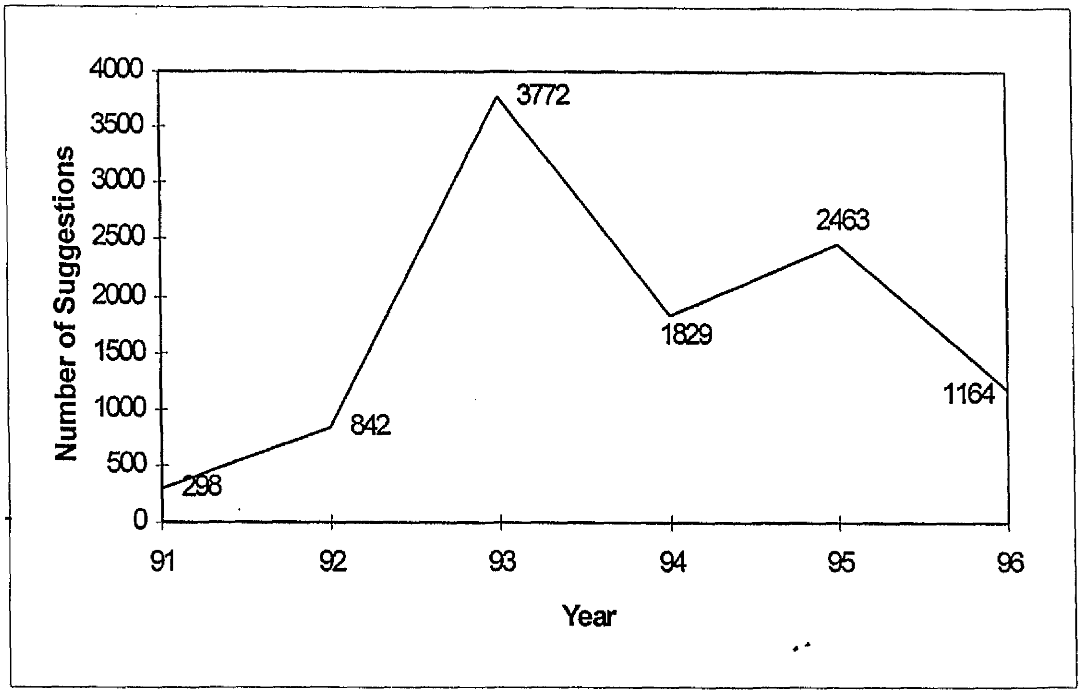


Figure 6.1. Opportunities for Improvements (OFIs) generated over the years at Company B.

The first three years of the suggestion scheme reflected the initial enthusiasm of the members of the organisation. This may be attributed to the initial efforts to train and communicate the principles and practice of TQ to all the members of the organisation. Senior managers observed that "employee involvement has increased with a corresponding increase in their awareness of work processes that concern them" (OCS, 1993). There were reported changes in "mind sets, 'the way we think', and more equal treatment of employees regardless of rank". These changes in the organisation were exemplified by the apparent changes in their salesmen. Many of these sales people used to be poorly dressed, poorly groomed, and not punctual in their appointments. After the seminars, these people became aware that their appearances were important as it reflected the company image. "They realised that they were the main contact of customers and consumers, and that they were the first line of defence of the company in its fight against competition and survival" (Mendoza, 1996).

Nevertheless, Figure 6.1 showed a drop in the number of suggestions in 1994. Mendoza (1996) attributed this decline in suggestions to the delay in responses and action from decision-makers or implementers of the suggestions. The growth in number of received suggestions reached proportions that could not be handled immediately the concerned personnel. These suggestions began to compete for attention with other tasks and responsibilities. The suggesters viewed these delayed replies and actions as diminished concern and recognition for their improvement efforts. This prompted the TQ administrators to implement the five-day response time campaign. This required the concerned personnel to reply and act within five working days after receipt of an OFI. This scheme effectively removed the backlog of unacted suggestions, which brought renewed interest with the system.

The suggestion scheme was also supported by an incentive system that recognised the best suggestions and provided other participants a chance to win some prize[1]. However, while there was recognition of the positive effect of these

[1]All suggesters were given raffle tickets upon submission of their suggestions. There were monthly raffle draws that gave out home appliances, among others, for prizes.

incentives on employees' motivation to participate in the suggestion scheme, there was growing disenchantment with the system. Rewards such as ballpoint pens were seen to be of little value. The OCS (1994) reported that respondents "find more meaning for rewards if these were directly translated to monetary rewards or salary increases". Other respondents suggested that the monetary rewards be proportional to the benefits that the company derives from the suggestion. Moreover, the low profile recognition of active participants with good suggestions was seen as inadequate. Respondents suggested that the recognition be publicised in company-wide newsletters instead of the very narrow section publications.

Furthermore, there were also growing doubts on the criteria for good suggestions. The OCS (1994) reported that "if the OFIs benefit the workers at company cost (expense), the perceived response will be 'we'll study the matter'." This belief was reinforced by the observation that most of the recognised best suggestions involved cost innovation that directly benefited the company. The respondents claimed that these situations caused the initial enthusiasm to wane.

The OCSs (1993, 1994, 1995) revealed other deeper issues in the implementation of the TQ programme. Some senior managers suggested that the bottleneck in TQ implementation was middle management. They claimed that there was little practice of TQ norms. Senior management recognised that workers were enthusiastic and keen on the programme, and clearly practised the TQ philosophy. They also acknowledged the strong support for TQ from the management board. However, 'The problem lies in the layers of management in the middle." One senior manager observed that "fear and resistance among the middle managers kept them from making TQ work".

Some workers complained that middle management compromised quality with bulk. Passing substandard products to meet the targets on the instructions of their direct superiors are a constant frustration to the rank and file who want to practice the TQ values. Thus, the workers perceived that this poor role modelling of middle managers and supervisors coupled with deficient people management skills were obstacles to TQ implementation.

On the other hand, middle management blamed top management for lower priorities placed on TQ practices. These middle managers explained that TQ could take second priority to give way to the achievement of business targets. "The predominant philosophy is 'We have to hit the track; let's apply TQ only when necessary, and when the situation allows", they claimed.

The issue on the concern for bottom line impact of processes became more apparent with the replacement of the Chairman in 1995. The former Chairman was known for his "high touch" (Macapagal, 1996) approach to management. He had an active participation in the programme and maintained personal contacts with all levels of the organisation. He was known to visit the production lines, late in the night, to talk to workers. In contrast, his successor was seen to be more concerned with operational control and its effects on the bottom line. Thus, there was more concern for reaching the targets than practising TQ in the later administration.

TQ was also beginning to be seen as an "add on.... a chore to existing functions". These middle managers felt that their working days were barely enough to fulfil their responsibility and daily operational problems. Balancing their responsibilities with TQ activities is one big difficulty. There was also a similar observation that "the TQ facilitator and deputy were spreading themselves to thin" in the organisation with their growing responsibilities and activities[2]. The respondents felt that the TQ co-ordinators will not have sufficient time to push the programme effectively.

Moreover, the diminishing involvement of top managers was an issue that de-motivated some sectors of the organisation. The survey (OCS, 1995) stated that "Middle managers acknowledge that while some board members and management teams sincerely hope to develop TQ as a way of corporate life, involvement is most visible only on paper. Memos and exhortations to live TQ abound, but in actual practice, visibility in TQ efforts is wanting". Respondents in the survey pointed out that spending by top management in expensive hotels, delegation of TQ work to subordinates and use of expensive cars are contrary to TQ principles. They noted that these reasons discourage full internalisation of TQ values.

Rank and file employees similarly questioned the depth of involvement of top management. They perceived a gap between the espoused TQ values and the values that were actually lived out. They felt that that there was a contradiction in the policy of openness. There was an observation that workers who aired their concerns in regular meetings with top management were branded as "insubordinate".

[2] The TQ Co-ordinator and staff were also assigned to handle corporate communications.

Another issue that hindered TQ implementation was security of tenure. Some supervisors recognised the relationship between improvement efforts and redundancy programmes. They said, "sustained TQ efforts may lead to down sizing, and later result in displacing personnel." The reorganisation in 1996 that included the termination of the services of some managers was believed to be a result of successful TQ efforts. It was argued that if managers were not secure in their positions, neither were the ordinary workers. Moreover, it was noted that unclear and undefined policies of past redundancy programmes further decreased the morale of the workforce. These led some people to question how the company values its people. Mendoza (1996) suggests that these fears partially explain the lower number of suggestions for 1996 when the company offered a voluntary retirement scheme.

6.4 Discussion

The preceding cases highlighted the interactions of the factors on each other. The development and progress of TQM implementation in these companies showed that the factors are not necessarily independent of changes and influences from other variables. Moreover, the interdependencies among these factors form cycles of feedback. There are circular causes and effects among the sectors of the organisation. This was evident in Company A where the lower level members looked to the facilitator's support while the latter was concerned with their participation and activities. Similarly, the top management of Company B was concerned with middle managers' inadequate participation and involvement in the programme. Senior managers felt that middle managers prevent the rank and file from becoming fully involved with the programme. On the other hand, middle management blamed top management and the policies, which give priority to bottom line results over other TQ activities.

These case studies also confirmed the centrality of top management commitment in influencing middle management, the allocation of resources, particularly training and facilitation, and the rank and file. Indeed, these cases suggest that top management commitment is a "precondition to employee commitment and support" (Fabi, 1992).

Moreover, these in-depth interviews highlighted the importance of the presence and visibility of top management in organisational activities. Members of the organisation, from middle managers to rank and file employees, perceived top management commitment not only through availability of resources and training but also through their presence, active involvement and support for all related activities. The seminars seemed to have sensitised these employees at closely observing their managers in all aspects of their work and the consistency to TQM principles. The results were higher expectations of performance and role modelling from their superiors. Failure to reach these expectations led to dissatisfaction and discouragement in their participation efforts.

Indeed, top management was shown to have its problems in translating the principles to practice. Whilst these two company cases showed that top management developed some appreciation and understanding of TQM principles through training, previous experiences, company visits and consultancy advice, effecting these ideals into practice proved to be influenced by other factors.

First, commitment did not appear to be uniform among the members of the top management team. Each member may have a different interpretation of quality principles or may have varying degrees of commitment to the programme. In both cases, it affects individual managerial decisions and actions, which may be perceived by the organisation as representative of the entire top management team.

In company A, the move by the plant manager to transfer the TQM function to the personnel department was seen as a political move to ease out the quality manager in favour of his protégé at the personnel department. In Company B, some middle managers were vocal in their observations of their management team needing to develop "a sense of synergy". Others suggested that there is a "need for the Board to preserve their team character". They further stated that disagreements among the team should be kept from the rest of the organisation and that issues must be settled in the boardroom. One suggestion of the importance of "level-headedness in the face of issue and concerns" reflected the embarrassing emotional public outburst of some top management members. These instances indicated support for Wilkinson's and Witcher's (1993) observation that the organisation is not necessarily devoid of a political dimension.

A second factor that is related to the non-uniformity of commitment among top management members is that performance and actions of managers are mainly a part of their personal management and leadership styles. This is illustrated in the different styles of two top managers in Company B. The first Chairman was known for his concern for developing smooth interpersonal relationships and 'high touch' management style, while his successor was reported to be more formal and was known for his focus on operational control. These differences reportedly had some subtle effects on the lower levels of the organisation that wanted close contact with their Chairman. A more particular example of personal management style (if not personality) was reported in the production department where lower level managers were scolded and shouted at in the presence of workers. The middle managers were gravely embarrassed in front of their subordinates. Moreover, they pointed out that such actions contradict the TQM philosophy of teamwork, prompting them to wonder about the commitment of top management to the TQM ideals.

Maintaining the level of commitment at the top is further affected by changes in top management composition. Transfers, resignations and promotions bring in new members, who have their own conceptions, assumptions and attitudes, in the top management team. Moreover, new members in the top management team may not necessarily share the same interpretation and understanding of TQM principles, particularly if these new executives are hired from outside the organisation. The frequency of changes can, therefore, also hinder TQM efforts if commitment is not sustained at the same or better levels.

The feedback from other members of the organisation to top management can also shape commitment. Performance from the middle managers, facilitators and rank and file was observed to have affected top management perceptions. In the first case, the concern for performance was realised when huge savings were gained from suggestions and team efforts of the organisation. Thus, Company A was encouraged to continue its TQM efforts. Nevertheless, it was pointed out that commitment to the programme was still mainly motivated by its main home office directives.

In Company B, the performance of the TQM programme did not necessarily affect top management. The company adopted a strategy that deliberately avoided actual evaluation of the programme. Macapagal (1996) argued that it was rather unfair for the organisation to be assessed during its learning period. He pointed out that it takes some time before the concepts from the training programmes could be successfully applied in organisational process improvement and much longer to be internalised. He viewed the first years of the TQM programme as its learning period. He has argued that commitment to the programme should not wane in the meantime where the programme has not yet been completely entrenched in the organisation.

6.5 Conclusions

The various interviews presented in this chapter confirmed the proposed model of Chapter 3. The views of the fourteen academics, consultants and practitioners supported the importance placed on the identified factors. Similarly, the in-depth interviews in the two companies also indicated support for the model's components. The support from these interviews for the TQM framework was further reinforced by a presentation at the British Academy of Management (Mutuc, 1995), where there were no major objections to the framework.

Moreover, these interviews provided added insights into the workings of the TQM programme as these factors interacted with each other. Indeed, each factor was not independent of other variables as suggested in the analysis of Chapter 3 and 4. Many of the interactions were centred on top management commitment as it provided much of the support that was necessary to undertake improvement activities. Furthermore, physical visibility and involvement by top managers was perceived to indicate management's interest in the programme. This last observation was an addition to the proposed model as it places top management visibility as a similarly important factor in the implementation of TQM.

The in-depth interviews in section 6.3.2 also indicated that top management commitment is not a given variable, neither is it a constant variable. It changes over time depending on the composition of the company's top management, each bringing with them their own personal view of the programme and their work. As a central variable to the TQM implementation efforts, sustaining a high level of commitment at the top becomes a more critical variable not only because of the constant turnover of its members but also because of the unavoidable variations of styles and personalities within top management. This suggests that top management need not only manage subordinates but also its own ranks. Indeed, Wilkinson and his colleagues (1993) reported that some of their respondents even suggested that the TQM programme could move further with the removal of 'quality sceptics'.

Nevertheless, non-uniformity of management styles and the frequent changes at the top appeared to have been resolved at Espino's (1996) organisation. She observed that despite changes in the company's top management positions, policies and management styles of succeeding incumbents were relatively identical. She attributes this to a prevailing company culture that is the same in any of its branches and affiliates around the world. The concept of continuous improvement, which can be achieved only through teamwork, was consistently accepted and practised by any of the executives that have assigned to their organisation. This allowed the smooth consistency of the quality programme and the continuation of supportive quality policies.

Espino's observations on the role of organisational culture similarly support the framework. The organisation's members' mental mechanisms, management rationales and company-wide mentality (Galgano, 1994) determine their reactions to changes in other factors. These thinking processes that have been acquired over the years within and outside the organisation may or may not be supportive to the TQM ideals. Thus, education and training and other sources of learning can re-shape these mental processes (McEwan, 1995) as shown in the rather successful learning programmes in the company cases. The importance of quality was reported to have been accepted by employees, particularly at the lower levels, as necessary for the continuance and survival of the organisation. More specifically, workers in Company B showed concern for the consistent practice of TQM principles, not only from their own ranks but even more so from their superiors.

However, there must be an interdependency between culture and education and training that is difficult to break. It must be noted that culture arose from a long-term experience that is supported and reinforced by accepted behaviour patterns, attitudes, beliefs and assumptions. It is possible that these traditions do not follow any rationale or would have been unappropriate after some time. Training and education, as recognised in the TQM principle, is required to correct this long time assumptions, attitudes, beliefs and practices that are inconsistent with total quality. Thus the success of a sustained TQM programme is partly, if not entirely, dependent on this conversion to a culture that is consistent with TQM.

Thus, it was observed in the case studies and in some of the interviews that relatively successful training programmes are able to impart the changes required by the programme in response to the increasingly intense global competition. These arguments appealed to the logic and common sense of the rank and file and the rest of the organisation as to the urgent need for change. However, such conversion and realisation of the importance of change is similarly a dynamic variable that is also influenced by other factors.

One central issue seems to focus on top management not being able to internalise and practice the TQM ideals despite similar initial training and education. Varying management styles and personal agenda are further complicated by short-term goals of improved performance and prevent managers from consistently practising the TQM principles. The inconsistency of managerial actions and expectations also led to similarly inconstant and unsustained levels of participation and involvement in the programme.

The two cases also suggested that sustenance of the programme is not necessarily dependent on the tangible benefits that can be derived from it. More specifically, the companies did not categorically indicate that top management was sensitive to inadequate improvements in market shares or customer complaints or external improvements. It is possible that they can be fully insensitive to these indicators as management is forced into supporting the programme as a directive from its home office (as in Company A), or as a part of a strategy to entrench the programme before formal evaluation (as in Company B). These observations can simplify the Integrated TQM model.

In sum, the interviews and cases discussed in this chapter showed not only the complex nature of the interaction of factors affecting TQM implementation. It also established that the factors are not static as often assumed or implied in many analyses and studies. The factors continually change over time as other factors impact on them and create feedback on themselves.

Secondly, these interviews illustrated the conflicting objectives that affect the programme. Managers are faced with the trade-offs from the bottom line effects of the programme in the short term against the longer-term expected benefits of practising the principles of TQM. The rank and file also faces a similar dilemma in taking instructions from their superiors who clearly contradict the accepted practices of TQM.

The case studies also revealed the effects of the limits of resources, in particular, time. Time, as a finite resource, limits the activities that can be undertaken. The critical support and training activities by facilitators, and the ceremonial and communications activities of managers are particularly affected by pressures of other competing tasks and responsibilities.

A third point of these interviews suggests the importance of the time perspective of assessing the success of the TQM programme. The differing time delays among the factors can influence the eventual performance of the entire programme depending on the sensitivity of actors to changes in each factor. For instance, top management may not presently be very sensitive to short term bottom line effects in the present, but cumulative disappointing results and delayed benefits or gains can lead to increased sensitivity and frustration. On the other hand, workers are rather sensitive to delayed responses to their suggestions (OFIs) as shown in Company B.

Furthermore, more tangible benefits from the programme can be derived only through constant efforts of the members of the organisation. This suggests the need for proper entrenchment of the new thinking processes and values in the company. However, the interviews and the cases noted that there is always a possibility that members, including management, can slip back to the old ways and values. This can further delay the realisation of benefits. Disappointment over the programme can lead to its demise.

These three points - dynamism of factors, conflicting or competing factor resources and time dependence - all confirm the suitability of a system dynamics analysis. The factors suggested by the initial framework and the insights from the interviews and cases in this chapter establish the foundations of the formal system dynamics model. However, more details about the interaction of the factors are necessary to build the formal model. Moreover, it was observed earlier that variations of TQM programmes amongst companies suggest that each programme may involve certain unique features. Thus, a complete company case study that takes into account both these considerations will be used for the model. Company C serves this purpose. It is discussed in detail in the following chapter.

CHAPTER 7
FOUNDATIONS OF THE MODEL: THE CASE STUDY

This chapter prepares the ground for the development of the formal model. This model represents the system that generates a problem behaviour. This system is composed of the factors that interact during the implementation process as suggested in Chapter 3 and supported by the interviews and company accounts of Chapter 6. The present chapter aims to identify more specific variables and boundaries for the system of factor interactions.

The study recognises the importance of grounding the model to theoretical and empirical foundations, and from published and verbal accounts (Forrester, 1961; Saeed, 1992). Thus, the chapter covers both sources of information in this chapter. It presents the empirical data gathered from Company C, following the theoretical framework developed in Chapter 3. These accounts will later form the detailed parts and assumptions of the model that will be developed in Chapter 8.

The second part of the chapter analyses these findings and simplifies the theoretical framework. The chapter concludes by interpreting these empirical findings from Vroom's motivation theory (1964).

7.1 Background of Company C

Company C is a glass manufacturer that was founded in 1958. It was a family -owned corporation until 1989 when it became affiliated with a large Japanese multinational company. This joint-venture arrangement provided for the more advanced glass technology that was imperative for its increasingly competitive market.

Being involved with continuous flow process manufacturing with high operating and maintenance costs, the company embarked on a corporate-wide cost-reduction programme in 1983. It was an umbrella programme that included several initiatives. One of these activities was the setting up of quality circles (which were called Excel Circles). The circles were launched through the training of some 14 middle managers who later formed 9 circles from their respective work areas. These initial efforts produced some positive results, but the redundancy programme and labour strike of 1985 hampered its growth. By 1987, all the remaining circles became inactive.

In 1991, top management decided to launch a more comprehensive programme (called TQC, for Total Quality Commitment) that involved all the employees and all departmental functions. A TQC Working Committee Chairman was appointed from the senior managers to oversee the programme. This encompassing programme was based on the "broader but integrated" principles of TQM. It stemmed from the realisation that the narrowly defined former programme, which was confined to only a small group, led to the problems and discontent among the non-participating members of the organisation, which eventually led to the programme's demise.

To avoid this earlier error, training was provided for everybody and management vigorously encouraged participation of all members of the organisation.

Thus, even with several initiatives under TQM, the focus of the company was still on the Excel circles. The former TQC Chairman pointed out that "We were trying to establish the necessary structures to make TQC the religion of the company. However, the Excel Circles remain the foundation of the programme" (Arriola, 1996).

The success that the programme had achieved over the years is indicated by the high level of participation. The number of Excel circles averaged 70.6 circles per year (Figure 7.1) with an average percentage participation rate (from the entire workforce) of 61.8 per cent per year (Figure 7.2). Moreover, its best circles have been consistent awardees in national quality circles competitions and conferences.

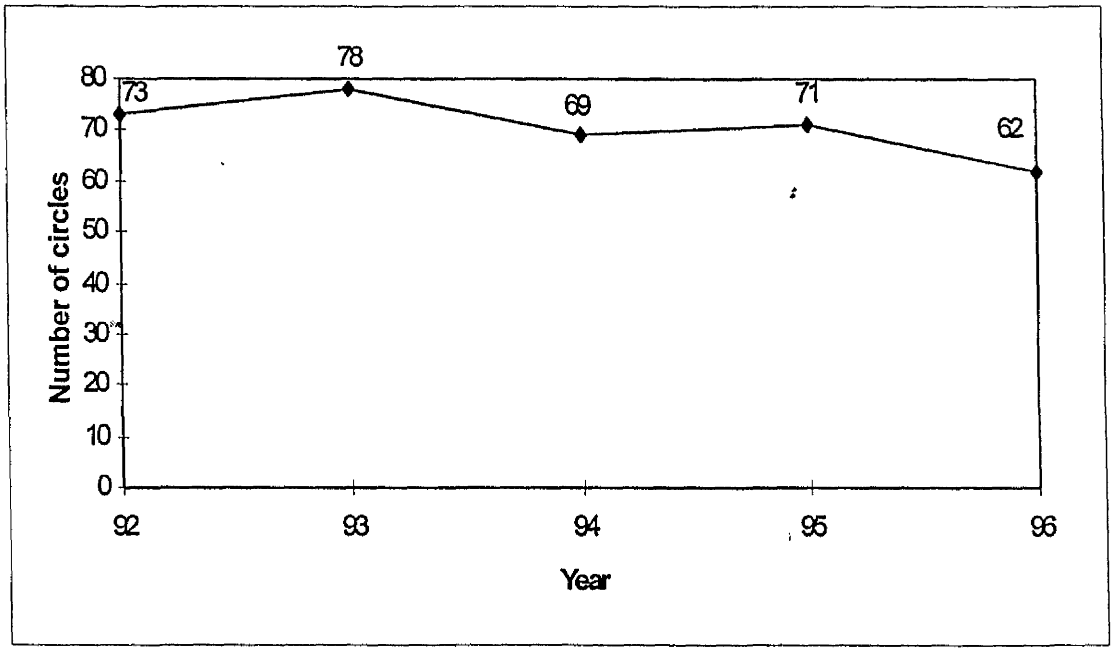


Figure 7.1. Number of registered Excel circles in Company C.

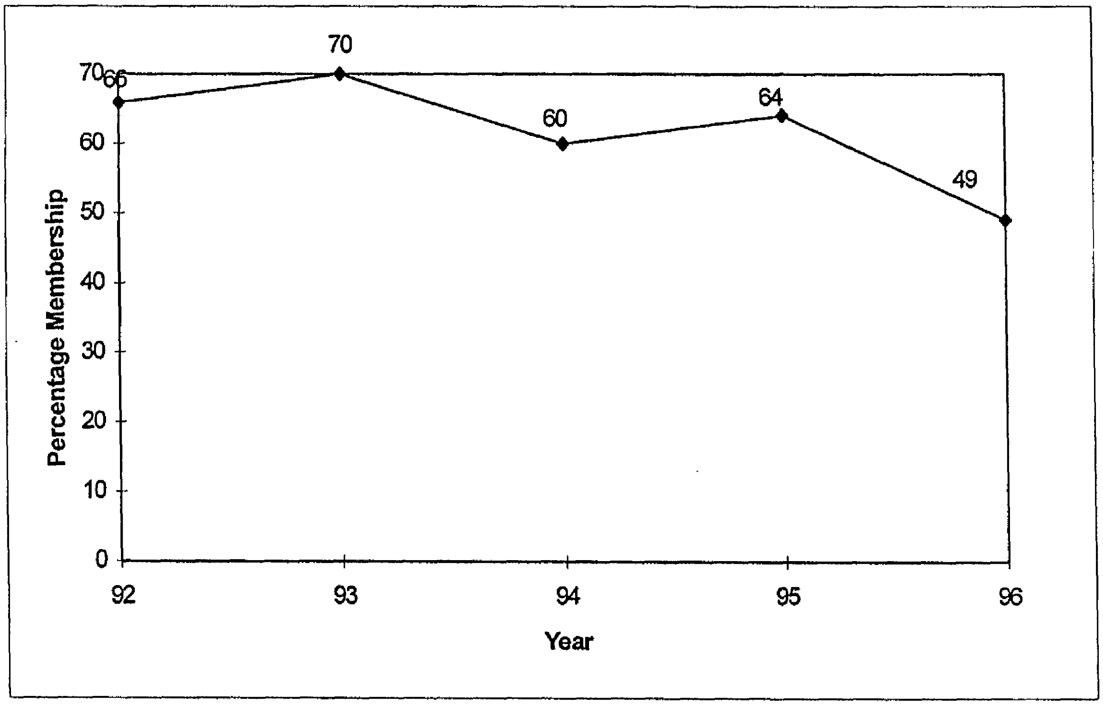


Figure 7.2. Percentage of total manpower that are members of Excel circles in Company C.

7.2 Company case findings

This section presents the data and other information collected from Company C. The data are presented following the Integrated TQM model framework. Moreover, the following discussions describe how each component influences each other.

7.2.1 TQM understanding

Customer focus in the Company C was shown to be related to the realisation of the centrality of the customer to the survival of the organisation. Trade liberalisation and the opening of the glass market has underlined the need to focus on the company's customers. Being the only glass manufacturer in the Philippines, the virtual monopoly that the company has enjoyed over its long history is being threatened by the increasing trade with foreign manufacturers that can compete in terms of both price and quality. From this perspective, TQM is seen as the strategy to defend its stronghold in the market. This thinking was observed to have cascaded down to lower management as indicated by one marketing executive's reply when asked about the company's position in the market: "We are prepared to face the increasing competition from imported products. In fact, we have already prepared ourselves as early as four years ago (when TQM was introduced)".

Moreover, the increased involvement in the export market, particularly the opportunities offered by their joint venture with the Japanese company has also led to a realisation of the importance of satisfying the customer. A production manager offered an interesting anecdote about the time when they sent their first batch of exports to Japan. A single fingerprint on the glass caused the rejection of the entire batch! This single incident led to a review of quality specifications and the processes for product handling. Prior to that time, quality was based only on the more apparent product features and dimensions. A more systematic and encompassing assessment of company's processes was later introduced and related to the broader objectives of TQM. The TQM chairman declared that quality had to be built into the entire organisation. He said "quality will have to be instilled in all aspects of corporate life from the hiring of employees to the export of the products and all the activities in between" (Agustin, 1996).

These improvement efforts have been sustained over the years through process analysis and problem solving. Continuous improvement is indicated by the constant generation of improvement ideas and analyses as solicited through the suggestion schemes and the Excel circles. Figure 7.3 shows the number of large projects that have been proposed by the Excel circles.

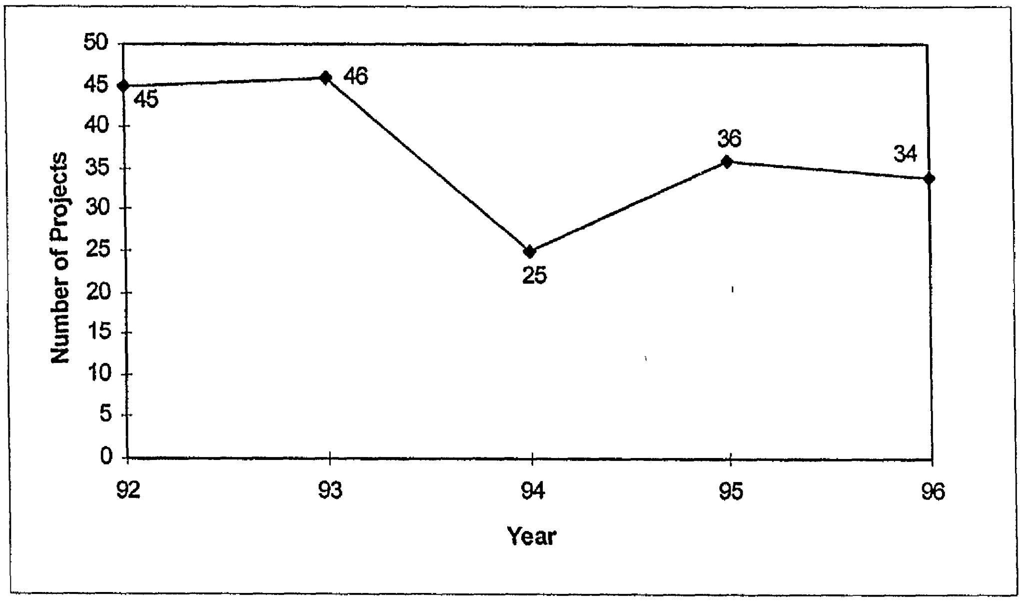


Figure 7.3. Projects generated by Excel Circles in Company C.

The third core principle of TQM (Dean and Bowen, 1994), teamwork, is similarly addressed with sincerity as articulated in the president's declaration that:

> "Certainly we in management encourages in the strongest terms each one's drive to achieve work quality. But it is also our strongest conviction that work quality should be achieved via teamwork." (Puno, 1994)

The company's TQM programme is thus focused on people empowerment. Employees are always given the opportunity "to shape the affairs of the company" because it is believed that this will lead to improvements in operations and customer satisfaction, while at the same reducing costs, and ensuring the company's long term viability (Agustin, 1996).

The interviews also revealed the sources of learning and understanding about TQM. Much of the understanding has been painfully gained from their previous less successful attempt to institutionalise quality circles. A number of problems arose that undermined the efforts of the quality circle participants and the entire programme itself. First, participation in the quality circle programme waned because it was associated with losing one's job, considering that its goal was cost reduction. The later redundancy programme served to reinforce this belief. Second, there were growing differences between circle members and non-members as membership brought some rewards and incentives that non-participants could not avail. This led to a perception of elitism and favouritism, mainly because, middle managers offered participation only to those they believed were co-operative, or more likely, whom they favoured.

Thus, management realised that other members of the organisation wanted to contribute to the affairs of the organisation but that the quality circles programme was limited in its scope and opportunities. These lessons from the previous programme, and the later intensive training, all contributed to further understanding of the requirements and principles of TQM.

In sum, the company case showed indications that the organisation had a good understanding and appreciation of TQM principles and its related practices. However, these learning and understanding are rather abstract unless manifested through actions and decisions. The following sections explore the experience of the organisation based on top management's manifestation of their understanding.

7.2.2 Top management commitment

Understanding is more concretely manifested by top management commitment. Commitment, as "pledging or binding of the individual to behavioural acts" (Kiesler and Sakumura, 1966: 349), is typically established through organisational visions and mission statements (MacDonald and Piggott, 1990; Schroeder, 1994). Part of the creed of the Company C states:

1. The customer is the reason for our being.
2. Quality is a virtue we shall uphold in everything we do.
3. People are our most important assets.
4. Teamwork is the core spirit of our operations.

.... These ideals we shall uphold and abide by. (Company documents)

The company's top management appeared to be very supportive and committed to the TQM programme. The necessary funds that establish and support systems and procedures for the programme have been sufficiently allocated (Tanteo, 1996). Communications and information dissemination, which included a separate newsletter, were also provided for. Training and education were initiated for all members of the organisation. Rewards and incentives were also established to encourage more participation in the programme.

Moreover, top management does not seem to be too concerned with bottomline effects of the programme. While savings and benefits derived from the improvement projects and suggestions are measured and monitored, these figures did not determine top management's consistent support and commitment to the programme. Agustin (1996) pointed out that management has learned its lessons from the previous programme's narrow goal of cost reduction. Such a goal suggested that benefits accrue only to the company without any concrete impact or gain for the suggester other some "little" rewards. Thus, the current TQM programme focused more on the developing and improving the lot of each member of the organisation through more training and opportunities for participation that he believes will lead to better job satisfaction.

With this objective in mind, the company's top management is more concerned with levels of participation than monetary gains or market share improvements. Participation figures not only indicate coverage of the programme but also the level of motivation of the company's employees. Thus, following the Deming's (1986) Plan-Do-Check-Act cycle, they view participation figures as opportunities to constantly improve the facilitation and support mechanisms of the programme. In addition, top management's commitment and support for the quality circles is reinforced by their quality circles' excellent performance and numerous awards in national competitions.

Asked if there was a possibility that the company will abandon its TQM programme if the results are not as promising as they used to be, the TQC Chairman replied that "there was no way they will cease with their quality efforts" (Agustin, 1996). A middle manager who was asked the same question, similarly replied that he "cannot imagine his company without TQM" (Angeles, 1996).

However, despite all these outward signs of support, commitment in practice may not be as constant and consistent as described in the mission statement. The factors that affect top management commitment (leadership and management style of the current head; the changes in leadership; and, level of consensus of the top management team) as discussed in Chapter 6 were similarly observed in Company C.

The person responsible for the implementation of the TQM programme brings with him his own personal management style as well as assumptions. This was demonstrated with the differences in the personalities and management styles of the TQC Chairman. The former chairman, who was also the vice president for marketing had the typical vivacity of sales personnel, and a keen eye for the bottom line. He had actively "preached" and promoted the TQC philosophy, believing that "TQM is a religion as it deals with values. As such it, needs preachers to spread the good news" (Arriola, 1996). He was known to have pushed everybody to the limits with his aggressive style. Some interviewees declared that they did not like his aggressive and demanding management style. Although he is friendly with people, his high standards and temper have discouraged some to approach him with problems. Moreover, while he actively pursued and encouraged TQM activities within the organisation, his critics have pointed out the poor performance of his own division. The marketing division had organised few Excel circles, and has not made a significant number of contributions.

In 1994, he was replaced by the vice president for logistics. The new Chairman for TQM was more low key and less boisterous. He had an engineering background, and would rather go to the shop floor to thresh out problems than assign the problem to one of his staff. He was more approachable and was liked by the TQM group. However, his less closer personal ties with the President of the company (in comparison to his predecessor) also accounts, as claimed by the interviewees, for the diminished priority given to quality activities.

Another aspect that determines the perception of management commitment is consensus of the top managers. The case studies have illustrated that it is not necessarily true that all members of the top management group wholeheartedly support the programme. One interviewee cited an instance when one top manager was heard asking his secretary what the words TQC meant! All these despite the intensive training that was provided for top managers and all the information campaign literature that was available. A second case cited by the interviewees was the ironic attitude exhibited by the Japanese senior manager. He was not concerned about quality activities but focused only on work and operational efficiency! He has not been seen attending these quality circle presentations and other activities. Finally, conflict among the top managers had been observed by employees. Asked about the reality such observations, the TQM Chairman, avoided the question with a rhetorical reply: "Disagreements are natural aspects of team work".

Thus, despite the appearances and claims of support for the programme, other members of the organisation do not agree with these pronouncements. For each of the manifestations of commitment, interviews with the concerned personnel showed some weaknesses and inconsistencies in the practice of the TQM ideals. These are discussed further in the following sections.

7.2.3 Systems and Procedures

The systems and procedures that were established to support the programme and facilitate participation are also seen as indicators of top management's commitment. Two supporting mechanisms have been cited in the interviews as critical factors in TQM implementation: incentive systems and implementation systems.

Following Deming's (1986) admonition, the company avoided financial rewards as an incentive system. The incentive system was designed to elicit more involvement by providing different rewards for different levels of participation. For instance, each Excel circle member gets a meal coupon that can be redeemed at the company cafeteria, for every meeting held. More significant activities such as a management presentation of a proposal merit bigger incentives. In a survey done for the company, some 51 percent of respondents-circle members indicated that these rewards are absolutely important.

Even as these incentives appear to attract and motivate participants, the effects of these rewards seem short-lived. The TQC section head observed that:

"The circles seem to set for themselves certain goals at the start of the year. This could mean winning the overall competition for best circles, or simply gaining some rewards along the way. However, when these goals have been achieved, they (Excel circles) tend to lay low and slow down with their efforts. ... Their goals seem to be set only to the corresponding rewards. The effect is, thus, limited in the short term. Real participation and involvement is not developed" (Cinco, 1996).

Indeed, there had been increasing discontent with the incentive system. There is a clamour for converting the rewards, including the meal coupons, to cash. It was reasoned out that food in the company cafeteria is bland and that there was no variety. Cash rewards, they argued, are more flexible.

The issue on rewards seems to extend to the company's merit system. Participation in the TQM programme had been viewed either as part of one's job, or as an additional task. In both cases, there is some added effort that, to their view, merits some recognition and compensation. However, in a number of cases, active participation in TQM activities did not bring additional benefits, particularly in the annual review system. It was observed that some non-participants in the programme actually received better assessment and higher performance bonuses and merit increases than active participants. One quality circle leader highlighted the impact of these controversies:

"The circle members enthusiastically attend meetings and participate in discussions and presentations. However, this enthusiasm slows down and diminishes when the results of the annual review are released. In particular, cases of people who are less active or have not been active at all yet gain higher merit increases, prove to be blows to the circle members' participation efforts. Circle members affected by these situations and who feel that their efforts are not recognised by management, begin to question the need for their active participation. They begin to become disinterested in attending meetings. It is only the leader's motivation that can sustain their efforts."

The second support system that was perceived to be important in the programme is the presentation and implementation of proposals and suggestions. In Company C, the circles formally presented their projects in a special session to top and middle managers. These managers asked questions, made their comments, and tried to arrive at a decision of whether to accept, reject or further study the proposals. While these sessions encouraged circle members, as they gave them opportunities to demonstrate their new found abilities and commitment to their managers, the waning participation of the managers had adversely affected their motivation. Moreover, the TQM section head observed that the absence of some key managers prevented immediate decisions on these proposals. This further discouraged circle members from further active participation and proposing new projects.

7.2.4 Resources

Management also manifests its commitment through the allocation of resources. Financial resources are clearly the first requirement that sustains the programme. The manager in charge of the TQM section reported that management has been generous in providing for the necessary funds to support activities. She pointed out that her "proposed budget for the TQM programme had, not even once, been rejected nor adjusted since the programme began, despite budget cutting in other departments" (Tanteo, 1996).

However, the employees perceive otherwise. The survey of Excel circle members in Company C showed that 53 percent of the respondents were not satisfied or only somewhat satisfied with funding from management. They believed that management is not providing all the necessary incentives and support for their activities. Moreover, some workers, who had represented the company in national competitions, had noticed the differences in the provisions that Company C had provided them in comparison to the more generous things that their counterparts in other companies had received.

Resources are also reflected on the support provided by the TQM staff. These personnel are tasked with initiating activities; providing training, technical advice and guidance; and monitoring performance. In other words, the TQM staff directly promotes the programme by motivating participants, and encouraging and attracting new participants. However, the various activities they undertake increase as more people participate. With limited time and resources, his workload catches up on his efficiency. The facilitators had been complaining of increased workloads over the years. The work pressure is exacerbated by perceptions of diminishing support from management. Moreover, they feel they are not sufficiently recognised.

The delegation of facilitation and training activities to departmental representatives was intended to relieve the facilitators of higher workload. Individuals in each department were identified to be responsible for the tasks of the TQM staff. However, the company failed to benefit from this system because the 'on-line' (department) facilitators had little training and preparation to undertake their new tasks, and that facilitation was considered a second priority to their operational responsibilities. Moreover, there was no additional compensation for these additional activities. Thus, the new facilitators were not motivated to perform these facilitating tasks, and did not relieve the TQM staff of their workload.

7.2.5 Perceived management involvement

Top management support was also indicated by its involvement and visibility in TQM affairs. However, involvement and visibility are perceptions of the rest of the organisation rather than concrete variables. These are subjective and judgmental measures by the members of the organisation as they see the activities of top management. This is reflected in the survey of quality circle members in the company. It was revealed that whilst 70 percent of the respondents believed that management's involvement in their activities was very important or absolutely important for the circles' operations, only 14 percent indicated that they were very satisfied or extremely satisfied. As noted earlier, quality circle participants and TQM facilitators had observed that a number of managers failed to attend presentations of the quality circles so that the appropriate decision and actions had delayed the implementation of improvement projects. On the contrary, top managers maintain that they have, and still, regularly attend TQM activities despite their hectic schedules. As there are no attendance records to show these claims, the involvement of managers become a subjective claim, perhaps a belief, on the part of the organisation.

Moreover, quality circle leaders have observed that the company president did not show the initiative to visit the departments, and find out about their conditions and problems, which he used to do in the past. Although it was recognised that he had a number of other concerns, the quality circle leaders still maintained that he should show his direct involvement by having more personal contact with his people. They added:

> "If other company presidents can do it, why can't he? The president is like a father who takes care of his children. He always finds time for them, no matter how pressing and demanding his work and other activities are. The president is father to us all, and we need his attention. We need to tell him our needs so he can attend to them. But we seldom see him. We do not even get a smile, a nod or a greeting when he passes us by."

Moreover, the president ceased to sign and personally endorse all TQM related memoranda. To the TQM staff, the signature was absolutely important and necessary as it signifies the president's direct concern for participation from all levels of the organisation including middle managers. The signature of the president added more authority to the efforts to encourage involvement in activities. Without the signature of the president, active involvement carried less weight, and TQM activities had lower priority, especially for middle managers.

Middle management support was also perceived to be essential in the implementation of the TQM programme. However, the interviews indicated that not all the middle managers were equally supportive to the programme. Some middle managers actually rejected quality circle activities by not allowing quality circle meetings, and insisting that the priority were daily operational targets. Others did not encourage participation because they did not know their roles in the programme.

The TQC Chairman blames their re-launching efforts in 1991 for the reactions of the middle managers. The re-launch of the programme overlooked the importance of the middle management as top management focused its attention on all other members of the organisation. The efforts were concentrated on soliciting the support of the union leaders, and maximising participation through extensive training provided to all workers and office staff. Training for middle managers was left for a later stage. This affected middle management's perceptions of its role in the programme and partly led to resistance to their subordinates' circle activities or lack of appreciation or understanding of their roles in quality circle activities.

Moreover, the participation opportunities given to the lower members of the organisation led to possibilities of exposing the middle managers' own managerial failures and inadequacies, or higher promotions for these creative subordinates. The TQC Chairman noted that:

> "I have yet to see a middle manager who is not concerned with his subordinates' excellent performance in the programme. His concern stems from the possible attention that the high performance can draw from higher management that can lead to promotions. The middle manager fears that the subordinate can be promoted to position higher than his."

Indeed, one such case where the subordinate was offered a position that turned out to be higher than his superior occurred in the past. The Chairman, however, pointed out that the recent years have not yet seen another similar situation. Nevertheless, the present personnel assessment system allows such a case to occur. This possibility justly causes some uncertainty and discomfort among the middle managers. As a consequence, some middle managers prevent or block training for their subordinates, and do not support quality circle activities.

However, there are still some middle managers who are supportive of the programme. They derive their own involvement from top management's own commitment, as well as, their own personal commitment and belief in the benefits to be gained from the programme. These managers believe that under-performers in the programme are a result of lack of commitment and support from their middle managers. They further believe that uncommitted middle managers are simply not convinced and satisfied by top management's commitment.

7.2.6 Other beliefs and perceptions

Job security was also one of the issues against the implementation of TQM in the company. Their experience in the former quality circles programme and the down- sizing that occurred during those years still left the present employees with some fears that quality improvement would lead to excess capacity and redundancy.

At the re-launch of the quality programme in 1991, top management assured, albeit, verbally, its employees that there will be no retrenchment within the following five years. However, the experience showed that the company had to trim down its workforce in 1994. This possibly affected the quality circles participation as shown in the dip in the graph of Figure 7.2 and 7.3. Top management allayed the fears of the employees through the regular meetings and fora, as well as through company newsletters and bulletins.

More recently, in 1997, a more liberal programme also tried to cut down on manpower by terminating the services of low performers and offering early retirement packages to others. An interviewee suggested that there is a growing discontent in the recent months with these moves of management. He suggested that while the cut on manpower was not viewed negatively by those who were leaving, mainly as the benefits were relatively generous, he asserted that management did not consider the effects on those who were left. Clearly, the result was an increased workload for them. He cited the case of a TQM staff who applied for early retirement. The application was approved without due consideration of its effect on the lone TQM staff who was left to handle the entire section's workload[1]. The interviewee suggests that management intention was apparently focused on cost reduction, as the replacement for this senior personnel will have a lower salary scale. He argued that this is contrary to TQM principles. Moreover, the performance of new personnel will initially be low due to learning. This will affect current training and facilitation activities. Eventually, the entire programme is affected by the change in personnel.

These observations about top management behaviours indicate some contradictions in the principles and practice of TQM norms. There seems to be an inconsistency with what are being 'preached' and management actions. One union officer cynically states "They expect us to act according to the principles of quality management but they themselves (top management) do not act accordingly!"

This observation was similarly reflected at one of the regular management-staff forum attended by this researcher. Some people sneered, and others at the back chuckled at the company president's reply to a question, "We will study the matter further and will give the feedback as soon as possible". Asked later for an explanation for these reactions, the management staff explained that this question had been raised regularly in the past three years!

[1] The TQM staff initially had 10 members in 1992, and went down to 3 in 1996. In the middle of 1997, one staff resigned leaving only two at the end o f the year. At the start of 1998, only one was

In sum, the interviews indicate disbelief with management pronouncements, and an "until it happens, we don't believe" attitude. One middle manager even pointed out that "on the surface, everything is well. But underneath, in the grassroots, something is happening". One quality circle leader was more blunt as he expressed his dissatisfaction: "We are giving management only two years to correct this unfair system."

7.3 Discussion

The accounts in Company C largely confirm the framework developed in Chapter 3, and are consistent with the findings of Chapter 6. As in the two cases of Chapter 6, management commitment in this company played a central role in the implementation of TQM, and is shaped by continuity of the management team, personal management styles and consensus among the members.

The interviews indicated that rank and file employees were rather sensitive to certain variables that suggested top management's commitment to the programme. The personal experiences of employees with top management members, or in other cases, second hand information, determined their perceptions of sincerity of top management. The declining perceived commitment of management indicated that the positive actions that top management had initiated were easily erased and overlooked by failures of one or more of its members. These few opportunities for management to personally deal with the rank and file employees may result in singular unfavourable events that could be broadly generalised and spread across the

left.

organisation. This, in turn, could affect overall participation efforts as reflected in the number of active Excel circles.

Top management's commitment is mainly manifested, first, by its personal involvement in quality related activities. The presence of top managers in these activities indicated not only moral support for the programme but also ensured that the necessary action and authority be extended to realise the quality improvement goals. More specifically, top managers can decide and act immediately on improvement projects proposed by quality circles. Quality circle participants expected that senior managers be present in project presentations as the managers have control over the organisation's resources and authority over its operations. Their absence in these activities could delay the implementation of their efforts to contribute to the programme. Moreover, a more subtle message that quality improvement efforts do not take precedence and priority over other top management concerns may be sent not only to the members of quality circles but also to middle managers and TQM staff. Thus, such absence in these meetings becomes more critical because it leads to a chain reaction of perceptions that top management is not committed to the programme to not only those present but also spreads to non-attendees of the meeting.

Second, the role of middle managers in the implementation of these projects is similarly seen as an important top management manifestation. They are directly positioned above the workers who meet and discuss to propose improvement projects. As such, they have operational control to allows or deny their subordinates to temporarily leave their present tasks and become involved in improvement activities such as quality circle meetings or actual implementation of their ideas. In

Company C, the non-uniform acceptance and support by middle managers was seen as a barrier to the TQM programme as opportunities to participate were not offered equally. Moreover, this situation confirms the earlier observations of Ford, et al, (1992) that some trainees are not able to transfer the newly acquired skills from training may be explained by the non-uniform opportunities to apply them. It may be worth repeating that Pentland (1989) found a higher possibility of skills decay for trainees who are not able to use their skills. In other words, the training that the company provided for its employees would have been wasted if the skills were not put to good use.

In the second place, the improvement proposals of the quality circle participants are directly under the administration of these middle managers. The acceptance of these proposals would be directly the responsibility of these middle managers, even as these are formally proposed to top managers. Moreover, the implementation and execution of the planned changes will require support and assistance from these managers. However, as in the literature reviews (e.g., Giordano, 1994), middle managers were observed to have reasons not to support and accept these projects. In this company, middle managers were noted to have felt threatened by the activities of their subordinates. Moreover, the observed disinterest and inconsistent actions of some top managers did not uniformly encourage these middle managers to be supportive of quality circle activities.

Third, the availability of funds to support the programme is also taken as an indicator of top management commitment. Funds are necessary to support current activities and partly for implementation of the projects. Thus, inadequate budget hinders quality initiatives and project realisation. However, direct information regarding the finances of the programme is not available to programme participants, and thus, are merely inferred from related events. In the company case, interviewees had impressions that there was little funding for the programme. This is based on their own observations such as less generous rewards in contrast to other companies, and delays in acceptance or implementation of projects. In both cases, employees began to doubt the sincerity of top management. In other words, the availability of funds is not evaluated from the actual budget as this information is not available but simply a perception of its adequacy through other indicators and observations.

The last two factors that affected employee perceptions of management commitment are the provisions for training and support from TQM staff or facilitators. In Company C, as in other applications of TQM, the development of improvement projects requires more than common sense. A more logical and organised approach is necessary to identify problems and improvement areas, and find the corresponding best solution to improve the current situation. Facilitators or TQM staff provides the necessary skills through more formal classroom training and education, and through informal on-the-job support, guidance and advice. Indeed, skills support was found to be essential to sustain the search for improvement as failure to identify problems or solutions to problems can lead to a cycle of failures and disappointment, and later complacency to current situation (Martinko and Gardner, 1982; McGrath, 1994), which is the anti-thesis of continuous improvement. The quality circle participants in the company case realised and acknowledged the importance of training to support the search for quality improvement projects.

However, the effectiveness of training and facilitation provided by the TQM staff was observed to be related to the perceived commitment and support of top management. The TQM staff or facilitators were observed to be affected by the inconsistent demonstration of interest, participation and involvement of top management. The availability of funds as well as the quick response to requests of the TQM staff were also found to affect the efficiency of these staff members. Thus, they needed similar support from top management. Furthermore, the staff were also affected by temporal constraints as work loads increase. Their training and facilitation activities had to compete with monitoring and report preparation tasks. Thus, training and facilitation suffered because of these constraints.

In sum, these five factors, other than manifesting top management commitment and sincerity, can be interpreted as measures that indicate the feasibility of improvement projects. In other words, the impression that these factors are present and adequate leads to the belief that improvement projects are possible and can be realised and implemented. Thus, the justification to participate is influenced by impressions, perceptions and beliefs rather than actual measurements and quantified visibility of top and middle management, funds availability and TQM staff involvement. Unfavourable impressions, as they reflect lack of support, therefore, discourage active participation.

The company case also revealed a second set of factors that influence participation efforts of workers. In contrast to the above factors that focus on external (to the participants) conditions, a second set of factors deals with more personal aspects of the reasons for employee participation in the programme. These factors involve an opportunity to achieve a rather personal goal, or gain some benefit from the programme. And the satisfaction derived from such achievement or benefit encourages the participant to continue his involvement in the programme.

The first of these internal factors is the contribution factor. The case showed that even the lowest employee has a need to air his ideas and participate in the management of the company's affair. In Company C, even security personnel and contractual workers were equally encouraged to join quality circles and other activities. This was similar to a contractual utility boy in Company B who expressed pride and joy for his rather simple suggestions, which were properly recognised by the company. Secondly, there is satisfaction derived from making quality circle presentations. Some of the interviewees pointed out that these presentations to managers and their colleagues brought them a sense of pride that had not been afforded to them before. They took these presentations seriously and spent time for the preparations: creatively designing their presentation materials, carefully preparing their scripts and explanations, and wearing their best suits. Thirdly, they believed that improvement ideas are necessary for company survival, as suggested in the training courses. These further encourage them to make new contributions. These observations support the findings of Allen et al (1997), Dean (1985) and Miller and Pritchard (1992) who found that members involved in employee participation programmes are generally motivated by their growth and self-expression needs.

A second internal factor that makes participation in the TQM programme an attractive task is the reward attached to it. As suggested by the TQM staff and noted earlier, quality circles were motivated by certain rewards and their performance was dependent on such targets. However, whilst the original rewards encouraged participation in the early years of the programme, the more recent years have seen discontent and complaints against the rewards system. Thus, it may be suggested that the effectiveness of rewards in motivating workers to participate have limits. Such limit was found to be related to the increased efforts exerted in the later years. Apparently, problem identification and resolution have become more difficult with the more obvious root problems having been resolved and corrected in the earlier years.

Finally, the abilities and skills learned in the programme provide another source of satisfaction for the participants. A worker who has been with the company for at least twenty years was happy to be given the opportunity to attend a series of TQM seminars. He said it was the first time he attended such a course and he was proud to be given some training. Another worker found the materials in the seminars very practical and not only applicable for quality activities in the company but also for his personal and domestic affairs. Thus, in general members of the organisation welcomed the training and education aspect of the TQM programme as it provided them new skills and understanding.

7.4 Conclusions

The various interviews with the personnel from different levels of the organisation in the company revealed explicitly and implicitly factors that simultaneously influence the participation efforts of employees, which in turn affect the success of the entire programme. These seven factors - top management visibility, middle management support, budget availability, training and facilitation, contribution factor, rewards and abilities and skills - showed that the TQM model framework is consistent with the reality of the practice of TQM. These interviews supported the importance of these factors but more importantly confirmed and established the relationships and interactions among these variables.

The framework when integrated with the organisational and management concepts can be viewed from a more simplified perspective. In particular, the factors and relationships derived from the various interviews and observations in the case studies are found to be consistent with Vroom's (1964) conception of the force of the motivation to undertake a particular task. Such a force of motivation for task is based on the valence, instrumentality and expectancy (VIE) theory.

Valence is the preference attached to a certain task, in this case, participation. Such preference or desire for the task is closely related to the expected satisfaction from outcomes - expected rewards and recognition in the company, or even possibly in industry. The three internal factors that affect satisfaction with the programme - contribution to the affairs of the company, rewards and recognition from the participation efforts, and the new skills and abilities derived from training - represent the valence of motivation. The combination of these three factors determines the importance of the tasks related to the TQM programme.

Instrumentality, on the other hand, refers to the subjective belief that the outcomes can be achieved. In this case, the systems and support provided by management improves on the belief that the rewards and recognition can be obtained. Top management visibility, middle management support and the budget allocated for the programme can translate the effort and ideas into reality. The adequacy of these factors indicates the possibility of realisation of the improvement projects. It is thus possible to achieve the goals of the programme. Moreover, management provides a TQM staff that will provide further training and additional skills to make participation and involvement more successful. Facilitation from these staff provides for more operational support of participation, which further increases the chances of realising the desired outcomes.

Expectancy is based on the subjective belief that the performing the task is possible. The case studies indicated that opportunities to participate and become involved in a programme could enhance this subjective belief. The efforts of top management to encourage workers and other employees corrected a former belief that participation is not possible and was only available for a selected few. This was clearly illustrated in the experience of Company C. The opening up of participation for all members of the organisation and its voluntary nature corrected the narrow implementation of quality circles in the previous programme. Thus, the equal opportunities offered to all members of the organisation can be represented by a value equal to 1.0 because the system does not discriminate against anyone.

In sum, the factors that were found to be important in the implementation of TQM in Company C can be categorised into Vroom's (1964) theoretical framework to explain the motivation of workers to participate in the programme. The level of interest to participate in the programme is mainly the reaction of the rest of the organisation to these various manifestations or indicators of top management commitment. The strength of this interest in participation is dependent on the combination of the strength of these manifestations. Moreover, one can reinforce the other or cancel off its strength.

A second observation may be made about these factors. These factors, when analysed further, show they are resources that the organisation can provide. Rewards and budget represent financial resources that encourage and support the programme. On the other hand, top management visibility and middle management can be treated as time spent with participants and activities, thus a temporal resource. Ability and TQM staff availability are treated more closely together as they are both influenced by both financial and temporal resources. Viewing these important factors in this way paves the way for further analysis of TQM implementation in terms of the dynamics of resources and requirements as they govern motivation to participate and contribute in the TQM programme.

Taking these two perspectives, the network of factor interaction is indeed a complex process. The dynamics brought about by limited temporal and financial resources cascade on to both the satisfaction and instrumentality factors. In turn, participation levels will not be constant and will tend to change through the life of the programme. Finally, participation levels will feed into the temporal and financial resources, thus creating a feedback loop. This could be the core structure that governs the TQM implementation system. The next chapter delves into these factors and loops further and builds the Dynamic TQM Model.

CHAPTER 8
MODEL FORMULATION: BUILDING THE DYNAMIC TQM MODEL

This chapter presents a description of the formal model developed to represent the interactions identified in the case studies. The integrated TQM model served both as a framework for the research and a conceptual model of the TQM implementation process. However, the contingency variables such as those described in literature in Chapter 3 and other organisational variables such as those included by the system dynamics studies reviewed in Chapter 4, as well as the empirical results and observations in Chapters 6 and 7 suggest that the integrated TQM model still lack a number of variables and interactions that may be necessary to delve deeper into the TQM implementation process. This chapter identifies more specific variables that can act as 'moderator' variables of the generalised model.

This chapter serves several purposes. First, the explicit presentation of the variables and functional relationships used for the model allows the closer investigation of the assumptions used by this researcher. Such provision for explicitness is closely related to the general issue of validity, or more specifically, model testing. Testing the model deals with the comparison of the model to the observable reality in order to support or refute the model (Forrester and Senge, 1980). Testing of the model maybe be viewed as a first stage of establishing validity. The model needs to establish its correspondence to empirical reality before it is accepted as a valid representation of that reality and useful for analysis. Thus, presenting the model details allows the constant comparison between the assumptions made against the reality and experience (Saeed, 1992) of the case studies.

Secondly, the documentation of the model variables and equations facilitated the conduct of the tests of model structure prescribed by Forrester and Senge (1980). These tests focus on the model structure and parameters without dealing with the relationship between structure and behaviour. The tests, which include structure verification test, parameter-verification test, extreme-conditions test, boundary-adequacy structure test, dimensional consistency test, all contribute towards establishing more confidence on the model.

Another important purpose of presenting the details of the model formulation lies in the specification of the model's boundaries. By explicitly setting forth the particular variables and relationships that were investigated, the model's limitations are established. The boundaries focus only on the piece of reality that the present modelling effort covers. Thus, the researcher acknowledges the limits of the current analysis.

This chapter begins with an overview of the model, which is basically a reformulation and restatement of the generalised model presented earlier. The integrated TQM model is further analysed in the light of the findings and observations from the case studies. The need to delve deeper into the interactions of the initially identified variables is recognised. The second part of the chapter covers the details of the more important sectors of the model. Finally, the chapter ends with a summary of these interactions and concludes with some general observations.

8.1 Overview of the Model

The reformulation of the generalised model relied on two theoretical perspectives. First, the implementation process is conceptualised from the innovation diffusion perspective. This allowed for understanding how employees decide to participate and how the programme expands or contracts. This view explores the interactions between participants and non-participants in the programme. The second theoretical view taken lies in the motivation by participants and non-participants. Specifically, expectancy theory (Vroom, 1964) postulates that the force of motivation is a function of expectancy and the motivation from the task. Both these theoretical perspectives not only provide a framework to analyse the interactions in the implementation process but also provide the mathematical relationships to relate the variables. The reformulated model is presented in Figure 8.1.

The model presented in this chapter re-conceptualises the same variables identified in the earlier model to facilitate the development of the simulation model. The boxes represent a group of variables based on the innovation diffusion theory and expectancy theory instead of the more conventional approach of using organisational functional relationships of the earlier model. This perspective highlights the contribution of such management levels to the overall motivation and participation process of members of the organisation.

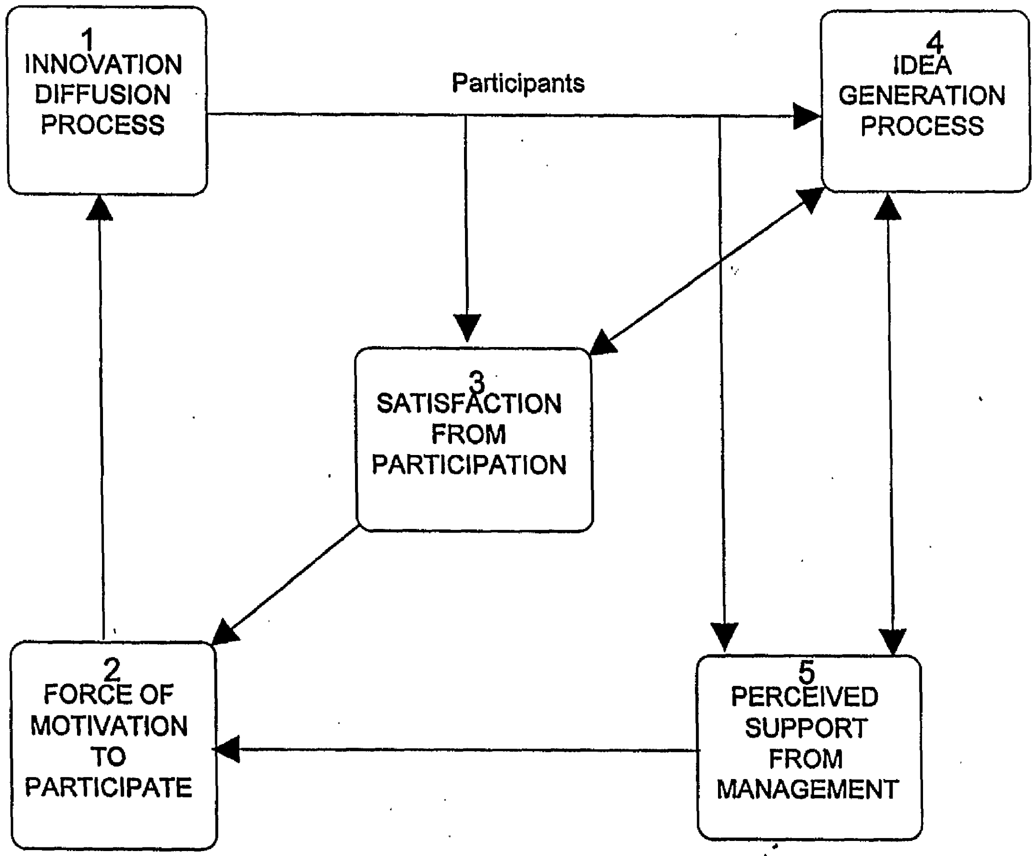


Figure 8.1 Reformulated TQM implementation model

The first box, Box 1, representing the innovation diffusion process, highlights the importance attached to encouraging everyone's participation in the TQM programme (e.g., Macdonald and Piggott, 1990). As mentioned earlier, the company case studies in the present research had placed high importance on the participation of all their employees. As a primary task of their TQM administrative groups, employees are encouraged to become active through various activities. These activities have been primarily designed not only to provide channels for productive contributions but also for recreational values, including less stress related endeavours. In all three companies, participation is voluntary and management actively encourages, but not requires, involvement in the programme.

The actual practice of encouraging participation is consistent with the innovation diffusion theory, where participation (or adoption) rates are a function of both participants and non-participants. Non-participants are encouraged (or discouraged, as the case maybe) to take part in the programme depending on the motivation exhibited by current participants. However, not all non-participants will be converted by their association with the highly motivated participants. This freedom in decision making reflects the voluntary nature of participation.

Box 2, force of motivation to participate, represents the factor interactions that determine the interest of participants to be involved with TQM activities. Such force of motivation, which is based on expectancy theory, conceptualises motivation as a function of valence and instrumentality for the outcome. Valence represents the preference for the expected outcomes: rewards, learning and opportunity to contribute. These factors are grouped in the satisfaction box, Box 3. Such satisfactions are derived from the experience of the participation process itself, as well as those derived from the idea generation process (Box 4).

The second factor that is explicitly presented here is the instrumentality of the outcome. Instrumentality is defined as the subjective belief that the expected outcome can be achieved by performing the task, which Porter and Lawler (1969) referred to as $P \rightarrow O$ (Performance to outcome) variables. In the present study, instrumentality factors are represented by the factors that deal with perceptions of organisational support (Box 5). These factors focus on the adequacy of top management visibility, middle management involvement, facilitation activities, training activities and budget availability. It must be pointed out that these are perceptions of employees rather than more objective measures of these factors. These perceptions represent the subjective belief that their efforts in participating can actually be realised and are successful.

Such perceptions are derived from their experience in the participation process. That is, these may be influenced by experiences of others through their daily contacts and interactions. Moreover, the idea generation process also creates such impressions of support.

The idea generation process represents the collection of new ideas, the processing of ideas and finally their implementation. This process highlights the roles that top and middle management take in the TQM programme. In suggestion schemes, middle managers are 'required' to reply immediately (to within 5 days in company B) to assure the suggester that action is being taken on his suggestion. Thereafter, the suggester is informed of the progress of his suggestion, until it is accepted and implemented, or is rejected and the reasons explained. In quality circles (of company C), the process involves group meetings that identify and analyse work related problems or improvement areas, and later, formal presentations to top management. The experiences from this process, as indicated earlier, influence both the perceptions of support and the satisfaction derived from participating.

Overall, this reformulated model has focused on the "it depends" character of the TQM implementation process, a character that the initial model had not expressed. By presenting perceptions of support and satisfaction as explicit functions of their experiences, the expected reactions become dependent on their assessment of the 'quality' of such factors. Furthermore, the new model facilitates the development of the details of the simulation model based on stock-flows.

One other comment is necessary before presenting the details of the simulation model. Expectancy, as it contributes to the force of motivation, is not explicitly shown in the model of Figure 8.1. It is, however, included in the details as described below.

8.2 The Innovation Process

The voluntary nature of participation in the TQM programme, particularly in the case companies that were studied, is represented by the innovation diffusion theory. The typical formulation of the diffusion process (Mahajan and Robert, 1979) is based on two sources: innovation and imitation. The latter process provides a representation of the voluntary nature of participation as it focuses on the interaction of potential adopters and current users. This is generally formulated as:

$$\frac{dm(t)}{dt} = b\,[u(t)]\,[m(t)]$$

where $m(t)$ = cumulative number of adopters at time t
$u(t)$ = un-committed at time t
b = coefficient of imitation

Thus, the number of converts at any time will be a product of the coefficient of imitation, the current participants and the potential participants.

Three types of individuals are conceptualised in this study: non-participants, who are the potential members who have a 'wait-and-see' attitude to the programme; the participants, who are presently involved in the programme; and, rejecters, who have quitted the programme (Macapagal, 1996). The relationship among these groups is shown in Figure 8.2.

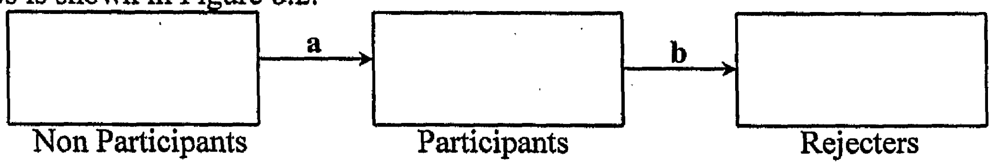


Figure 8.2. Interactions between the groups in a TQM programme

The arrows indicate the single direction of change. Thus, non-participants can become participants, and participants can become rejecters. It is further assumed that it is not possible to return to the previous state[1]. Following the above formulation of innovation diffusion, the rate at which groups change to the next state is a function of the two states and the coefficient of imitation. In other words, the conversion rate (**a** and **b** in the diagram) represents the number of 'converts' which is a fraction of the number in the previous state. This fraction is determined by the interaction with those of the next state and their propensity to follow their lead (coefficient of imitation).

[1] Basec on the interviews, active TQM participants do not become objective non-participants after they leave the programme. Typically, they leave the programme disappointed and frustrated and "would not want to do anything" (Cinco, 1996) with the programme again.

Thus, the participation rate, a, depends on the interaction of non participants and participants as shown in Figure 8.3. The number of current participants provides an impetus or pressure on non-participants to follow their lead and jump on the bandwagon. The higher the number of participants, the greater is this pressure on non-participants to imitate the present adopters. This pressure is also dependent on the efficiency of communication within the organisation. In the TQM programme, this propensity is determined by the level of communication and contact amongst employees, through union meetings and information dissemination, company newsletters and announcements, and less formal means such as personal contact and rumours.

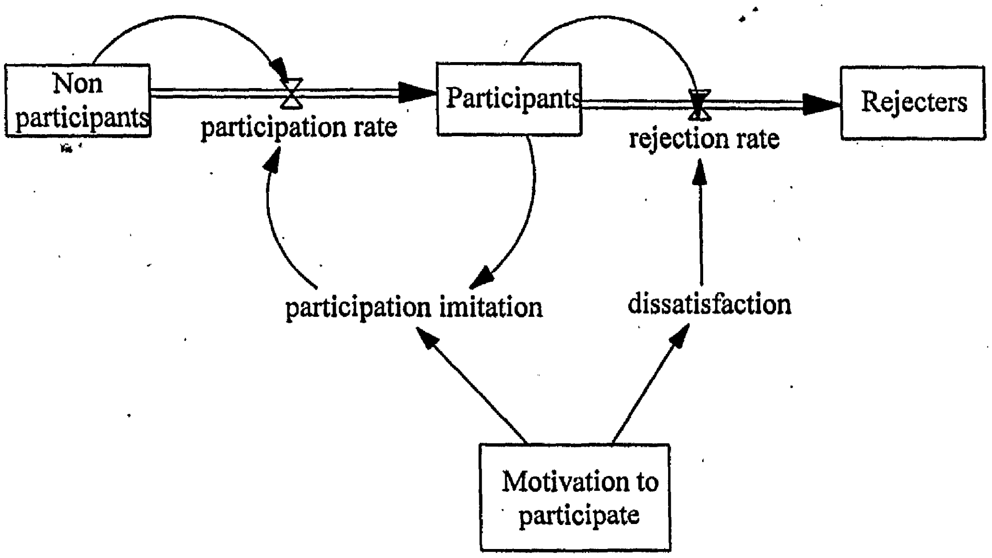


Figure 8.3. Interactions in the innovation diffusion and rejection process.

A more important determinant is the information that is being communicated to the non-participants. This information is based on the motivation to participate. It communicates the assessment of participants of their experience in the programme. The more favourable this assessment is, the higher is the motivation to participate, and the greater is the participation rate. On the other hand, when this assessment of the participation experience is negative, it influences participants to reject and quit the programme. The less favourable their experience is, the higher is the rejection rate. This also discourages non-participants, and participation rate drops.

8.3 The Motivation Process

As discussed earlier, the motivation process is based on the concepts of valence, instrumentality and expectancy. The motivation to participate is based on two factors: job security and the preference for participation. The cases, as well as TQM literature, have pointed out the effect of perceptions of losing one's job because of participation efforts. As employees relate participation with possible redundancy and streamlining programmes, their motivation to participate falls. It cancels off some, if not all, of the preference for participation, depending on their subjective belief, or expectancy, of the probability of the losing one's job because of the participation programme.

The preference for participation is based on the important factors that have been identified in the Chapter 3 and expounded on in Chapters 6 and 7. These factors have been categorised into two groups. The factors related to rewards, contribution and learning were grouped under satisfaction variables. These variables were seen by interviewees in the case studies as the outcomes, which determine the valence or their preference for participating. The expectations of future satisfaction from a particular task, in this case, participation, and its outcomes encourage people to be interested in such a task (Vroom, 1964). Conversely, when there is lower expectation of satisfaction with the task, people will tend to avoid the task. In the present analysis, the participants' past and current levels of satisfaction with participation will determine their preference, or avoidance, of participation.

On the other hand, top and middle management time allocated to the programme, the availability of budget, training and facilitation work provided by TQM staff are all classified as perceptions of support. These factors represent instrumentality, or the subjective belief that people can actually perform according to their expectations. In other words, these factors provide the necessary resources that make participation possible for the employees.

Taken together as a product, the satisfaction and perceived support variables determine the preference to participate. Their multiplicative relationship suggests that optimum preference for participation can be achieved only if both factors are at their optimum levels. Otherwise, low levels in one factor will cancel out the high effect of the other.

8.4 Satisfaction from participation

The satisfaction variables are related to the outcomes that are expected to be derived from the participation efforts. The satisfaction enjoyed from obtaining such an outcome will determine the continued preference for the activity.

8.4.1 Contributions

The more common argument for participation is that employees and workers want to contribute their ideas to improve efficiency of processes and working conditions (Sneddon, 1995). It is further argued that these workers are best located to identify these improvement areas and can help optimise such processes. Thus, the participation process is aimed at both satisfying the workers' need to contribute (similar to the points of the human relations field) and improving efficiency of processes and quality of products and services.

The satisfaction derived by employees from contributing ideas is based on what have been implemented and their expectations of what they can contribute. This constitutes the contribution ratio. The higher the contribution ratio, that is, implemented ideas are greater than or equal to their expectations, the greater is the satisfaction derived therefrom. Conversely, when implemented ideas are less than these expectations, there is low satisfaction.

The satisfaction derived from the programme determines the expected future involvement. This may be quantified with their expected number of ideas and contributions. Greater satisfaction will encourage workers to expect more contributions. However, this expectation is based on a long-term average of satisfaction due to contributions rather than current experience of the programme. Day-to-day satisfaction fluctuates depending on these determinants, and workers do not act on these short-term changes but considers past experience as well. These short-term experiences are aggregated in average satisfaction due to contributions.

The expected contributions are also determined by perceptions that the work place, the department or the organisation requires some improvements. The need to improve the present conditions increases the expectations for contributions. The need for improvement is based on the contribution ratio. This ratio reflects the subjective need of the organisation for improvements. If the ratio is low, the need for improvements is high. On the other hand, when there are more implemented projects than expected contributions, there is no perceived need to contribute. In this latter case, the expected contributions are maintained at their current level. These relationships are summarised in Figure 8.4.

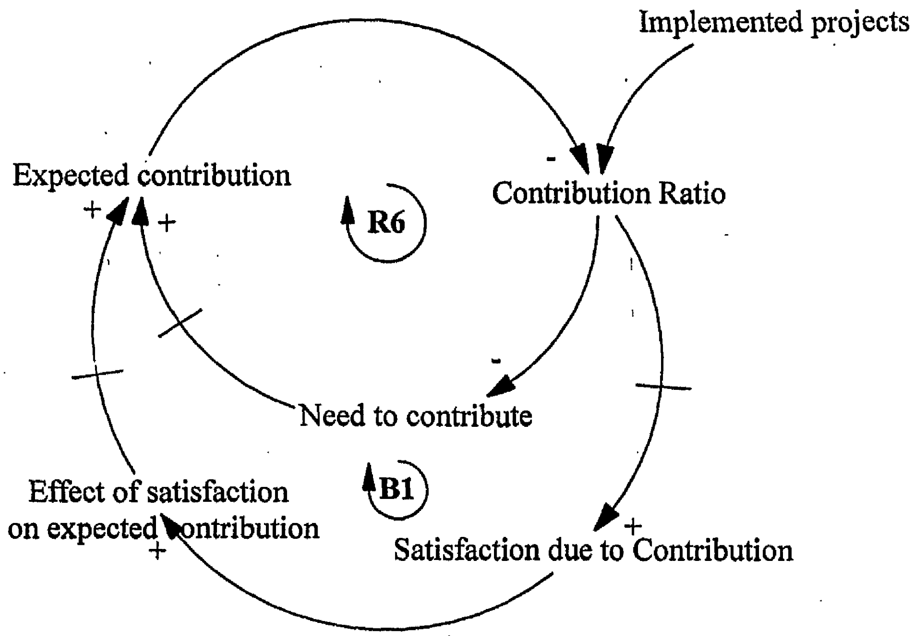


Figure 8.4. The interactions of satisfaction due to contribution.

The above figure highlights the effect of two interacting feedback loops. The need loop (R6) is a reinforcing (or positive) feedback loop that tends to amplify current conditions and adjusts its expected contributions accordingly. Thus, when the contribution ratio is low, the need to contribute is triggered to increase its expected contributions. Being a denominator, higher expected contributions further reduces the contribution ratio, which, in turn, encourages more expected contributions. This becomes, depending on one's perspective, a virtuous circle that leads to continuous generation of ideas, and continuous improvement. It may also move in the opposite direction when the contribution ratio is high. This leads to a vicious circle that cannot generate new projects.

The other feedback loop is balancing (or negative). It tends to control the contribution ratio through expected contributions. The level of satisfaction encourages greater expectation, which decreases the ratio and later, depresses satisfaction. This balancing loop has an alternating positive and negative effect on the system.

8.4.2 Rewards

The role of rewards in TQM programmes has been a subject of debate mainly as the main proponents of TQM have argued against the use of rewards. However, in the present case studies, rewards have been identified as an important factor in the workers interest in the programme. Rewards, however, is conceived in this research as a general term that includes a variety of incentives and not limited to financial terms.

The satisfaction derived from rewards is similarly conceived as in the contribution satisfaction. The current and the past satisfaction are aggregated into an average function, and serves as the determinant factor of total satisfaction with the participation programme.

Satisfaction is based on the rewards ratio, a comparison of the actual rewards received or made available against the expected rewards. The expected rewards are a function of effort exerted in the programme. This, in turn, is dependent on the level of ability and the difficulty of identifying and finding solutions to the improvement ideas. Moreover, difficulty is conceived as a function of the accumulated accepted improvement projects. The earlier improvement projects are not difficult to identify and solve mainly as they are rather apparent, perhaps due to years of neglect. Once these apparent problems have been cleared, the succeeding improvement areas become increasingly difficult to identify and solve as they are not obvious or may be more complex and involve more factors (Schneiderman, 1988; 1998).

Thus, when the level of ability is higher than difficulty, the effort is kept at a minimum and does not increase expected rewards. The present rewards are seen as sufficient for the present efforts. However, when ability is less than difficulty, the effort involved in identifying and solving problems increases proportionately. This will lead workers to expect greater rewards for their efforts. The relationships of the variables in rewards satisfaction are illustrated in Figure 8.5.

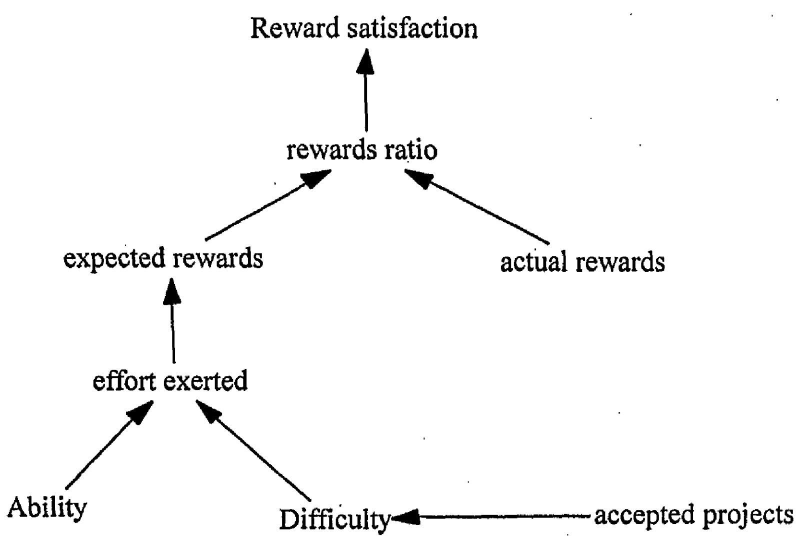


Figure 8.5. The interactions in the satisfaction due to rewards.

8.4.3 Learning and Ability

The third determinant of satisfaction with the participation programme is learning and ability. This factor is treated mainly as an important input in TQM programmes in TQM literature. The case studies revealed the preference by the workers for learning and development of new skills. The interviews showed that this new ability encourages them to continue their involvement in the participation programme.

Ability is conceived as an accumulation of learning. The learning rate is modelled as a delay function of techniques and skills derived from training and facilitation provided by the TQM staff, as well as, in-process learning or learning by doing. The learning derived from the TQM staff is based on non-linear transformation functions of the staff availability for training and facilitation. That is, the higher the available time of the TQM staff for each task, the higher is the learning derived from it. The in-process learning is a similar non-linear transformation function based on accepted projects and the total proposed projects. This project ratio reflects the quality of the proposed projects. That is, as the projects equal or exceed the proposed projects, the learning is proved to be greater.

Moreover, the level of frustration moderates the learning rate. Literature has suggested that frustration can negatively affect the accumulation of skills (Earley, 1993). Thus, greater frustration will reduce retained learning. Frustration is explicitly modelled as an average function of past and present experience of negative feelings.

Frustration is modelled as being due to the rejection of projects, the delayed implementation of projects and the level of difficulty of current efforts. Increases in any of these factors will accordingly affect total frustration levels.

Finally, ability is also depleted by obsolescence. It is recognised that current level of ability becomes obsolete and cannot be used in some future problems and initiatives. This is conceived as a fraction of current level of ability. These relationships are summarised in Figure 8.6.

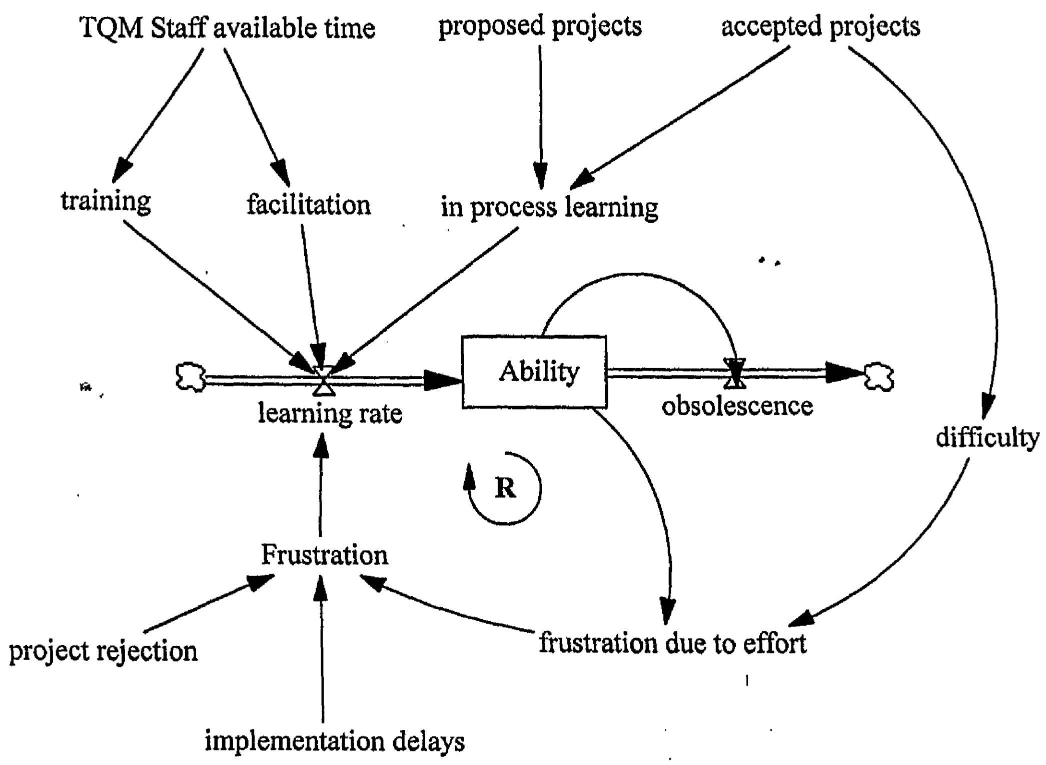


Figure 8.6. The interactions in the development of ability.

8.5 Perceived support from Management

The rest of the identified critical variables can be grouped together to represent the support the organisation provides the programme. However, the participants act from a subjective perception of these available resources. This perception is a longer-term average of the indicator of support. This latter variable is modelled as a ratio of actual available factor resource and the requirements for the particular factor. Thus, the factor resource is seen to be supportive relative to the needs of the participants. In effect, a greater number of participants will rapidly deplete the available fixed resource, leading to perceptions of inadequate support. The following sections discuss these general ideas more concretely.

8.5.1 Top management visibility and involvement

Literature has highlighted the importance of top management direct involvement in the TQM programme. This was supported by the comments from the workers, union leaders, quality circle leaders and TQM staff in the case study companies.

This concept is operationalised in the model through the time made available by top management for TQM activities. This is assumed to be constant in the present model and not affected by other factors outside the TQM programme. It is realised that this time allocation is affected by a number of activities that top managers are involved with. This area is rather complicated and will not be explicitly included in the boundaries of the present model.

The interviews with workers indicated that they expect top managers to be present in a number of TQM activities. These include quality circle presentations and assessments, as well as shop floor visits for informal interaction with workers. These requirements from top management are, thus, a function of both the current number of participants as well as the submitted projects for evaluation.

Top management visibility ratio, which is a comparison of the available time and the required time, falls as the number of participants and project contributions rise. The visibility ratio represents the short-term experience of visibility and it feeds in to a long-term average of visibility. This average can be seen as the memory of past and present visibility of top managers. This latter variable influences the perception of top management support. These relationships are graphically presented in Figure 8.7.

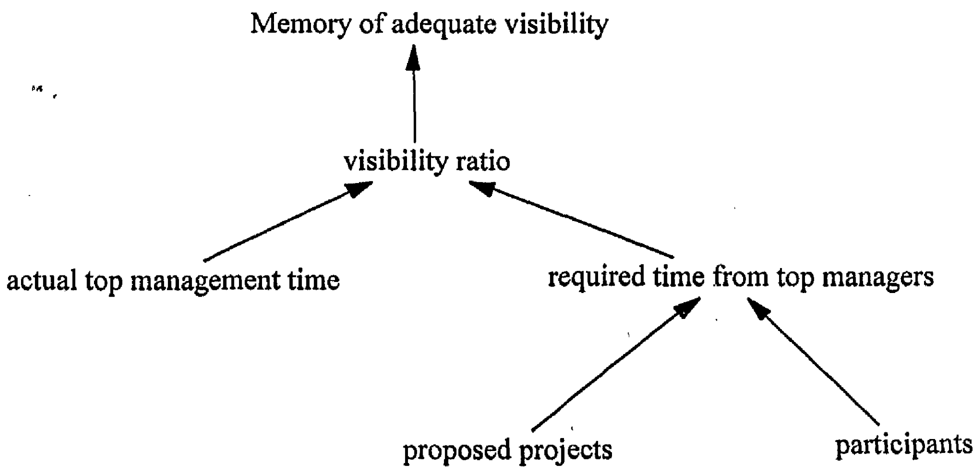


Figure 8.7. The interactions in the memory of adequate top management visibility.

8.5.2 Middle management involvement

The involvement of middle management is also seen as crucial in the implementation of the TQM programme. Middle managers' role is important not only in the assessment of the proposed projects but also in the implementation of these projects. These requirements from middle managers are based only on the number of projects that are proposed and accepted. As these projects increase, the perceived middle management support declines.

Unlike top management time involvement, middle management time allocated to the TQM programme varies. The first determinant factor of middle management actual time is middle management commitment. The commitment of these managers is typically influenced by top managers. Middle managers are as committed as their superiors are. The model assumes that memory of top management visibility directly influences the commitment of middle managers. When past experiences indicate that top management is not visible and involved, middle management commitment drops, and the time allocated to the programme is reduced.

The second determinant of middle management time is job insecurity brought about by increased participation. Improvement efforts by their subordinates open up new possibilities that threaten their own jobs. New suggestions identified by workers may indicate how poorly they are performing their jobs. Another possibility is that good work done by workers can bring them promotions. In any case, greater participation increases this threat to middle managers so that they would rather not allocate time for the programme. Project approvals will take longer and implementation of projects will be blocked as the perceived threat grows. Figure 8.8 shows these relationships.

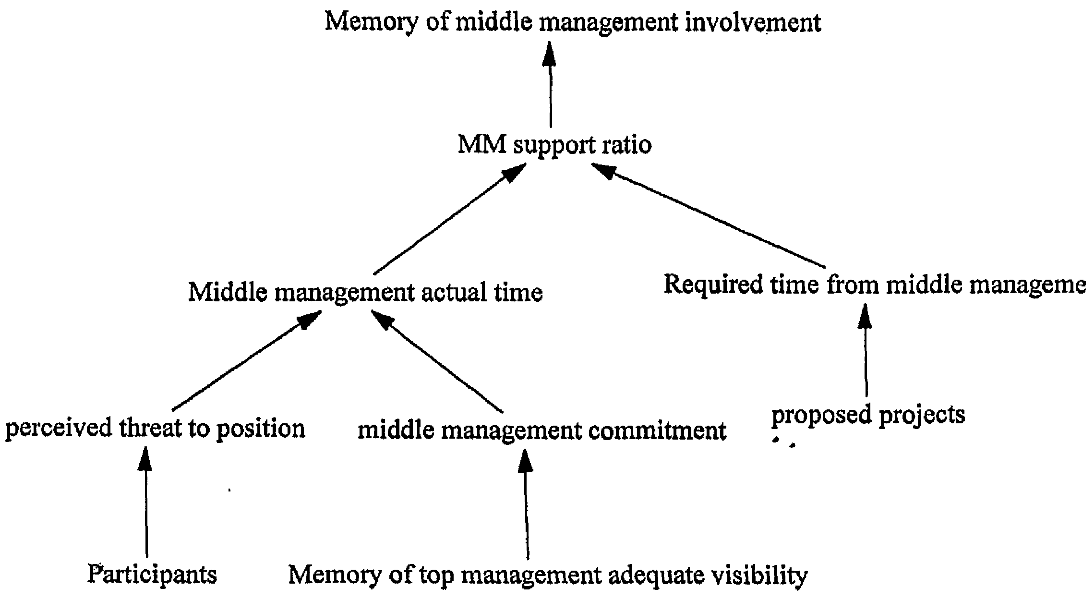


Figure 8.8. The interactions in the memory of middle management involvement

8.5.3 Budget availability

The discussion of budget availability in many TQM analyses is rather implicit. However, this does not underestimate its importance. What are neglected in these discussions are the perceptions of workers of the availability of financial resources. This was highlighted in the case study when perceptions of the participants were not consistent with actual accounts of budget availability. The model recognises these differences and includes them as another perceived support variable.

The perception of support is based on the perceived budget ratio. This variable is a product of the actual budget ratio and the perceived availability of budget. This latter variable, in turn, is similarly a memory variable based on an average of past and present experiences.

The indicators of budget availability are the project rejection rate, the project implementation delays and satisfaction with rewards. The perception of budget availability is inversely proportional to project rejection rates and implementation delays. On the other hand, it is positively related to satisfaction with rewards. Figure 8.9 shows these relationships.

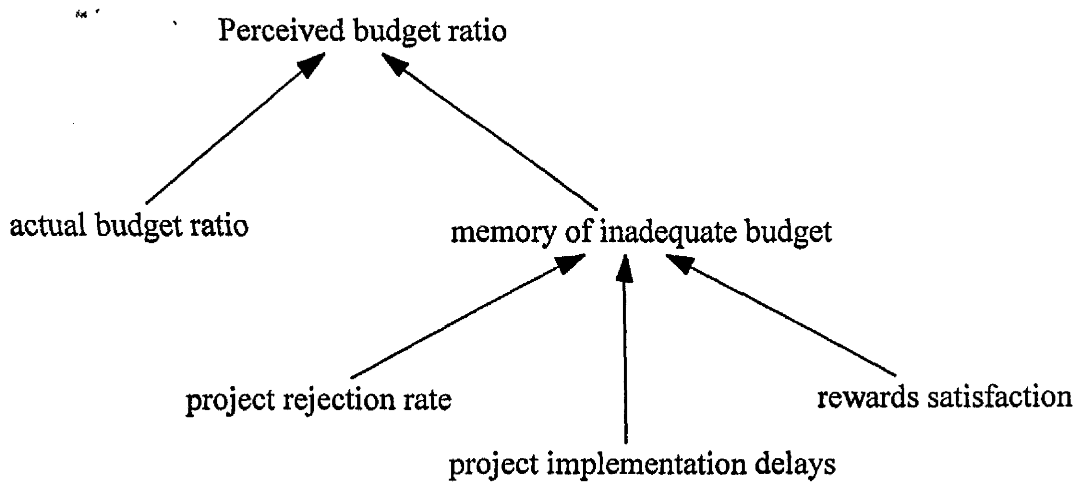


Figure 8.9. The interactions in the perceived budget ratio.

8.5.4 Perceived support from TQM staff

The availability of training and facilitation are indicators of the organisation's support for the programme. Training and facilitation provides the necessary skills, techniques and other knowledge that proves to be instrumental in successful participation efforts.

The work of the TQM staff may be categorised into three: training, facilitation and monitoring activities. The TQM staff is assumed to place more emphasis on training and allocates a large portion of their total time to preparing and conduct of seminars and training sessions. The remaining time is spent between monitoring and facilitation tasks. The allocation of time between these tasks differs from case to case, and depends on the emphasis placed on each activity. In the companies that were studied, around 80 percent of the time of the TQM staff were spent on training activities. The rest was spent on monitoring, that is, receiving, processing, and preparing reports about all the TQM activities. If there is still remaining time, the TQM staff can visit the quality circles during their meetings and guide them through their efforts.

The training needs are a sum of the regular training activities that is available for all company personnel and TQM training for participants. As the number of participants grow, so do their training requirements. Other training needs, such as special topics relevant to the participants' specific needs, are also identified through monitoring activities. Training needs also increase with more monitoring activities. Thus, the higher the training needs, the lower is the training ratio. This, in turn, is an indicator of low support.

Monitoring activities are based on the number of participants involved. Greater participation requires more monitoring time. Facilitation involves personal involvement of the TQM staff with the quality circle activities and is similarly dependent on the number of participants.

The actual time spent for monitoring and facilitation activities are negatively influenced by work pressure. Work pressure is indicated by the ratio of the total available time of the TQM staff and the total of training, monitoring and facilitation requirements. Since it is assumed that training is the priority of the TQM staff, it is left unaffected by work pressure. However, the effective monitoring and facilitation times are reduced by increased work pressure. This, in turn, pulls down both the monitoring ratio and facilitation ratio.

The facilitation ratio is further affected by perceptions of organisational support. When the TQM staff do not perceive top and middle management to be adequately involved, and when the budget is seen to be inadequate, the effective time for facilitation falls. Eventually, when the facilitation ratio goes down, perceived support also declines. These are shown in the diagram on the next page.

A general comment is necessary for these interactions. The diagrams in this section did not show any feedback loops. The loops were shown to facilitate description and understanding. These interactions are part of larger feedback loops that involve participants and project contributions. These variables feed in to total satisfaction and perceived organisational support, which determine the motivation to participate. This, in turn, determines conversion rate and eventually the level of participants. This closes the large loop as participants determine the required time from the resource factors. It may be noted that these large loops are balancing loops that are limited by the actual resource availability. The project contributions, on the

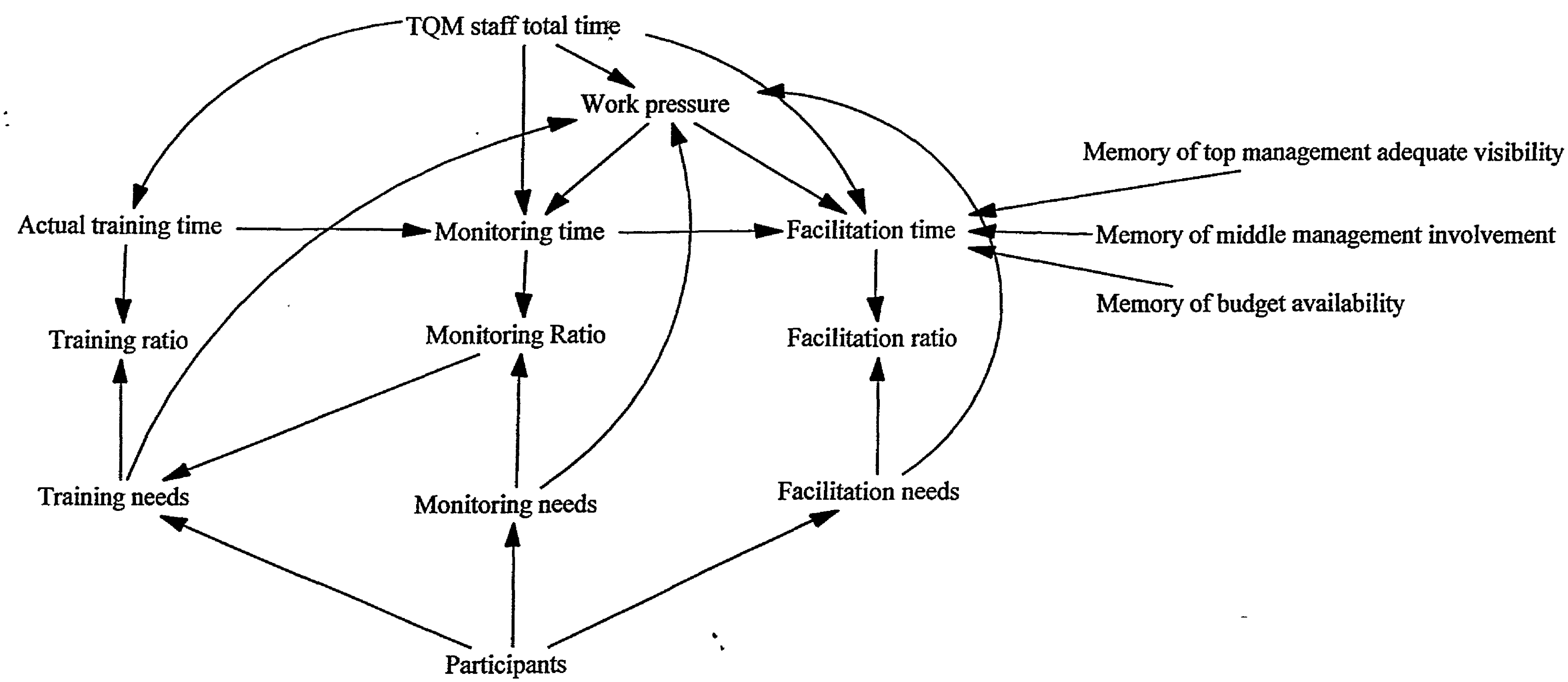


Figure 8.10. The interactions in the training and facilitation support variables.

other hand, are also influenced by the number of participants. This forms the other large feedback loops. In addition, other loops are formed from the generation of these project contributions. These are discussed in the next section.

8.6 Idea generation process

The idea generation process involves the identification and solution of improvement projects and the processing of these projects until they are finally implemented.

8.6.1 Project identification and solution

The identification and solution of improvement projects are typically difficult tasks. A large literature on problem identification and problem solving has identified a number of barriers and difficulties attached to these activities. Moreover, Lawler and Mohrman (1985; 1987) include among the problems of quality circles the lack of agreement on which problems to tackle as members have different concerns. These issues are addressed to by the use of techniques and procedures that facilitate problem identification and solution. Thus, one of the factors that affect the generation of projects is the level of ability of the participants. The higher their level of ability, that is, their knowledge and skills for problem identification and solving, the greater is the average number of projects that can be proposed.

A second factor that determines the indicated number of projects per circle is the level of difficulty of the projects that are being tackled. As mentioned earlier, difficulty is a function of the accumulated number of accepted projects. Thus, as more projects have been accepted, the more difficult and complex are the current projects. This level of difficulty, thus, prevents the completion of the improvement identification and solution tasks.

A third factor of the indicated number of projects per circle is the percentage number of meetings held. This concept may be specific to the company case study. The TQM staff calculates the planned meetings for the entire year and monitors through the year the actual number of meetings held. Thus, the percentage meetings held represents the performance of the quality circles against their plans. It is recognised that the number of meetings held increases the indicated number of projects per circle as the holding of meetings represent the efforts of the circles to identify and resolve their quality problems and improvement opportunities.

These three factors that determine the indicated projects have a multiplicative relationship. Thus, for optimum number of projects per circle, these three factors should also be at their optimum levels. Otherwise, a low value in any of these factors can pull down the outcome. Typically, there is a competing relationship between difficulty and ability as they have opposite effects. Ability tends to offset the effects of difficulty so that there is at least one project for the entire year, that is when the meetings held is 100 percent. When ability is higher than difficulty at this percentage of meetings, then there are more than one project per year per circle. At the other extreme, when difficulty is higher than ability, the indicated number of projects per circle will approach zero depending on the levels of ability and difficulty.

The percentage meetings held is based on the motivation to hold meetings. This is similarly based on expectancy theory. Expectancy, in this case, is based on the belief that holding meetings is possible. In the company case study this is assumed to take the value of 1.0 as middle managers usually allow the circles to hold their meetings, or at least, hold them at some more convenient time. The force of motivation to hold meetings is based on the preference or valence for meetings and its instrumentality, the belief that the outcomes can be achieved.

8.6.2 Force of motivation to hold meetings

The preference to hold meetings is an additive function of preferences related to the outcomes to be derived from meetings held. There are five factors involved: contributions, rewards, ability, facilitation and imitation.

Contributions are specific outcomes that can be derived from holding meetings. The preference or valence for contributions is based on the satisfaction derived from contributing and from the need for contributions. It is expected that the project contributions that are proposed will be implemented. Moreover, the belief that this outcome can be attained and implemented is dependent on their perception of organisational support for the programme. The product of these two factors adds to the preference for holding meetings. To wit, when there is a high preference for contributions and a perception of strong organisational support, then there is a stronger motivation to hold meetings. When any of these two factors is low, then motivation to hold meetings also diminishes.

Rewards represent the second outcome that encourages the holding of meetings. These rewards include some short-term incentives such as food stubs for every meeting held and longer-term incentives such as representing the company in national quality circle competitions together with some possible prizes. The preference for these rewards is directly related to the satisfaction derived from these rewards as discussed in an earlier section. The instrumentality of achieving these outcomes through meetings is based on the rewards ratio. This variable indicates the effort that the circles can exert to obtain the desired rewards. Thus, the product of reward valence and instrumentality contributes to the motivation to hold meetings. Only optimum values for these two factors can lead to greater interest in holding meetings.

The third factor that encourages circles to meet is ability. As mentioned earlier, the interviewees in this research expressed some intense satisfaction derived from learning new skills and using them. Thus, the level of ability determines the preference for meetings. The greater the ability, the greater is the valence for ability. The instrumentality for using these learned skills and techniques during these meetings is equal to 1.0 because these skills are meant to be used for these sessions. Hence, higher ability also leads to higher motivation for meetings.

The last two factors directly encourage the holding of meetings. Preference for meetings is directly influenced by facilitation activities. When the TQM staff members have available time for facilitation, they push and encourage the quality circles to meet and identify new improvement areas. Thus, a high facilitation ratio, as it indicates the TQM staff availability for these activities, contributes to the meetings motivation.

The imitation factor is based on the level of participation and represents a bandwagon effect. The contribution to meetings motivation is positively related to the level of participation. Thus, there are more meetings when there is a higher level of participation.

These five factors are additive. They are independent of each other and do not influence the other. Figure 8.11 shows these factors together.

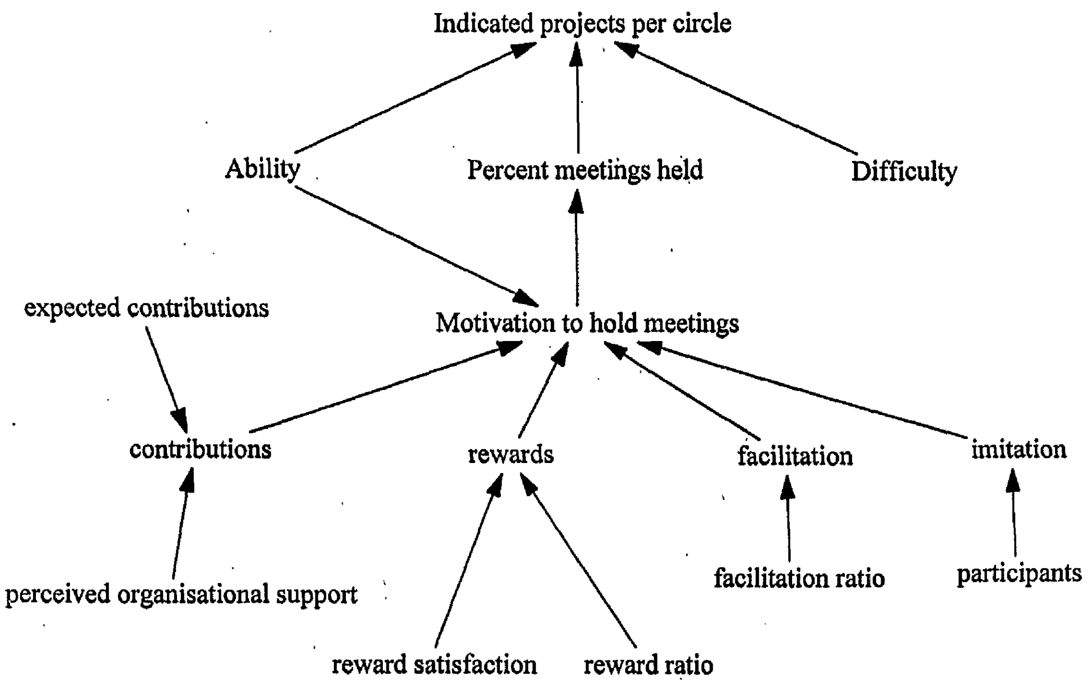


Figure 8.11. The interactions in the indicated projects per circle

8.6.3 Contributions processing

The improvement projects involve a systematic analysis of the area of concern highlighting the reasons for choosing the area against other alternatives. Furthermore, it includes several proposals for solution to the problem or an improvement. These analyses are formally presented to top management for consideration. Top and middle managers listen to presentations and later study the proposals. Some suitable projects are accepted and are implemented when the necessary resources (time, funds, equipment, expertise, etc.) are available. Some projects are rejected for certain reasons such as unfeasibility, impracticability, or that they are already being undertaken. Other projects take longer time to be studied as they involve further comments from other people. This process is shown in Figure 8.12.

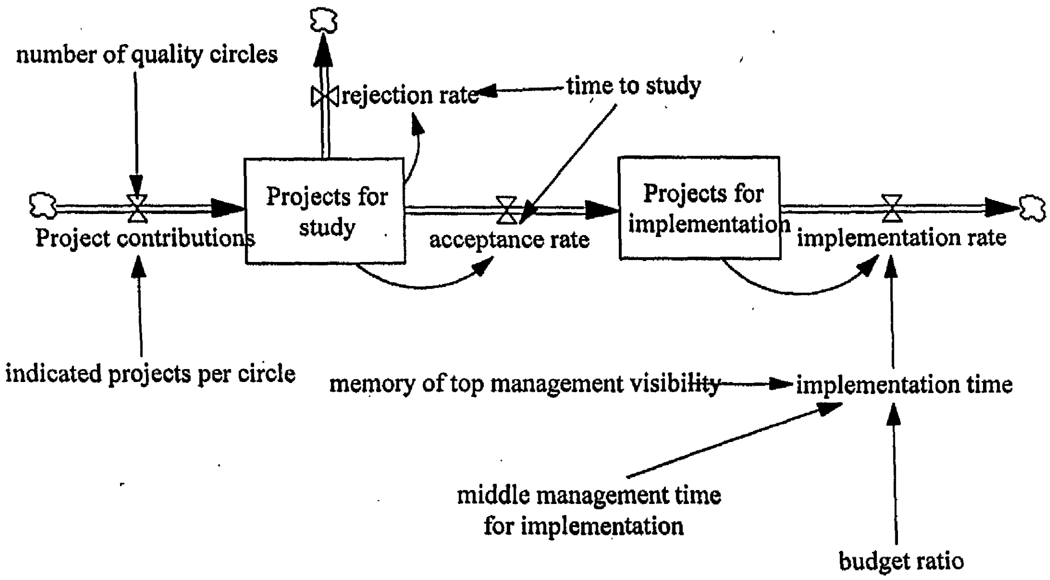


Figure 8.12. The interactions in projects processing

The number of projects that are received for study is an average equal to the indicated projects per circle and the number of quality circles. The number of quality circles is based on participants. These projects go into the stock and wait until they are presented and studied. Some are immediately accepted or rejected while others stay for further study. The model assumes that the time to study is constant and represents a long-term average. The interviews with the TQM staff in the company case study suggested that the time to study vary according to the availability of top and middle managers. This was not delved into in the present model.

The effects of top and middle management involvement were more strongly felt in the implementation of projects, and these were included in the model. The memory of top management visibility puts an additional pressure to implement the projects sooner. The time allocation by middle management for project implementation also reduces time delays. Finally, availability of budget provides for the necessary resources, materials, equipment or expertise that might be required for the execution of the project. In sum, the availability of top and middle management time and budget shortens implementation time and increases the number of implemented projects.

8.7 Summary

The main purpose of the preceding discussion is the detailed presentation of the relationships among the variables. These relationships were based on theories, TQM literature, and more importantly from the case studies conducted in this research. Little attempt has been made to explicitly show the feedback loops to which these variables belong. Thus, this section integrates the different parts that have been presented. Figure 8.13 integrates all these variables into one comprehensive diagram.

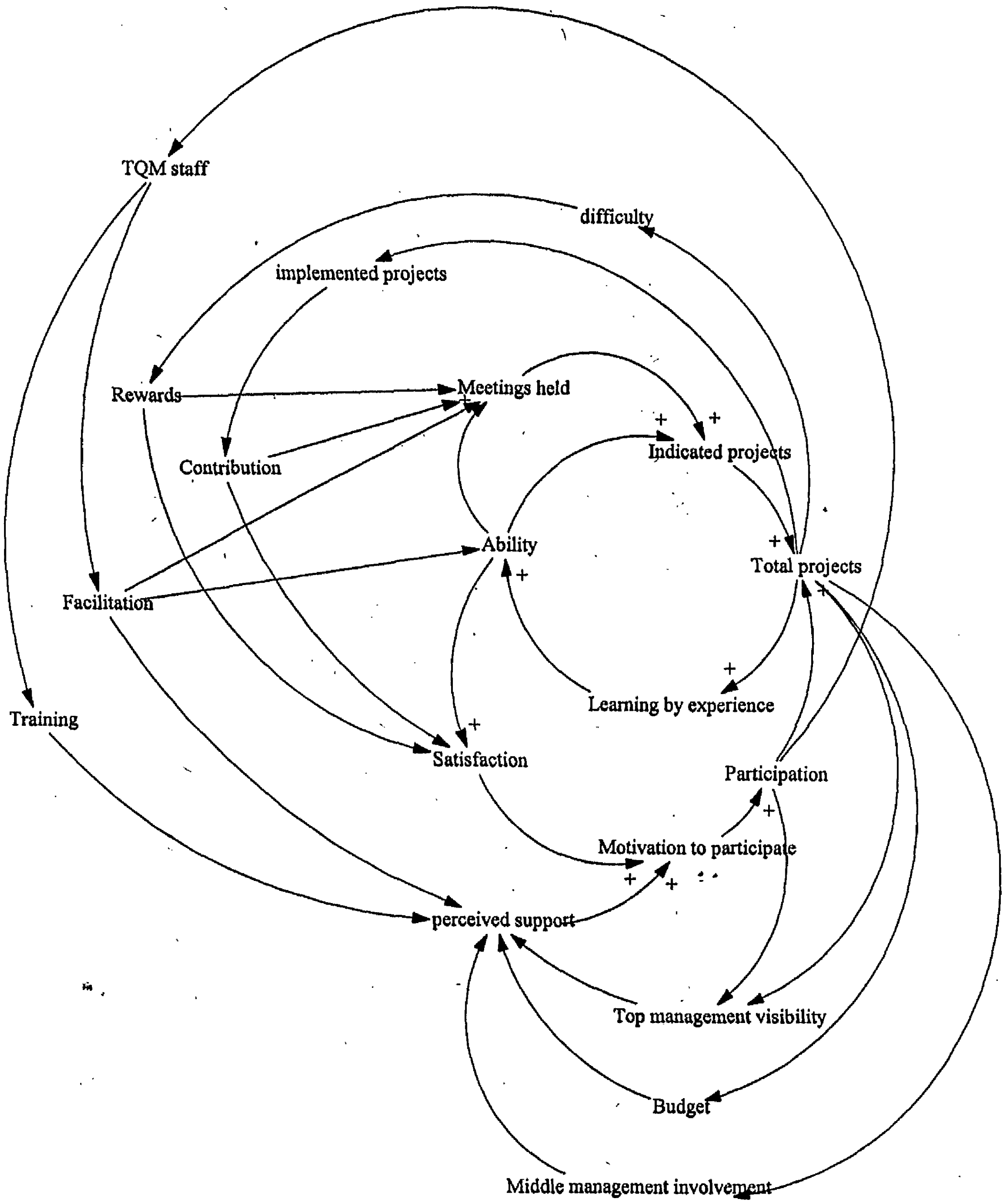


Figure 8.13. Integrated influence diagram of the Dynamic TQM Model

As mentioned earlier, participation and the total generated projects close the loops of the factor resources. These two variables thus, are not the simple end towards which the TQM process is geared to, but also are links that affect future performance of the resources. Closing the loops creates further dynamics that is not apparent in earlier TQM analyses.

More specifically, total projects lead the system to its limits as defined by the temporal resources allocated by top and middle management involvement, and the TQM staff, as well as financial constraints dictated by the budget. As the total projects increase, these resources begin to be depleted until such time that additional projects, which require them, are not accommodated. At this stage or even before the resources get totally used up, the perception of support start to drop, and total projects would eventually slow down in their growth.

The satisfaction factors also follow a similar pattern. TQM staff will have a greater amount of work and efficiency goes down. Perceived support decreases, motivation to hold meetings drops and ability development also slows down. Eventually participation and total projects are affected.

In the case of rewards, the limiting variable is difficulty. As more total projects are proposed, the level of difficulty increases. Efforts with problem identification and problem solving increase, together with expected rewards. This leads to a lower rewards ratio and diminished satisfaction. And again the impact is felt with participation and total projects.

Contribution dynamics, on the other hand, are not constrained by any resources but are affected, as shown earlier by other inherent concerns. These suggest that satisfaction that is derived from contribution is not as stable as suggested in literature.

Overall, Figure 8.13 highlights the complexity of the TQM implementation process, and negates the simplicity by which consulting-based literature pictures the process. The presence of a number of major variables leads to complex interactions and interdependencies. The multi-causal nature of participation and total projects makes the prediction of success a not so easy task. Furthermore, the feedback loops add further dynamism to these interactions.

8.8 Conclusions

The Dynamic TQM model presented in this chapter established the point made in the first chapter: that the TQM process is inherently a complex system. This complexity has often been overlooked, neglected, or simply avoided in the more prescriptive based literature. Gill and Whittle (1993) have observed that:

> In consulting attempts to make TQM more attractive and easily grasped, the subtleties lying behind what is being proposed are obscured, partly in case such complications queer the sales pitch. Thus the TQM

> intervention not surprisingly appears to managers to boil down to the installation of techniques in a mechanistic, step-by-step way .... (p287).

It can be argued that efforts to sell the TQM programme to organisations is based on the logic and belief that its techniques will lead to inevitable success. It has been suggested in this literature that workers have this inherent need to participate and are waiting for such opportunity to contribute and do their part. It is further assumed that such a need will continually reinforce itself. That is, satisfaction derived from the programme can encourage them to continue being active participants.

More fundamentally, acquiring certain knowledge and skills can both provide a sense of satisfaction and encourage them to propose improvement projects. This leads to further learning and satisfaction through the experience. This constitutes an infinite chain reaction that reinforces learning and satisfaction. This can be argued as the core of the TQM programme. If workers are taught techniques and skills and are encouraged to practice these skills, as the Japanese have done, this could lead to continuous and endless improvement. It is argued further that efforts to support the programme can be measured on how successful factor inputs are in activating these reinforcing loops (as shown Figure 8.14). Indeed, quality becomes free (Crosby, 1979) if these loops are triggered and can generate continuous improvement.

However, as the model indicates, a number of things can happen before these core loops are activated. The interdependencies of the variables prevent a linear perspective to predicting success. Even the meticulous procedural approach to implementing TQM can lead to possibilities other than success. The conceptual analysis suggested by the model point the existence of natural limits in the growth of the programme, which constrains the desired outcomes. But in the interim, other problems can develop.

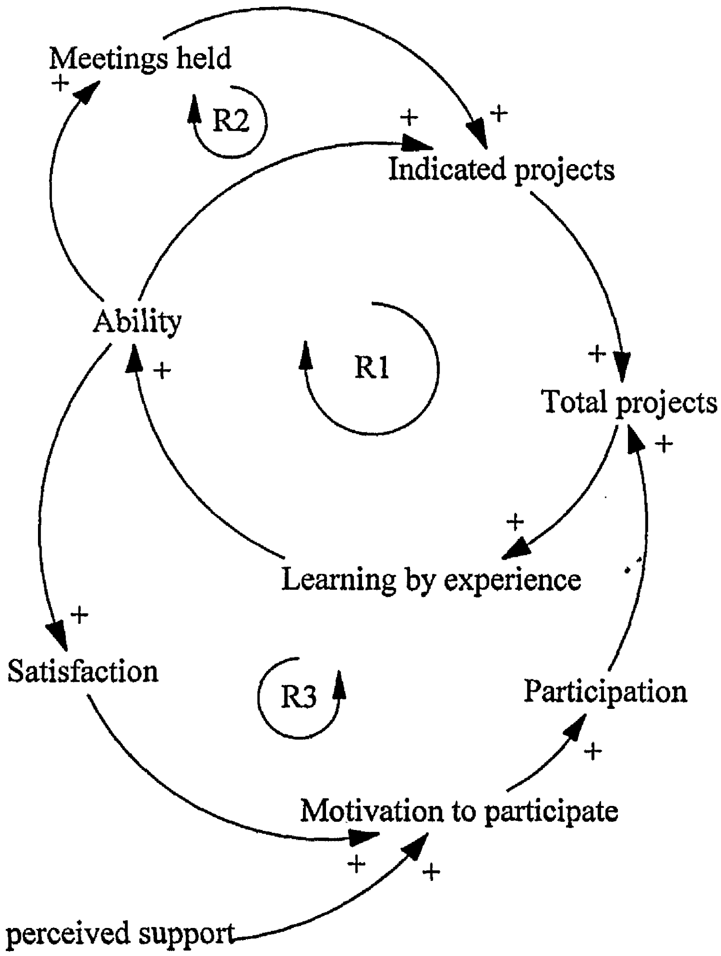


Figure 8.14. The core loops of the TQM programme.

These points will be explored further in Chapter 9 by testing the corresponding simulation model. The simulation will show how the variables react and interact with each other, and how they lead to success or failure.

CHAPTER 9
MODEL VALIDATION: RELEVANCE OF THE DYNAMIC TQM MODEL

The main objective of the model is to derive some understanding about the sustainability of TQM implementation efforts. The success in achieving such an objective lies mainly on the model's congruence with reality in order that the analyses and implications derived therefrom are plausible, reasonable and realistic. Thus, as in other mathematical models, the main method of establishing such correspondence between model and reality is a comparison between the two sets of system data (Forrester and Senge, 1980).

Thus, this chapter aims to evaluate the performance of the model by comparing it with actual historical data derived from the case company. Establishing correspondence with reality is the basic premise of a validity test. Thus, congruence with the measured quantifiable variables of the system is established not only from qualitative inspection and comparison but also by using more quantitative methods of goodness-of-fit tests. The summary statistics proposed by Sterman (1984) were used for this latter task. Secondly, the more qualitative comparative approach is adopted in the analysis of the intangible and unmeasured variables. The graphical behaviour of these variables were compared with the descriptions from the interviewees and further validated by the interviewees' own confirmation of these behaviour patterns. Moreover, more confidence in the model is further established by retelling the history of the case based on the intangible and unmeasured variables and their ability to explain the nuances of the history.

Implicit in these analyses is the contribution to further understanding of TQM as applied in a real case. The model can explicitly show how the intangible variables are affected by changes in other parts of the system and how these intangibles manifest themselves on the measured quantified variables. Furthermore, included in the efforts of fine tuning the model to closely replicate the actual system's historical behaviour are more minute parameter value adjustments and numerous simulation runs. These runs reveal the reactions to varying changes in parameters. Consequently, more detailed understanding is gained from these parameter modification tests.

The chapter first discusses the history of the company's TQM programme (which it calls TQC for Total Quality Commitment). This history mainly involves some prior experiences with quality circles and training initiatives. The initial parameter values are inferred from this discussion of the pre-implementation initiatives. The second part of the chapter shows how the model is able to replicate the actual historical performance of the case with respect to five available measured variables. A statistical comparison of the two sets of data is also presented. The third section deals with analysing the case by presenting other relevant intangible and unmeasured variables that have been simulated by the model. The chapter concludes by relating these results with previous chapters and highlights some points that will be further discussed in the next chapter.

9.1 Total Quality Commitment at Company C

The present TQM programme at Company C traces its history to an earlier programme that involved quality circles and other initiatives such as War on Waste

(WOW), Energy conservation (Enercon) and a suggestion system known as PIP (Productivity Improvement Program). This section deals with an account of the initiatives that focused on the quality circles, known as Excel circles. They were adopted in the original programme in 1984, and continued and modified when TQM was introduced in 1991.

9.1.1 The Excel programme (1984 - 1988)

The introduction of quality circles in the early 1980s created some initial impressions on the members of the organisation. The quality circles' main goal was to identify areas for cost reduction and improvement. This rather 'narrow' goal later proved to be its main weakness when it began to cause a number of misconceptions and misunderstandings.

The Excel Circle programme was conceived and initiated to improve the production and technical functions, as they were costly operations. The quality circles were tasked with identifying cost reduction projects by applying the seven tools advocated by the Japanese quality gurus. It initially involved some middle managers who were trained to be quality circle facilitators. After the training, these middle managers identified volunteers[14] in their work areas and trained them with the techniques of problem solving.

The programme, however, had its limitations as it focused its activities on the improvement and participation in the production function. And even in the

[14] The first participants were not purely voluntary in that the middle managers themselves chose and offered the task to some of their subordinates, typically because they favoured them, or that they are seen as co-operative and have some potential.

production area itself, not everyone was recruited into the circles programme. Thus, non-participants in the production areas, as well as in the other functions, were observed to be have been slighted and left out by their inability to participate The recognition and rewards given to quality circle members who had initiated successful projects further aggravated this.

The limited implementation of quality circles in the organisation was viewed as favouritism to the selected few. An unintended consequence was the perception of elitism. Moreover, there were growing differences between participants and non-participants. Members were seen as unfairly trying to get on management's good side and occasionally chided for their 'boot-licking' activities. At times, Excel circle members were asked by non-participants to share with their rewards but the participants usually rejected these requests. As a consequence, non-quality circle members delayed implementation of the improvement projects or did not totally accept them. Non-participants would block, or simply not co-operate in, the implementation of these improvement projects. These rifts with non-participants discouraged some quality circles members until a few circles became inactive or totally were dissolved.

Another problem that arose from these initial improvement efforts was the inevitable retrenchment programme (partially due to national economic conditions) in 1985 which caused the loss of 25 percent of the company's total workforce. There had been an impression that the cost reduction efforts of quality circles led to improvements that caused the redundancy of many employees. Cost reduction was equated with savings on costs by eliminating and terminating their services. On the other hand, involvement with the quality circles was not a security for their tenure in the company, as a number of active quality circles members were also made redundant. These perceptions of job insecurity were further aggravated by the termination of the services of a manager who acted as a circle facilitator. While the reason of his termination was not related to his function as a quality circle facilitator, the failure to divulge the real reasons by management reinforced the belief that QC activities were linked to the retrenchment of employees. These impressions coupled with other labour issues culminated with a labour strike a few months later.

Thus, there was a realisation of the very narrow perspective of the first quality circles programme. The launching of a broader system-wide programme based on TQM enabled a more systematic approach to understanding the issues and objectives of the programme. A number of activities and tasks were organised and initiated.

9.1.2 Total Quality Commitment (1991 - present)

The first initiatives involved setting up goals of the programme. The new programme shifted its goals from cost reduction and productivity improvement to quality improvement and employee participation. The head of the programme pointed out:

> "We used to strive only for product excellence, but we realised that there is also the customer supplier undertaking that we have to consider. ... The quality level of our product now depends on the customer. We only give them what they require. Our corporate slogan "The customer is our reason for being" says it all." (Agustin, 1996).

The second objective of recognising employee involvement was also enshrined as the third point of the company's creed:

People are our most important assets.

The programme was expanded beyond the production function to include all members of the organisation, and even solicited the participation of its suppliers. The Excel programme was revitalised and participation became voluntary but vigorously encouraged by management. The employees were motivated to participate in the programme both through direct and indirect means. First, there was an information campaign to promote active participation. In-house newsletters, bulletin boards and posters publicised the goals of the programme and the benefits of active involvement. Secondly, activities that not only involved work-related functions were also initiated. More leisure activities such as sports and literary competitions were also introduced to highlight the other objectives of the quality circles programme, which is the total development of the person. These activities were seen as attempts "to convert the members of the organisation to the new quality programme" (Ariola, 1996). The head of the TQC at that time said of his projects: "I believe that TQM is a religion as it deals with values. As such, it needs preachers to spread the good news" (Ariola, 1996).

The opening of the programme to every member of the organisation removed the initial perceptions of elitism and favouritism. This alleviated the problems of rifts between members and non-members, and virtually eliminated the lack of co-operation by the non-participants and the their blocking of projects. Furthermore, improved relations in the company removed one of the sources of de-motivation of participants.

The design and implementation of an intensive training programme represented the corner stone of the re-launching of the improvement programme. The first targets of the programme were the union officers who were recognised for their influence and power over their colleagues. The training were intensive week-long seminars that focused on the importance of TQC as a necessary weapon to help the company to deal with the threat of increasing competition. Having won the leaders over, they were personally asked to lead and enjoin their colleagues to attend the seminars and become active participants of the quality improvement programme. Eventually, the entire organisation had attended the TQC training seminars and were given the opportunity, and encouraged, to identify improvement areas.

The training, which was organised and led by a staff of 11 industrial engineers, were generally well-received by both union officers and workers. The unusual opportunity for training afforded them some new-found self-importance and improved perspectives and understanding of the programme. The seminars appeared to have been effective in imparting the objective of the programme and in clarifying the many issues and misinterpretations that arose from the past implementation efforts. One union officer rightly pointed out that "the TQC programme is very important to our company, and ultimately to us, as it prepares our company to participate in global competition." Other workers who were interviewed for this research similarly shared the same sentiments and understanding of the programme.

One particular worker's appreciation of the seminars even extended to applying the problem solving techniques he learned to his own domestic affairs!

In general, the strategy taken by the management to re-initiate the programme by expanding membership opportunities, a wide spread information campaign, and an intensive training programme for everybody appeared to be effective in improving the initial impressions and perceptions of the organisation. The past unfavourable experiences seemed to have been blotted out of their memory and the present activities enabled the workers to look at things differently. One active circle member summarises these improvements with his own observations in the company:

> "It used to be that people in my department worked on their own and did not care about others. At times, they were unruly. The machines were dirty, as well as the work areas. With the Excel, teamwork developed, and they learned to co-operate. The machines and work area became tidier and they became disciplined."

9.2 Representing the initial conditions

Typically, failure in earlier attempts to initiate organisational changes result to certain unfavourable perceptions and attitudes towards management. These impressions and experiences from the past tend to affect the later implementation of an organisation-wide programme like TQM. However, unlike these cases, the company in this research seemed to rightly realise and analyse that its mistakes lie in the fundamental assumptions it made and the potential errors in thinking and perceptions it led its work force. Management appeared to have learned much from this previous experience and endeavoured to correct them through a more organised company-wide programme and ably supported by an intensive information and training campaign. The main result was the correction and improvement in earlier perceptions. Thus, unlike other TQM implementation programmes, it managed to re-launch its programme with renewed enthusiasm from its members[15].

The impact of these activities is represented in the model and the initial values are presented in Table 9.1. The initial efforts by management to change these impressions have led to very favourable expectations on a number of variables. These are indications of fairly high satisfaction with rewards and satisfaction with contribution. Moreover, the valence or preference for rewards related to meetings is also assumed to take on the high condition values, whilst the contributions valence is assumed to take a lower value, mainly because the workers attached relatively higher values to rewards than contributions.

The high profile participation and involvement of top managers, particularly the president and the marketing vice president[16] sent some favourable signals to the organisation throughout the pre-implementation stage activities. A TQC facilitator pointed out that the president's personal involvement and initials/signature on all TQC-related memoranda signified the importance of all quality improvement activities and lent priority and authority to all these activities. Thus, this simulation assumed the high conditions for top management visibility.

[15] These observations were later confirmed with further interviews with both the current and former head of the TQC Working committee, both of whom are company vice presidents. They said that there was much brainstorming and discussions prior to the re-launching of the programme. The main realisation was the need for everyone's involvement. Despite the initial failure of the Excel circles programme, they decided to re-initiate it as they believe that it will develop the needed teamwork, and camaraderie, not to mention, problem solving activities.

[16] He was the head of the TQC Working Committee at that time.

Despite efforts to correct the early misunderstandings and mistaken impressions of the quality circles, the memories of the past are difficult to erase. Thus, slightly lower than high conditions are assumed for the intangible variables of satisfaction by participants, perceived support by participants, and motivation to hold meetings. Furthermore, the seminars also failed to correct the impression of management's concern for cost reduction. Their other experiences apart from the earlier quality circles programme, such as low annual bonuses and few benefits, had given them some evidence to doubt management's willingness to provide the necessary financial support to the projects. Consequently, the memory that budget is inadequate is assumed to be high.

The initial effect of threat to authority of the middle management is set to a high value. The present head of the TQC programme admits that their re-launch activities and training neglected the role of middle managers in the programme. The seminars for them had been conducted only after all the other rank and file had been completed and many quality circles have been organised and began to operate by then. As a result, many of these managers failed to understand what their subordinates were doing and perceived them to be a threat to their own authority. The case of a subordinate being promoted to a position higher than his manager further increased middle management insecurity. Nevertheless, the initial support of middle management to the programme has been largely dictated by top management's full support for the programme. It appears that they could not afford to disagree with the organisation's top managers despite their own insecurities. Thus, initial management support is assumed to be equal to 1.0 even as its initial the threat to middle management is rather high. The initial values of these variables are tabulated in Table 9.1.

Table 9.1 Specifications of low, medium and high initial conditions for the level variables.

Variable	Initial value
Motivation to participate variables	
Satisfaction by participants	0.7
Satisfaction due to rewards	1.0
Satisfaction due to contributions	1.0
Perceived support by participants	0.6
Middle management support ratio	1.0
Memory of top management visibility	1.0
Memory of budget inadequacy	0.8
Meetings Variables	
Motivation to hold meetings	0.6
Valence for rewards	1.0
Valence for contributions	0.2
Job security	0.0

It may be noted, however, that these values were generally derived from the details of the case study and later discussed with the TQM head. Moreover, the fine-tuned figures had been inferred from the parameter adjustment process of the simulation model to the historical data. Countless runs were required to determine and estimate as closely as possible the values of these initial conditions as to optimise the fit between simulated and actual system behaviour.

Furthermore, other relevant but confirmed assumptions were also made. The budget ratio was assumed to be a constant 100 percent. Interviews with the manager and facilitators responsible for the TQC programme revealed that top management had been very supportive and generous with the TQC activities. They stated that all their annual budgets had always been approved, even as management controlled the budgets of other functions. These interviewees also said that they are satisfied with the financial support that top management has extended to their projects. Thus, this support can be represented as total availability of funding.

The interviews with some top and middle managers also revealed that the organisation has adopted TQC as a permanent function in the organisation. A middle manager said that he thinks that there is no possibility that top management would give up and dismantle the programme. The vice president for logistics, who is concurrently the TQC head, when asked about the possibility of withdrawing the TQC programme in the face of declining trends in participation and projects, firmly pointed out that "it is out of the question that we are going to abandon the programme". The TQC head also pointed out that their commitment extends to the allocation of the necessary resources to support the programme. This suggested that the current performance is not affecting the commitment of top management and will continue to support the programme. The implication of these statements on the model is the constancy and consistency of top management commitment and the continued allocation of resources to the programme. Thus, the model assumed the conditions of the initial model as discussed in Chapter 8, and subsequently run in Chapters A3 and A4, in the second volume.

The only other exogenous variables used for the simulation are the total number of workforce, the average number of members per circles, and the number of facilitators over the years.

9.3 Simulation Runs and Summary Statistics

The parameter values discussed in the preceding section were used as input to the generalised TQM model. This section presents the results of the simulation run and demonstrates the model's ability to replicate observed historical behaviour. The model replicates the behaviour of the data sets of five variables, namely: total number of proposed projects, percentage participation, number of quality circles, indicated number of projects, and percentage meetings held. The historical behaviours of these variables were presented in the Chapter 7 as the reference modes. Figure 9.1a and 9.1b shows the simulated behaviour against the historical data[17].

The evaluation of the ability to endogenously replicate the historical behaviour is based on goodness-of-fit measures suggested by Sterman (1984). These include the mean absolute percent error (MAPE) between simulated and actual data and the Theil inequality statistics (Theil, 1966). Sterman (1984) showed how the partitioning of the error between model and data based on the Theil statistics could be used to analyse the flaws in simulation models. He recommends that bias due to unequal mean (U^M) and unequal standard deviation (U^S) be minimised to establish more confidence on the model.

[17] The tick marks represent the end of the year. Thus, time 0 represents the end of 1992, and the data point for this time reflects the total performance for 1992.

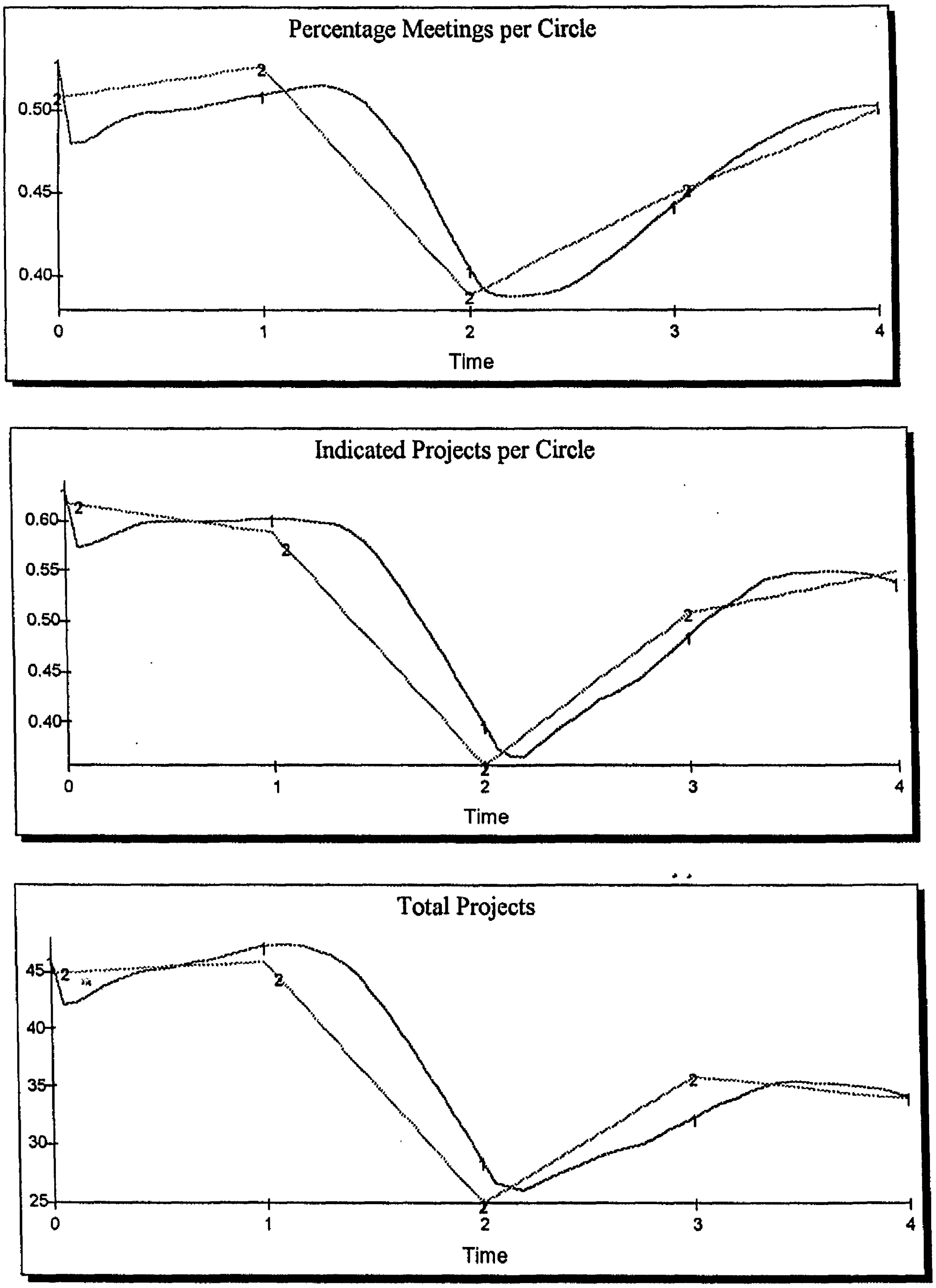
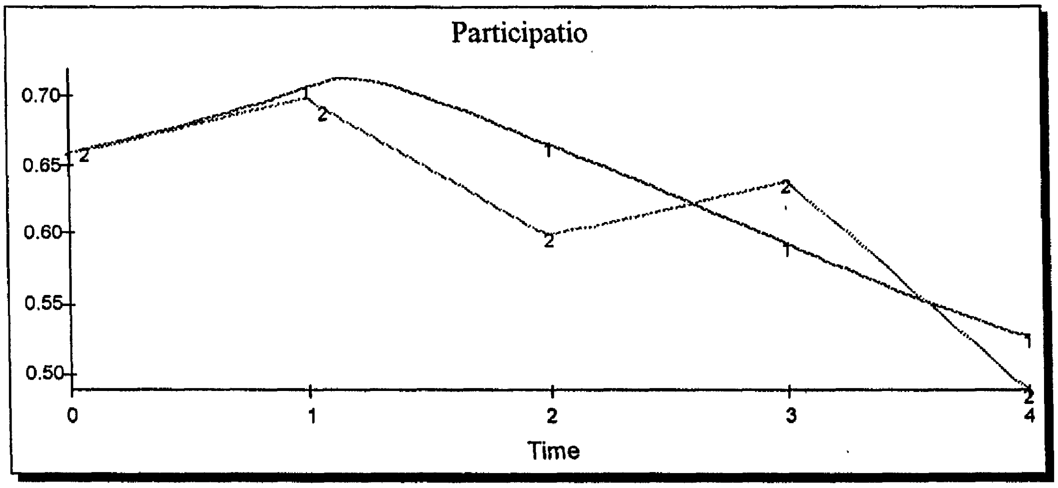


Figure 9.1a Comparison of the simulation results with historical data where 1 represents the simulation results and 2 is the historical data .



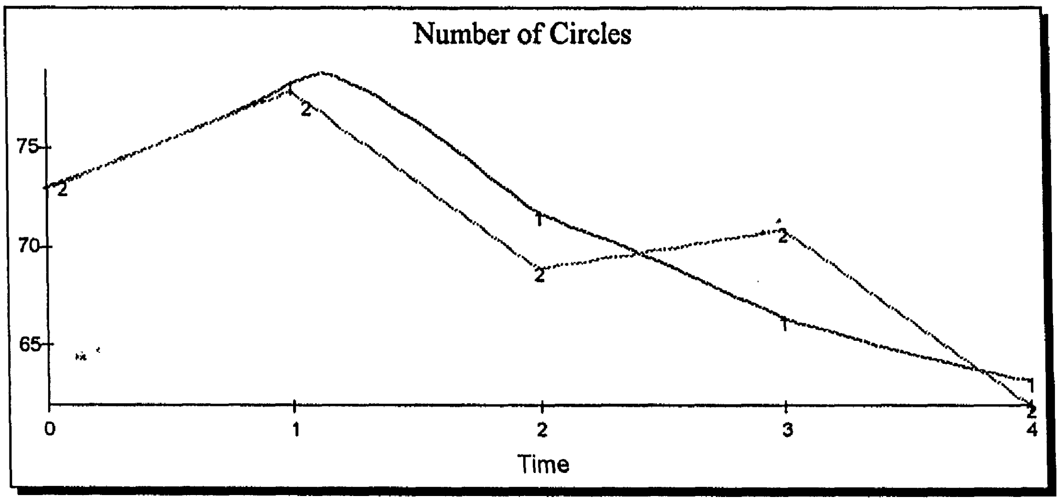


Figure 9.1b. Comparison of the simulation results with historical data where 1 represents the simulation results and 2 is the historical data .

The simulation begins in 1992, when the TQC was launched and new quality circles were organised. It runs through 1996. The historical fit of the model against the five variables for which time series data is available is assessed in Table 9.2. The MAPE ranged from 1.7% to 5.1% and averaged 3.3% for the five variables. The other errors similarly showed low averages of 2.97 for the mean-square error (MSE) and 5.8% for root-mean-square percentage error (RMSPE). The average correlation coefficient is relatively high at 0.851.

Table 9.2 Summary statistics for the actual and simulated data.

Variable	MAPE	MSE	RMSPE	U^M	U^S	U^C	R^2
Percentage participation	0.0508	0.0013	0.0634	0.0930	0.0490	0.8605	0.7538
Number of circles	0.0265	6.0903	0.0353	0.00005	0.0001	0.9998	0.7898
Average number of projects per circles	0.0174	0.0004	0.0536	0.0960	0.1058	0.7984	0.9508
Total number of projects	0.0383	5.7844	0.0801	0.0574	0.0030	0.9412	0.9085
Percentage meetings held	0.0244	0.0002	0.0299	0.0453	0.0446	0.9155	0.9220

The best fit among the variables is registered in the percentage meetings held variable where errors are very low and R-squared is a high 0.922. The top graph of Figure 9.1a shows that the simulated values almost followed the path of the actual data, although not as close at the beginning of the simulation period. Nevertheless, the errors were rather low. The MSE is a negligible 0.0002, and percentage-wise, the MAPE indicates a minimal 2.4%. The RMSPE is also very low at 2.9%. Moreover, a comparison of the Theil statistics shows that the error is concentrated on unequal covariance suggesting stronger confidence on the model's ability to replicate the percentage meetings held.

The average number of projects (second graph, Figure 9.1a) similarly recorded an excellent fit with an MSE of .00048, a MAPE of 1.74 %, and RMSPE of 5.36%. Its r-squared value is very high at 0.951. These negligible errors offset the effects of the bias due to the mean (U^M) and standard deviation (U^S), which were the highest among the five variables. However, Sterman (1984) still considers the values of these biases to be low compared to the unsystematic errors (U^C).

Despite the smoothing out of the actual participation values by the simulated figures, the percent participation (top graph, Figure 9.1b) also gives very low errors. Relative to other variables its r-squared value of 0.754 is low, but it reasonably indicates good correlation. The high concentration of errors due to covariance (86.0%) also indicates confidence on the fit of the model to the historical data.

In contrast, the number of circles and total projects had relatively higher MSE of 6.09 and 5.78, respectively. These variables represent the ratio/product of two simulated variables, and thus, errors in their component variables are amplified. However, percentage-wise, these errors are not very high. Their MAPE are still low at 2.65% and 3.8%, respectively, and the RMSPE are 3.5% and 8.0%, respectively. Furthermore, the errors are mainly unsystematic error of more than 90%. Thus, these figures are still reasonable indications of a good fit between the simulated and actual figures.

Overall, the figures in Table 9.2 satisfy the criteria set by Sterman (1984). The errors are very low with high correlation coefficients. Partitioning the errors based on Theil statistics yielded low error bias due to the mean and standard deviation. This indicates that the model's mean and standard deviation for each of these variables closely approximates that of the actual data. Thus, most of the error is concentrated in covariance, which Sterman attributes to a large random or noise component, or contains a cyclical mode that may be present in the historical data but not captured by the model. He further points out that a large U^C indicates that a large portion of the error is unsystematic and that "the model should not be faulted for failing to match the random component of the data" (p 56). Therefore, these figures signify that the model is able to endogenously reproduce the experience of the real system.

9.4 Retelling the case study with graphs

The implementation of the programme in 1991 started with an intensive series of training sessions for every member of the organisation, which as pointed out earlier, corrected many of the misconceptions about the programme, and helped improve their impressions and biases against the quality improvement efforts. These were made possible through the efforts of 11 full time TQM staff. Top management, having learned its lessons well from the previous implementation failure, endeavoured to provide as much resources, including financial requirements, as possible. The president and his vice presidents were regularly visible and involved throughout these seminars and other activities. Middle management was also seen to be visible in these activities. These factors combined to create a modest initial perception of organisational support.

Furthermore, the new opportunity to contribute one's ideas to promote quality improvement and cost reduction, the opportunity to learn more through seminars and multi-skilling training, and the incentives offered for participation in quality circles were welcomed by the workers. The interviews suggested that these opportunities were well received at the outset of the programme mainly because they had not been provided in the past. One worker said that in his 30 years with the company, it was his first time to attend such a training seminar, and was grateful for the opportunity, as it gave him so much pride. Overall, the programme was seen in good light and these factors represented a fair indication of expected satisfaction from the programme.

Some 66 percent of its population registered as circle members in 1992 (year 0 in the graph), the programme's first formal year of operation. The effects of the favourable initial conditions provided the momentum for increased interest in participation, so that participation improved to 70 percent in 1993 (time 1 in the graph). However, from that time onwards, participation declined, and generally followed a downward trend. This is shown in top graph of Figure 9.1b.

The motivation to participate reveals the initial slight upward trend that goes through to 1993 (Figure 9.2). The abrupt change in direction following this favourable trend is due to the reorganisation and redundancy programme at this time. The rumours about possible dismissal reminded the organisation of previous experiences, arousing much insecurity in their present positions. This largely negated most of the positive motivation to participate. Towards the middle of that year, motivation to participate stopped falling and showed tiny recovery as the fear of losing their jobs were tempered by the actual circumstances, and they did not lose their jobs. However, motivation slid again by the end of year 2 (1994).

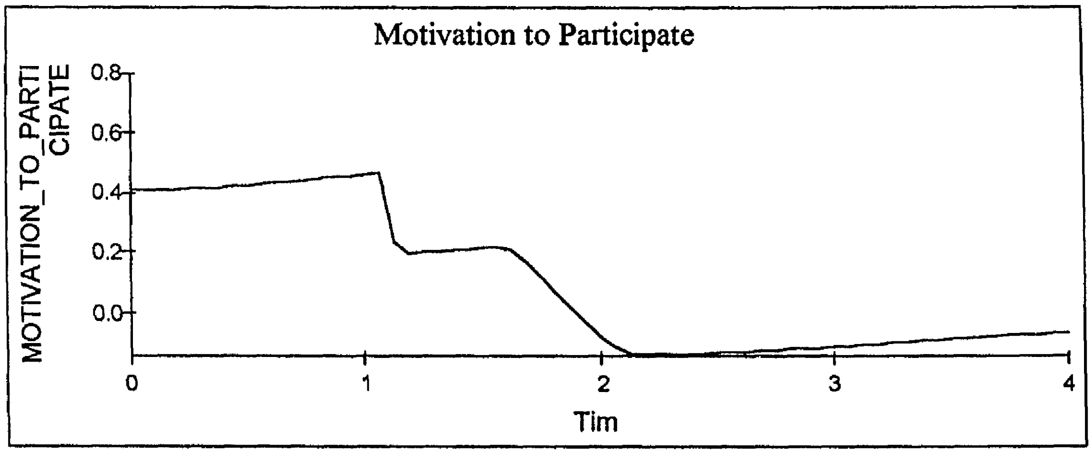


Figure 9.2 Simulated graph of motivation to participate

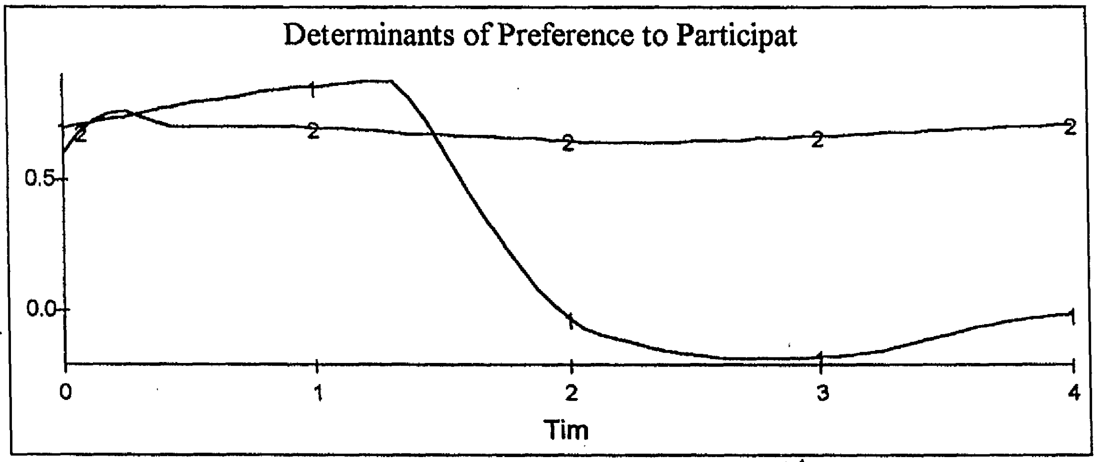


Figure 9.3 . Simulated results of satisfaction with factors (1) and perceived organisational support (2) .

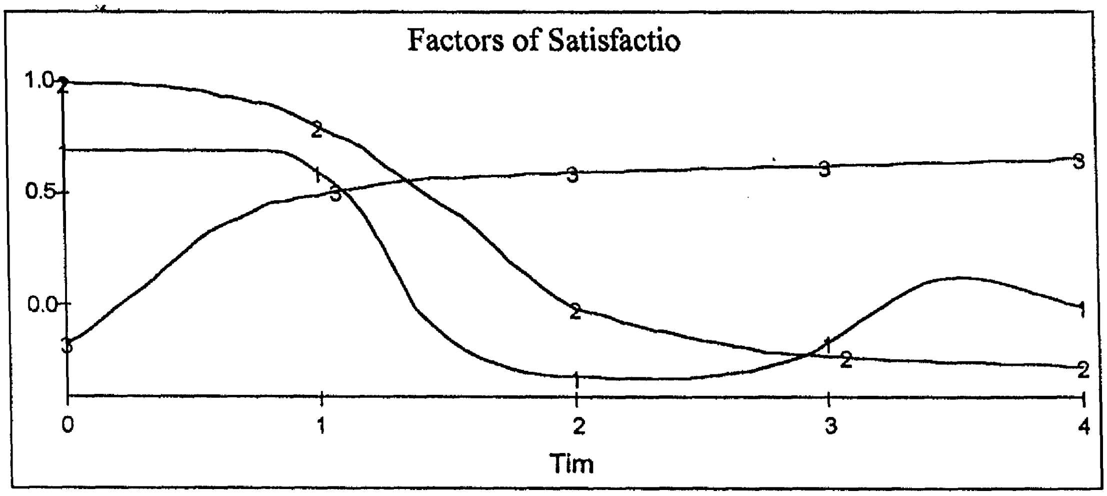


Figure 9.4 . Simulated results of determinant factors of satisfaction: due to contribution (due to rewards (2); and, due to ability (3) .

Indeed, as Line 1 in Figure 9.3 shows, total satisfaction with the programme was following a downward trend. Participants in the programme actually were still satisfied with the programme when news of the redundancy programme spread. However, before the first half of the year was over, satisfaction began to wane. This accounts for the second slide in motivation to participate (Figure 9.2). In this decline, the satisfaction due to contribution and to rewards prevented total satisfaction and the motivation to participate to recover despite the increasing motivation due to ability development (Figure 9.4). In fact, satisfaction due to rewards was falling as early as the first year, albeit, slightly. The novelty of the activities and the incentives were losing their effect on the members of the organisation as they begin to realise that these incentives did not correspond to their earlier expectations. At this time, there was little dissatisfaction with the rewards and incentives but this soon increased rapidly.

The graph of this satisfaction due to rewards (Figure 9.5) confirms the growing dissatisfaction of programme participants, even as they started out with very high satisfaction with the simple rewards that they received. The interviews revealed that the quality circle members began to be dissatisfied with the meal tickets[18] that each received for every meeting they held. They had suggested that the these be converted into cash so that they might have their food delivered by fast-food restaurants where food is better and offered more variety than "the same tiresome bland food" of the company cafeteria, or for those who aren't hungry, to keep the cash. Management rejected such suggestions keeping in mind the dictum of Deming (1986) and Crosby (1979) against financial rewards.

[18] These meal tickets were to be claimed for any food they chose at the company cafeteria.

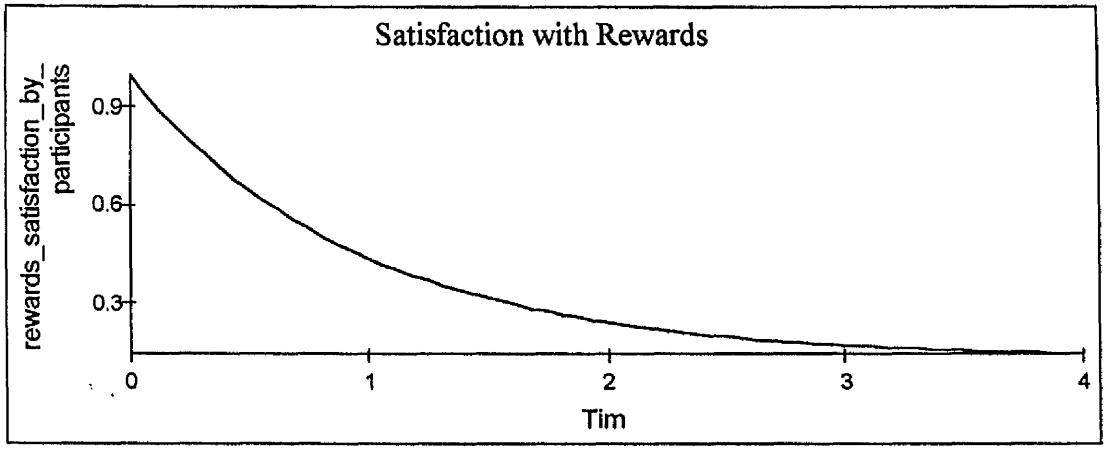


Figure 9.5 . Simulated satisfaction with rewards reflecting the comparison of actual and expected rewards .

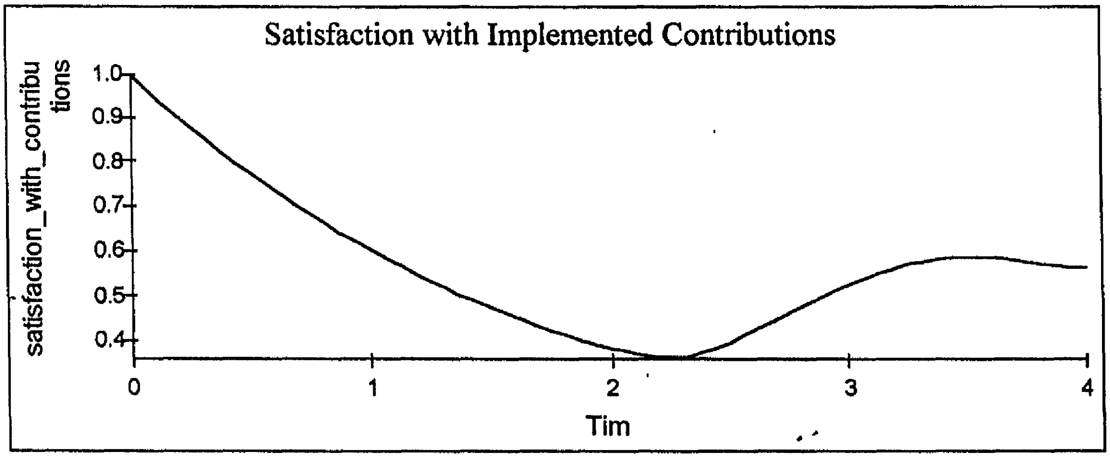


Figure 9.6 . Simulated satisfaction due to contributions ratio reflecting comparison . implemented projects and expected contributions.

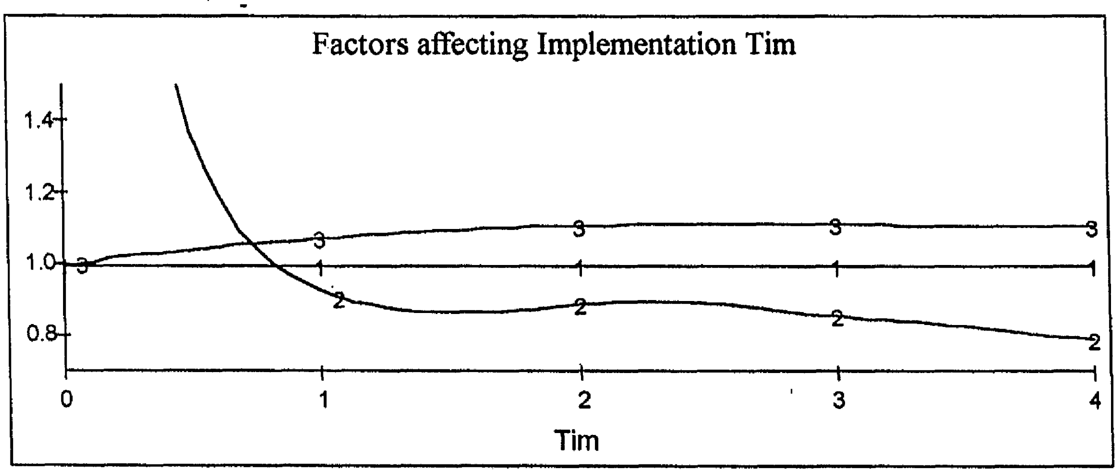


Figure 9.7 . Simulated results of the factors causing delays in implementation: due. to perceived budget availability (1); due to middle management involvement (2); an . due to perceived top management visibility (3) .

Another source of dissatisfaction was the amount of benefits received from the successful projects. A union leader opined that the quality circles were identifying projects that generated savings for the company, but to which the proponents benefited very little. He argued that even as the members were given some monetary reward for their efforts, the improvement resulting from the projects actually yielded cost savings over the entire life of the improvement project. Thus, the reward offered to the proponent was an insignificant fraction of the total savings derived from the project!

A third case of reward dissatisfaction was the reward package given to quality circles that represented the company in national conferences and competitions. As these members meet other quality circles from other organisations, they realised how little they received in comparison to their counterparts, who enjoyed more benefits and rewards.

Finally, the efforts in the quality programme were seen to be connected to the annual employee evaluation and the corresponding performance bonuses by the employees. Quality leaders, on seeing that others who aren't participating are receiving higher bonuses than active participants complained that their quality activities did not count in these annual reviews. Thus, although the incentives were initially seen as good and satisfying, its effects wore off as their expectations were not met by the actual rewards received. This is reflected by the slow, then rapid decline of satisfaction due to rewards (line 2 in Figure 9.4).

The other determinant factor of total satisfaction, which is due to contributions, similarly declined, although it showed a slight recovery later (Figure 9.6). The decline of satisfaction due to contributions reflects the high expectations that the employees had placed on their efforts. Their satisfaction is based on the actual implemented projects as compared with the expected contributions. This expectation does not consider the time delays between acceptance and final implementation of the projects. Thus, as the contributions or proposed projects need to pass through an evaluation process, as well as a planning and co-ordination for implementation, the implemented projects do not exactly match the expected contributions.

The mismatch between expected contributions and initially low implemented projects led to a declining satisfaction with contributions and decreasing expectations of contributions. The downward trend continued until the implemented projects became visible after the evaluation and implementation time elapsed. Decreasing expectations and the delayed visibility of past-proposed projects combined to increase the contribution ratio and its corresponding indicated satisfaction. At around the middle of 1995, the satisfaction due to contributions recovered. The contribution ratio and satisfaction due to it began showing signs of waning again at the start of 1996, slowing down its positive effect on motivation to participate.

Although the 100 percent availability of funds did not extend the implementation of projects (line 1 in Figure 9.7), middle and top management effects, indeed, delayed the projects, as indicated by greater than 1.0 values (Lines 2 and 3). These review and implementation times were further extended by middle management's reluctance to invest more time to these projects (Line 2 in Figure 9.7[19]). The initial threat that participation posed to their jobs caused this reluctance to implement projects. However, as noted above, this threat subsided as the participation levels went down and as top management continued to show its support. In addition, the perception of decreased perception of visibility of top management also contributed slightly to implementation delays (Line 3). As top management was perceived to be less visible, the perceived importance of implementing these projects also decreased. The facilitators noted that in many instances, projects that were formally presented in meetings were not acted upon despite the excellent analyses by the quality circles. One reason is the absence of the concerned top and middle managers who had direct responsibility for these work areas and are better able to decide on these matters. These delayed decisions prevented the implementation even after the circle had completed their tasks.

Through this time, perceived organisational support as the second determinant of the motivation to participate (Line 2 in Figure 9.3) was maintained at generally the same level. There was an immediate increase followed by a decline that reached into the first part of 1995, and then very slightly improved thereon. A closer investigation showed that the initial increase was due to the evidence of budget availability (Line 1, Figure 9.8). The evidence of ample budget for the programme improved the initially low perception of adequate budget support. Between 1992 and 1993 all the projects were generally appropriated for. However, the delays in implementation that began in 1995 were reflected on the lower

[19] Note that the graph has been cut off at the top and does not show the complete graph of line 2. However, it indicates that the implementation delays were largely due to middle management effects.

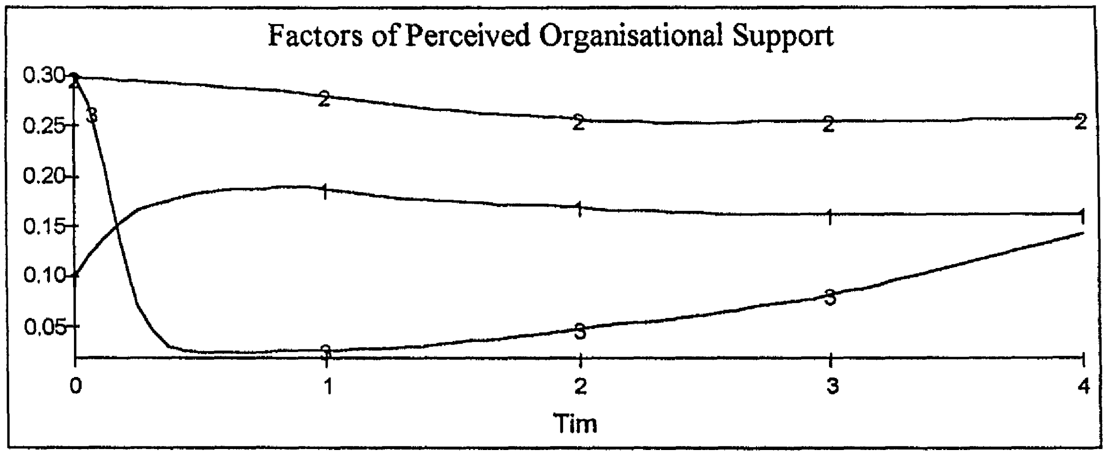


Figure 9.8 Simulated results of the factors that determine perceived organisational support: due to perceived available budget (1); due to perceived top management visibility (2); and due to perceived middle management involvement (3).

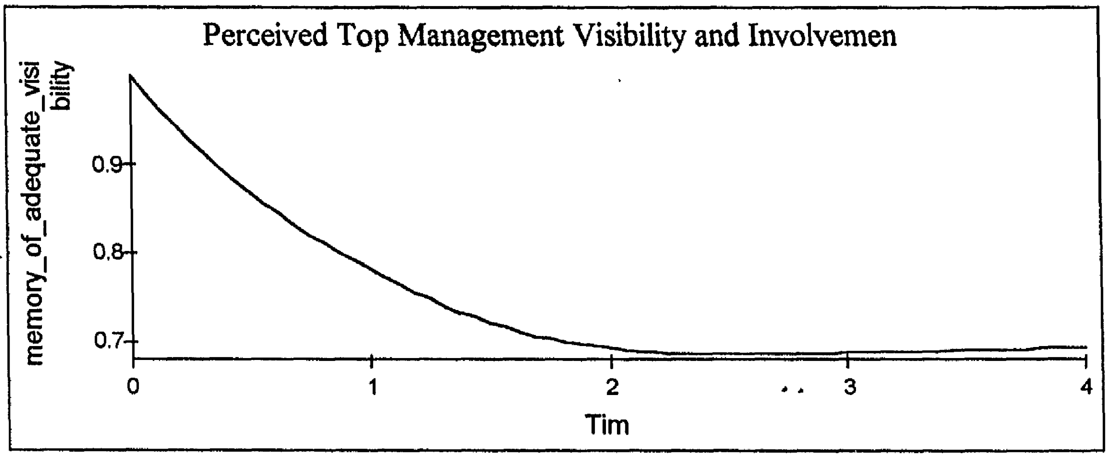


Figure 9.9 . Simulated perception of management visibilit

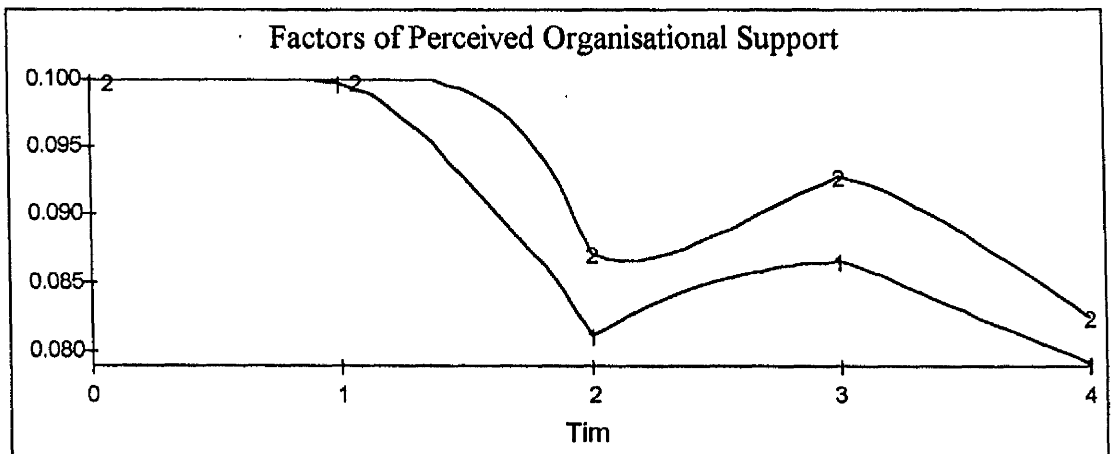


Figure 9.10. Simulated results of factors that determine perceived organisational support: due to available training (1); and, due to facilitation (2)

perception of funds availability as workers believed that the cause of rejected projects and delayed implementation was inadequacy of budget. Moreover the increasing dissatisfaction with the actual rewards received also suggested the insufficiency of funds. Thus, even as the manager for TQM was satisfied with budget provisions and the generosity of top management, workers seemed to doubt their financial support. Thus, perceived budget availability was slightly declining from 1994 (time 2) onwards as shown by line 1 in Figure 9.8.

Top management visibility (line 2, Figure 9.8), as the weightiest determinant of perceived support similarly showed a declining trend, despite the claims of top management to have been providing the same amount of time to the programme. In the interviews, they had cited their constant and regular attendance in all quality related activities, and took time to speak to quality circle members. However, the perceptions of employees appeared to be different as indicated in the survey that revealed that only 14 percent of the respondents were very satisfied to extremely satisfied with top management visibility. One quality circle leader even pointed out the analogy of the top managers as a father and head of the family who has to keep in touch with his family despite work and other pressures. The increasing demands and expectations of workers can explain the discrepancy with employee perception and actual time devoted by top management to the quality programme on its top management. These demands increase as their numbers and their projects increase. Thus, the fixed available time of management is seen as diminishing.

A second explanation of this low perception of top management visibility is the uneven involvement of the company's top management. The workers and quality circle leaders reported some personal observations of each member of top management that suggest each is not totally supportive of the programme. This was further accounted for by TQM staff who similarly observed other management team members' lack of concern for the programme[20]. Finally, the head of the TQM Working Committee indirectly admitted that there are indeed some differences of opinions within top management as he confided that "full consensus is not always possible in organisations." (Agustin, 1996). Thus, consensus can affect perceptions of support. The simulated perceived top management visibility and involvement is shown in Figure 9.9.

The third factor of total perceived support is based on middle management involvement. It started with a sharp decline and slowly recovered (line 3, Figure 9.8). The large turnout of workers who joined the quality circles coupled with the neglect to prepare middle management for their roles in the programme aroused a feeling of insecurity among these managers. Thus, their avowed commitment conflicted with their willingness to devote more time to their subordinates who are members of quality circles. As the threat to their authority diminished with decreasing participation, and top management showing its complete support to the initiatives, the middle managers began to devote some time but not completely to the demands and needs of the circles. This was reflected in the improving perception of support coming from the middle managers.

The work of the TQM staff accounted for two perceived support factors: training and facilitation (Figure 9.10). The work resulting from the large turnout of

[20] It may be interesting to note that the TQM staff claimed that their Japanese senior vice president was one of those managers who were observed not being supportive to the programme! To this

66 percent of the organisation who decided to join quality circles was sufficiently handled by the initial 11 staff members assigned to the quality programme. This was evidenced by the training and facilitation ratios that were both greater than 1.0 as shown in Figure 9.11. Despite the additional participants the following year and the reassignment of two of the TQM staff to other functions, the ratios still showed rather high values, albeit with a downward trend. This decline continued to 1994 as the staff was reduced to four, then three members.

Even from the beginning of the programme, the staff had increasing work pressure (Figure 9.12), as the demands of the job were greater than the available time. The demands were kept at around 1.5 times their available time. During the entire simulation time, the TQM staff began to perceive top management as being less supportive to them (line 2 Figure 9.13). The head of this group noted that the president became less involved with the programme. Where before, he took time to review progress and note down memos, his presence was felt less and less as the programme progressed. At this time though, the middle managers were observed to be more involved, although still at a lower level. In sum, the fewer TQM staff coupled with increasing work demands and pressure and a perception of a less supportive top management resulted in a lower motivation to encourage the holding of meetings. The slight recovery was due to the declining participation levels and number of projects.

In contrast to the positive momentum of the participation level, indicated projects initially declined and recovered only at time 2 (1994). The simulated values

Japanese, everything is all work (Cinco, 1996).

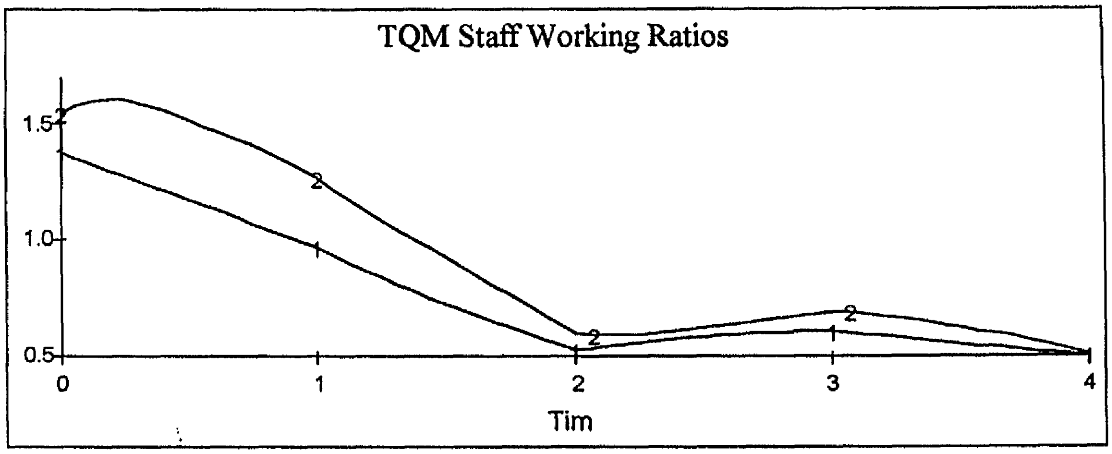


Figure 9.11 . Simulated results of TQM staff work comparing actual time and TQM participants needs: training ratio (1) and facilitation ratio (2) .

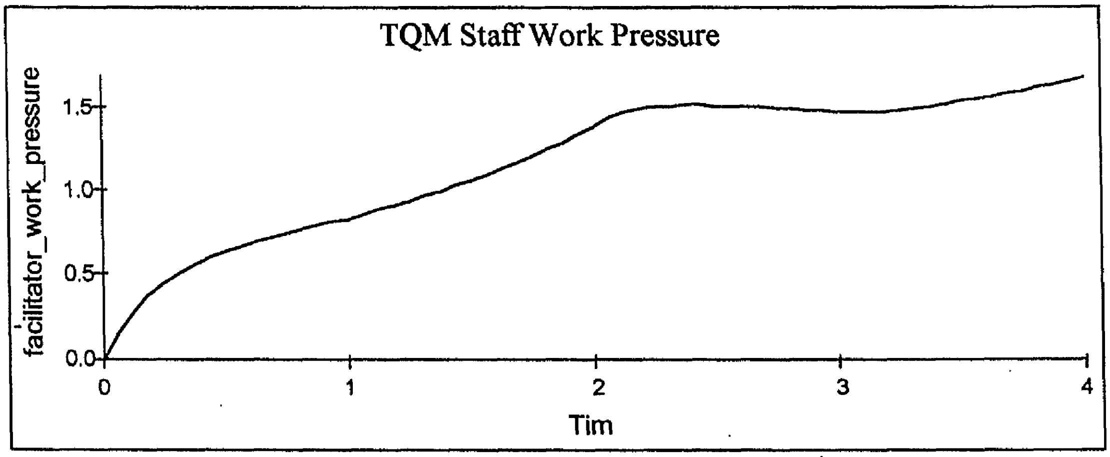


Figure 9.12. Simulated TQM staff work pressure as a comparison of available time and .. required time from TQM activities and participants.

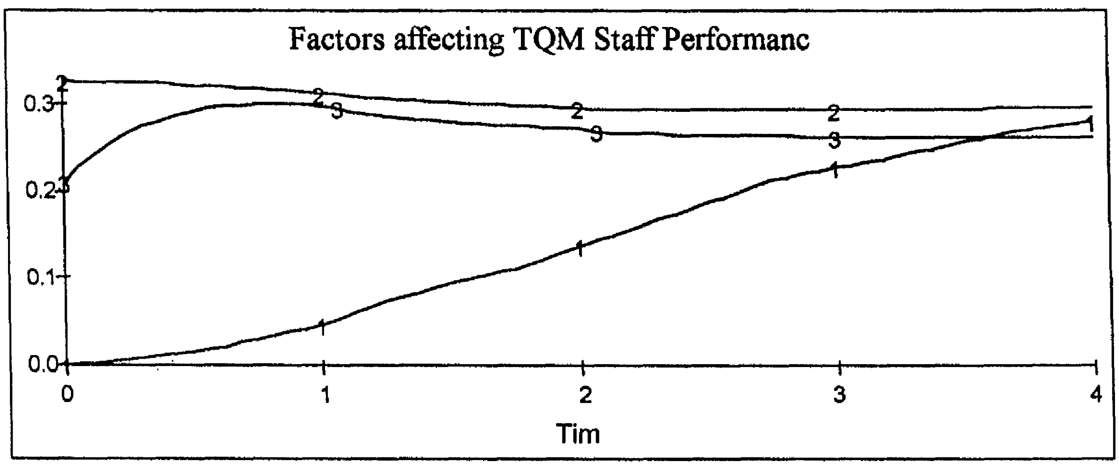


Figure 9.13 . Simulated factors affecting TQM staff performance: due to perceived .. middle management involvement (1); due to top management involvement (2); and, due t budget availability (3) ..

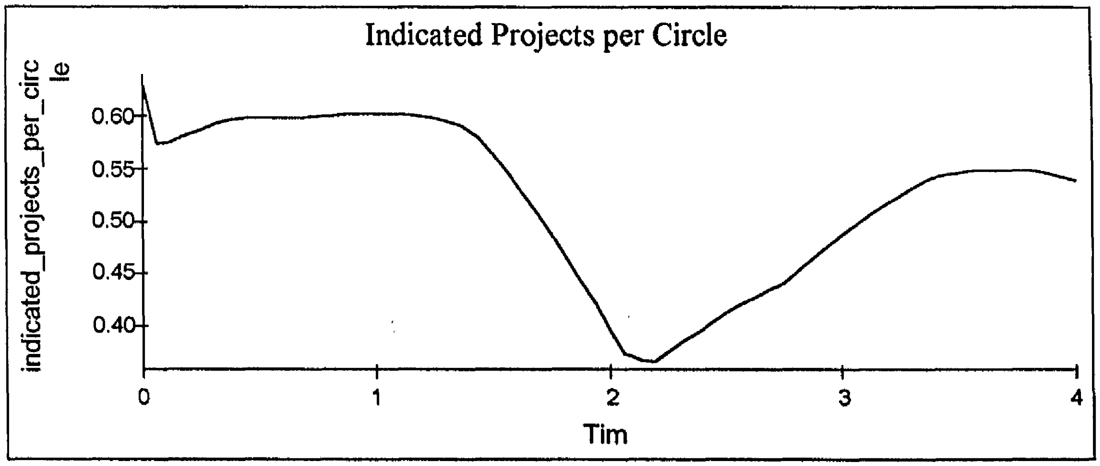


Figure 9.14 . Simulated results for indicated projects per circle

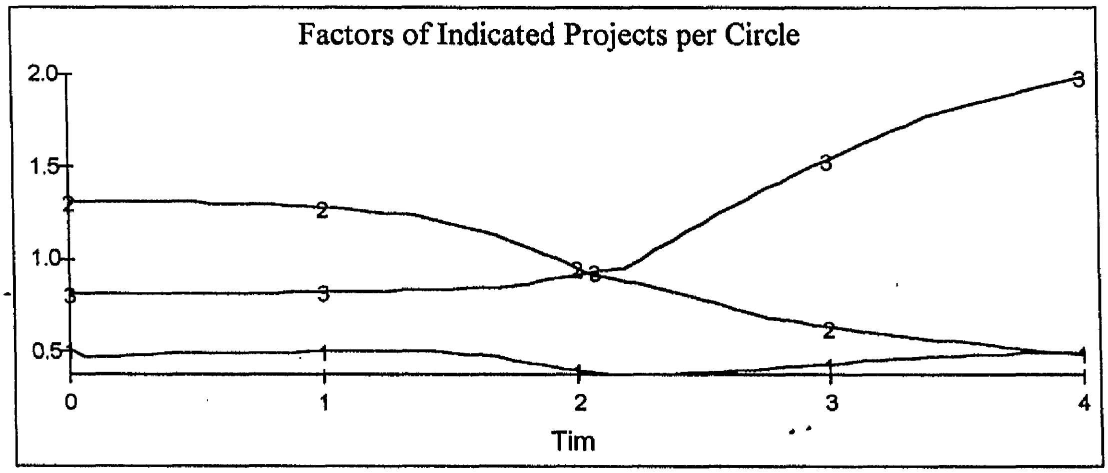


Figure 9.155. Factors that determine the indicated number of projects per circle: . percentage meetings held (1); effect of ability and difficulty on the identification .. and solution of new projects

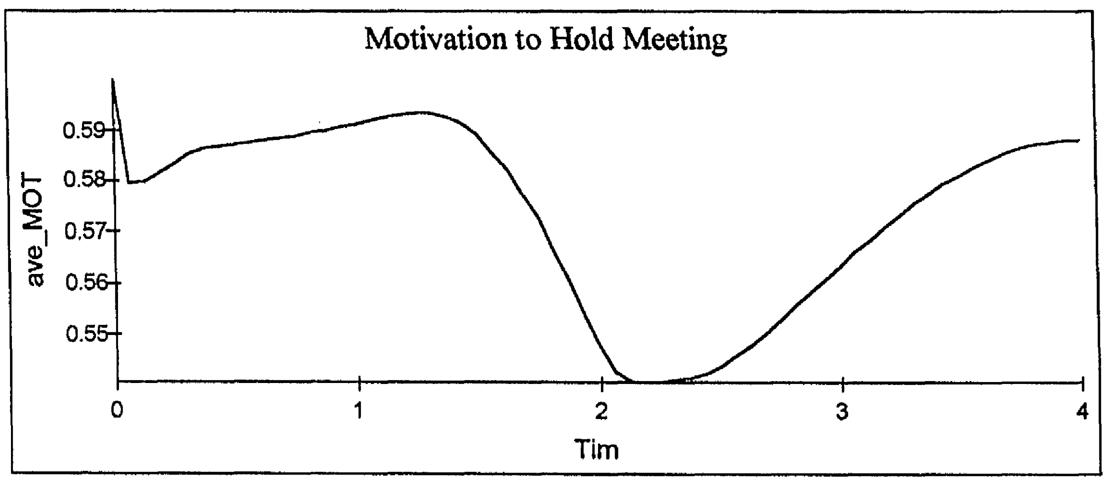


Figure 9.16 : Simulated results for motivation to hold meetings

in Figure 9.14 similarly showed some trends although there was an immediate decline that recovered. In the first years, the effects of difficulty (line 2) and ability (line 3) did not have much drastic effects on indicated projects, as revealed in Figure 9.15. The effects of difficulty and ability were largely constant during the starting year so that the shape of behaviour was mainly due to percentage meetings held. After year 1, ability began to increase due to both the TQM staff efforts and learning through experience.

Throughout 1994, the effects of difficulty were more considerable than the improvements in ability so that the combined effect is to pull down the indicated projects. Thus, the training was focused on improving problem solving skills and the use of specific tools and techniques. In fact, the circles themselves began requesting more training on other tools. The TQM staff noted that:

> They (Excel participants) seem to mature now and have realised the importance of these tools. Secondly, they must be dealing with more difficult problems than they used to, requiring them to act and think more systematically in their brainstorming sessions. (Cinco, 1996).

The success of the training and facilitation efforts may be seen from the large improvement in ability. By 1995, the rate at which ability was increasing appears to be offset by the effect of difficulty (Figure 9.15). In this case, the net effect was a positive trend.

These factors' effects are coupled with the behaviour of percentage meetings held (line 1 in Figure 9.15 and Figure 9.16). Indeed, the percentage meetings held reflect much of the V-shaped behaviour of the indicated projects. After the initial fall, the percentage meetings had a slight increase in the first quarter of the

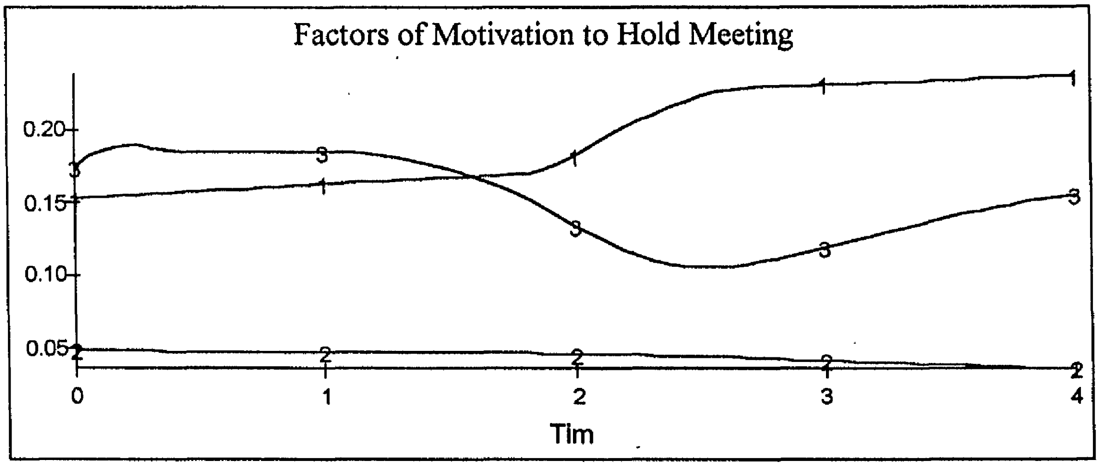


Figure 9.17 Simulated results for factors affecting the motivation hold meetings: due to ability (1); due to rewards (2); and, due to contributions (3).

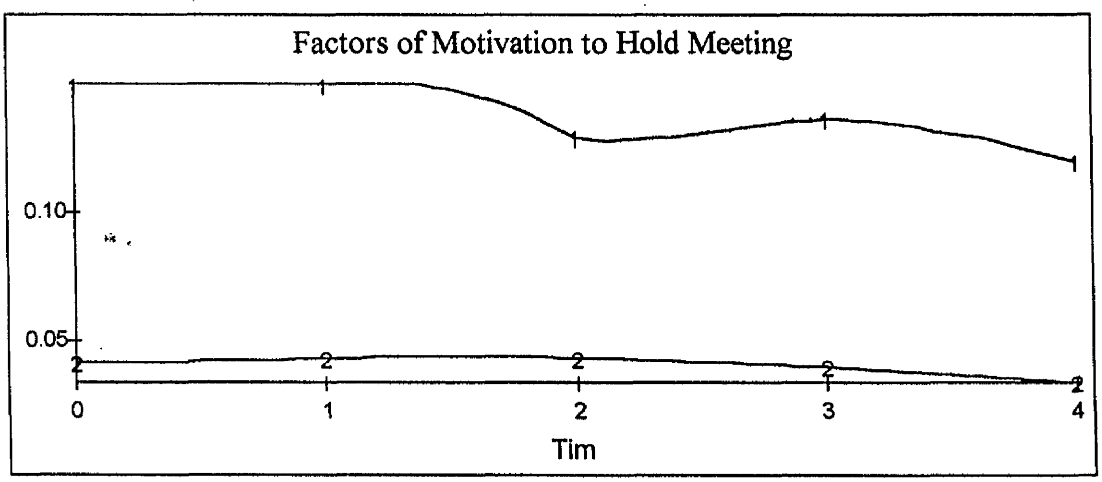


Figure 9.18 Simulated results for factors affecting the motivation hold meetings: due to facilitation (1); and, due to bandwagon effects (2) ..

simulation. This is due to the increasing level of ability (line 1 in Figure 9.17), as well as the initial reaction of motivation due to contributions (line 3).

During year 2, percentage meetings began to fall due to the three factors. The failure of actual incentives to match expectations (line 2) contributed to loss of motivation to hold meetings. Similarly, the pattern was marginally decreasing but began to steeply fall at around year 2 (1994).

The motivation due to contribution also fell in 1993 due to initial high hopes of contributing to the improvement programme. As mentioned earlier, the inherent delay from the proposal of the projects to the implementation, and complicated by middle management and top management visibility, caused a mismatch between expectations and implemented projects. This caused disappointments that de-motivated the participants from holding meetings between 1994 and 1995. Towards the beginning of 1996, the motivation to contribute recovered, as past projects became visible with implementation. This helped increase the number of meetings held.

The motivation due to facilitation (line 1 in Figure 9.18) was at a constant high value until 1994. This reflected the number of staff involved in organising and supporting quality circles activity. The eleven TQM staff members, who were soon left by three members in 1993, had sufficient time to provide the necessary support and advise to the fledgling quality circles. However, the reorganisation in 1994 decreased the number of TQM staff from eight to four and transferred much of the facilitation task to some line managers and supervisors. Since facilitation was a secondary task to these personnel, less facilitation and support was provided to the circles. The four TQM staff, who soon became only three, still tried to find time to support and help the circles as much as they can. The slight recovery in 1995 actually reflected the decreasing number of quality circles and thus represented less work for the dwindling staff.

Finally, the only factor that motivated the quality circles to hold meetings was the level of ability. They were encouraged, even excited, to apply their new found knowledge and skills to actual problems in their work area. The use of Pareto analysis, fish bone diagrams and brainstorming techniques were exciting ideas that they wanted to put into practice. This motivation to learn never seemed to wane throughout these years. The interviews indicated that they are still willing to learn newer things. One quality circle leader even pointed out that the training given to them is not sufficient and that they feel they need more detailed training on these and other tools.

In sum all these dynamics, as they influence the two determinants of total projects, are reflected in the behaviour of the generated projects. In other words, the behaviour pattern of total projects is not simply explained by a single or a set of variables but also determined by their interactions and interdependencies.

9.5 Summary and Conclusions

In the preliminary parameter sensitivity simulation runs[21] prior to behaviour reproduction, it was observed that the model was behaviourally insensitive to parameter adjustments. However, it was found to be numerically sensitive to some variable changes and which have a number of general consequences. First, the initial conditions dictate much of the behaviour of the system in its first few years. Depending on the perceptions and satisfaction with past experience, the level of participation, percentage meetings and held and total projects generated can have a positive or negative slope. In addition, the starting level of participation determines the rate of change in its succeeding levels as well as the resulting peak. Moreover, the tests also analysed the effects of variations in the level of factor inputs or resources. It was shown that the level of these inputs directly determines performance of the system variables.

The details of the case study in this chapter confirm these previous observations to a certain extent. The initial success of the programme as indicated by the upward trend in the levels of participation, indicated projects, percentage meetings, and total projects are shown to have been mainly due to the soundness of the starting organisational conditions. As pointed out earlier, the amount of effort in promoting and supporting the programme at its pre-implementation stage has yielded these positive results.

Even the huge turnout for initial participation did not tremendously affect the level of perceived support derived from training and facilitation. This is evidenced by the training and facilitation ratios which were greater than 1.0[22]. The availability of these resources was apparently made possible only because of the number of TQM staff. Hence, there was more available staff to provide for the higher training and facilitation requirements. Unfortunately, the company did not see these benefits of a bigger TQM staff and continued to allow the reduction of its number to four, then three[23].

This last point suggests the role of continued support through the allocation of resources. In a real case, the allocation of resources is not actually kept constant as other events or concerns[24], apart from the allocation policy itself, tend to impose their effects on the level of these factor inputs. In the final analysis, it is the availability of these inputs that can have a direct impact on the behaviour of the most important variables of the system as indicated by preliminary runs discussed in Chapter A3 and A4.

Apart from the reduction in TQM staff support, the level of rewards was also not up to the expected levels. The case replicated the growing discontentment with

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[21] These simulation tests are shown and discussed in detail in Chapter A3 and A4 in the second volume.

[22] This was largely in contrast to the results of Chapter A4, where increased participation at the outset sharply diminished and depleted the available training and facilitation resources.

[23] According to the recruitment and training officer, the inability of top management to recognise the importance of the TQM staff to the implementation efforts was more recently (in 1996) demonstrated in the acceptance of the resignation of one of the two remaining members of the staff. The company offered an early retirement plan to reduce its workforce and this staff member decided to avail of programme as she was becoming disillusioned and getting tired with her job, and it afforded her with some substantial monetary benefits. The training and recruitment officer argues that management should not have accepted such a resignation without considering the workload of the TQM staff. He points out that management is concerned with the cost reduction it entails, as a replacement staff will surely have a lower salary scale. However, it does not consider the adjustment and learning time required for this new recruit to reach peak performance.

[24] The policy determining the level of the resource input was not studied mainly because of top management's avowed support and commitment to the programme. Nevertheless, the policies that determine these levels seem to be outside the assumed boundaries of this research. The present study

the rewards scheme. The simulation showed that, indeed, this dissatisfaction affected the motivation to participate.

These two variables, TQM staff and rewards, contributed to the decline of the main variables. Their effects were slightly delayed as the realisation that the actual resources do not match the expected or, required resources involved an adjustment process. In reality, perceptions do not change automatically but do take time, as they consider past actions before being convinced with current performance or events. It takes some time before the intangibles are translated to more observable behaviour. One quality circle leader enumerated a number of instances that indicated their dissatisfaction with the organisation's top management, and asserted that "we are giving them (top managers) two more years to prove their commitment. Otherwise, we will stop participating in this programme. We have had enough of this charade!"

Judging from the facts of the case, top management has been totally focused on the launching of the programme so that all necessary resources had been properly allocated. However, the actual implementation seemed to have been neglected, perhaps as a belief that the re-launching effort is the only important activity that can support the programme. Moreover, it may have been thought that the programme once re-launched can manage to be on its own thereafter as participants then understood the principles behind the programme and the roles they were to play.

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does not include the cost reduction and profit generation sectors of the organisation where the policy regulating the factors most likely reside.

This reasoning is largely similar to the virtuous circles that the TQM advocates have claimed: that workers want to participate and all they need is an opportunity to make their contributions (e.g., Sneddon, 1995). That is, once the opportunity has been offered a virtuous circle of participation and satisfaction will sustain the programme. Indeed, the TQM engine identified in this research is made up of three reinforcing loops. Once the ability variable is triggered, it pushes the other variables towards a higher performance. What has not been realised is that ability is directly triggered only by the activities of the TQM staff. Hence, by reducing their number, the trigger on ability is correspondingly made smaller! On the other hand, the opportunity to contribute involves more complex dynamics before it is able to trigger these reinforcing loops.

Secondly, the immediate effect of success could have given top management the evidence that they can leave the running of the programme on its own. This impressive starting performance did not indicate any problems nor any undesirable events, so that they may have assumed that everything has been done in the right way. Indeed, the earlier simulation runs showed that initial performance is due to launching efforts.

However, the measurement system does not register many of the important intangible determinants of the tangible variables. Much of the dissatisfaction and failings of the system are not immediately reflected in the performance indicators. Thus, as in the case of declining satisfaction due to rewards, as well as due to contributions, these are left unnoticed until their impact on the system become apparent. The simulations show that the dissatisfaction began even at the outset of the programme but their impact were reflected in participation, indicated projects, percentage meetings, and total projects only in the third year, 1994.

Thirdly, top management might not have been aware of the increasing demand for their attention. The interviews with quality leaders justified their requirements from top management by directly quoting from the lectures and seminars they attended. They mentioned points such as "80 percent of quality problems are due to the system, and top management is responsible for the entire system"; "top management support and involvement is necessary for the programme"; and that "our employees are our number one asset". In these interviews the participants have focused on top management's decreasing visibility and involvement. On the other hand, top management asserted that they have not decreased their involvement and support for the programme and had been giving the same support since the start of the programme. These conflicting views suggest workers only perceive top management's visibility and do not measure it. What the participants see is relative to the amount of required time from top management. Thus, as demand for attention increases through more participants, more activities and projects, the same amount of time allocated by top management is perceived to be less. There is less time spent for each project and for each circle, and there is a perception of decreasing support despite the same amount of time allocated[25].

[25] These points do not discount the increasing attention that other projects require. The Chairman of the TQC working committee, who is also the VP for Logistics, was complaining to this researcher about his increasing workloads other than his regular job and TQC responsibilities. He was also tasked with other projects including the building of a new facility in another city. It might even be suggested that as workers see that their top managers are involved with other projects, they (workers) would tend to relate this to decreasing time with the TQC programme.

These circumstances highlight the difficulty of managing the intangibles of the system, mainly as this is undertaken indirectly through the allocation of resources. The preliminary experiments of Chapter A4 indicated that reducing the resources have a negative impact on the entire system. It is only a consistent and fixed level of resources that can help sustain the improvements derived from the success at the beginning of the programme. In fact, this constant show of support through resources can reverse the negative initial conditions. However, the time element involved separate actions from their intended results and the corrective actions may prove too late to improve on the conditions.

A more specific point that makes the managing of the programme more difficult is that the details of the performance do not actually reveal the underlying trends. Focusing on the detailed fluctuations and changes in graphs may have an effect on the way the system is being managed. For instance, the recovery of the participation levels in 1995 obscures the declining trend indicated in the simulation. This improvement could have given top management an assurance that the problem in 1994 has been resolved. At the 1996 annual review, the declining trend caused some anxiety on top management and was the focus of discussion. Apparently, the problem was not addressed in the previous year. The interviews with various personnel regarding their dissatisfaction with rewards attest to this.

What distinguishes this case from the theoretical cases analysed in the initial runs is the reason for the decline. In those experiments, the ideal and consistent allocation of resources sustained the programme until the difficulty set in and began to erode the success of the system. In the present case study, the allocation of middle manager commented in one interview that "on the surface everything seems to be well. But underneath, something wrong is happening that management cannot see."

The next chapter focuses on the policy design to identify leverages to sustain and prevent the declining behaviour.

CHAPTER 10
POLICY DESIGN AND BEHAVIOUR IMPROVEMENT: SEARCHING FOR SUSTAINABILITY

The ultimate objective for efforts to understand a problem is its resolution. After recognising the parts that lead to the problem behaviour, efforts are then focused on identifying ways and means of improving such behaviour. This is accomplished through policy analysis and design. This involves applying a variety of approaches ranging from simple parameter changes or modification, to the more complex task of modifying the feedback structure. The present chapter deals with using these approaches to improve on the observed problem of declining participation, indicated projects and total projects.

It was earlier suggested that the TQM programme's goal of continuous improvement is closely connected with its sustainability, and the declining patterns of behaviour indicate the inability of most TQM initiatives to keep their programmes continually active. Thus, the process of behaviour improvement is directed towards a search for sustained existence of the programme, indicated by a stable equilibrium in the system.

The model developed in this research suggested that there are inherent feedback loops in the system that can create the decline patterns other than those typically ascribed to in literature. In the present model, top management participation has been restricted to its visibility and direct participation in the programme. But its commitment to the programme is indicated and implied by the fixed resource allocation, and is assumed not to be affected by even an unfavourable performance of the system. Still, the simulated behaviour floundered and eventually, the main system indicators declined toward zero[26]. These simulations, therefore, demonstrate that top management is not solely responsible for these undesirable behaviour patterns. The interaction of the variables and the feedback loops account for negative consequences that limit the growth of the programme even in the its most ideal form. Analysing and understanding these initially dormant loops can provide the key to finding a resolution to the seemingly inevitable decline of the programme.

This chapter presents some attempts to control and prevent the observed downward trends. The first part of the chapter deals with a scenario analysis and re-constructs the case study with apparently better implementation strategies. It is mainly concerned with the short-term declines occurring during the programme's first ten years. The second part involves a more detailed analysis of the feedback loops and causes of the longer-term decline observed in Chapters A3 and A4, and attempts to introduce new structures to improve behaviour. The chapter concludes with a comparison of these approaches and their managerial implications.

10.1 Some scenario analysis - short term perspectives

This chapter deals with some 'what-if' questions regarding the implementation strategy in the company case study. The tests in this section are concerned with confirming the undesirable behavioural effects of the problem causes suggested in the preceding chapter. This is undertaken by comparing alternative scenarios that correct the suggested root problem with the base case

[26] The longer theoretical runs in Chapters A3 and A4, in contrast to the runs in Chapter 9, actually showed the main indicators moving towards, if not reaching, the zero value.

results. It is expected that eliminating a real problem cause should bring more favourable results. Moreover, the tests also confirm the implementation decisions and moves made by the company. In other words, the tests attempt to show if the company could have performed better if it adopted a different strategy.

This section improves on the system's weak points identified in Chapter 9. Coupled with some knowledge of the system's sensitivity to these parameters, as documented in Chapter A4, this section tests these ideas by inputting the more ideal conditions. Five sets of experiments are presented in this section.

10.1.1 Fixed TQM staff

The reduction in the number of TQM staff was seen by the interviewees to be an apparent cause of the decline of the main indicators of the system. It led to greater workload and pressure, which in turn, lowered the perceived support due to training and facilitation, and the motivation to hold meetings. Furthermore, the limited available time slowed down the development of ability. These points were taken from the perspective of the remaining TQM staff who had become disillusioned by growing workload and top management's lack of attention to their plight. This section tests the scenario that assumes a fixed number of TQM staff.

Figure 10.1 shows the results of the simulations that inputted a fixed staff of three, five and ten members (lines 2, 3 and 4, respectively). Total projects and

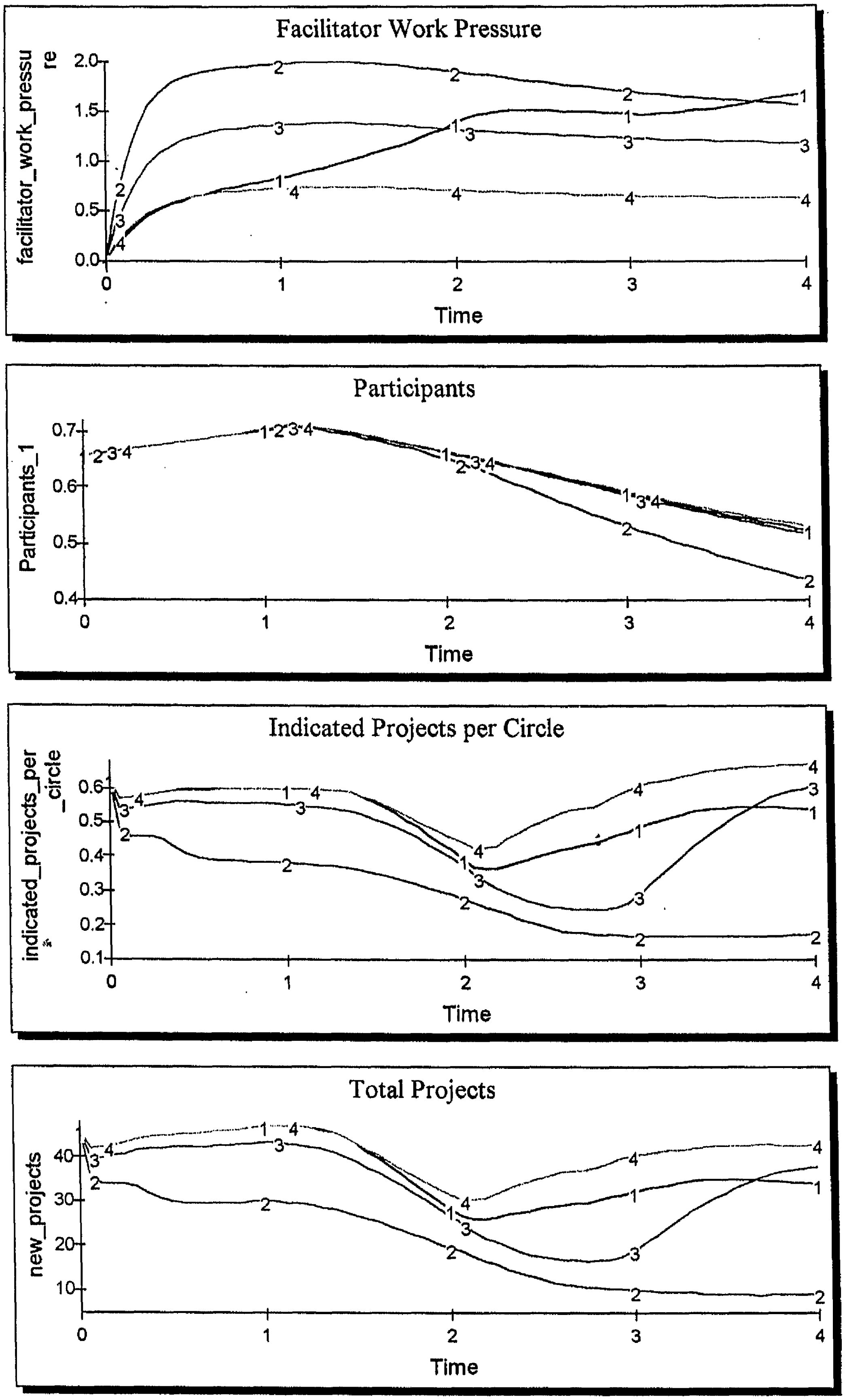

Figure 10.1 : Results from the keeping a constant number of staf

indicated projects immediately fell when only three staff members were assigned. This was caused by a huge drop in facilitation activities that support and encourage quality circle meetings. In addition, there was less training to sufficiently develop and improve ability.

As the number of staff was increased, the behaviour of total projects and indicated projects approximated that of the base run (line 1). But the main impact of a fixed TQM personnel with 10 members is visible only in the second part of the simulation at around time 2. Table 10.1 shows that with this number of staff, there were 15 more projects than the base run. The additional staff members encouraged a greater number of projects from the participants as average indicated projects rose from 0.52 to 0.58.

Table 10.1. Comparison of results from TQM staff experiments.

TQM Staff	Total projects	Average motivation to participate	Average Indicated projects
base run	150.46	0.11	0.52
3 members	83.05	0.06	0.29
5 members	131.30	0.10	0.46
10 members	165.30	0.11	0.58

The table also highlights the minimal effect of an increased number of staff members on the level of participation. The second run is an exception. The resulting level of participation fell faster than the other runs because the slower development of ability significantly affected the motivation to participate.

10.1.2 Increasing top management time

Chapter 9 also reported that top management was perceived to be less visible and involved in the later years of the programme as compared to its presence at the programme's initial years. The simulations as well as the actual interviews bore this out. In particular, the TQM staff complained about top management's decreasing commitment to the programme. They had claimed that lack of top management support affected their own performance and efficiency. Thus, a scenario with more management time is tested and compared with the base run.

The results of the simulation in Figure 10.2 indeed shows the increased top management time had some positive effect. The motivation to hold meetings due to facilitation improved as top management time was increased from two hours per month to three and four hours per month (lines 1, 2 and 3, respectively). However, this change is marginal and its ultimate effect on total projects was rather low. Table 10.2 indicates that the additional number of projects generated by more time by top management was only three projects over the five years, which is less than one extra project per year. The level of participation was almost unchanged except for a tiny improvement in the slope, which was only visible after time 3.

Table 10.2. Comparison of results of top management time experiments.

	Total projects	Average motivation to participate	Average indicated projects
Base run	150.46	0.11	0.52
3 hours/month	153.66	0.11	0.53
4 hours/month	153.75	0.11	0.53

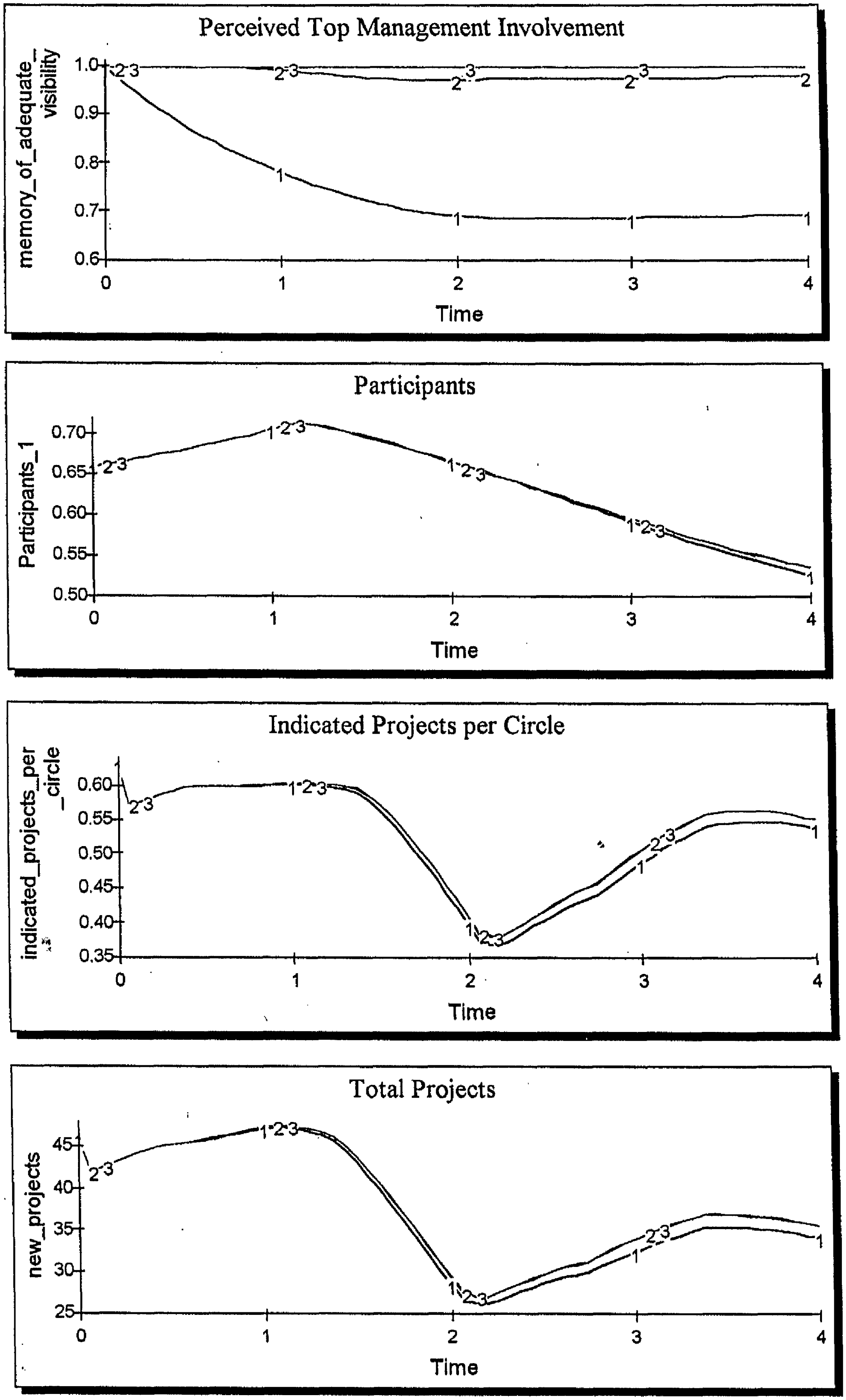

Figure 10.2 Results from increasing top management time

10.1.3 Increasing Rewards

The problem that was made more visible by the simulations is that of inadequate rewards. The training programmes coupled with the more apparent display of top management support at the outset of the programme may have been very successful not only in introducing the programme and encouraging employees' participation but also with raising their expectations of the rewards they can gain from these programme. It was also suggested earlier that the novelty of programme had a positive effect on the expected satisfaction due to rewards. But as the time progressed, the actual rewards compared with their expectations eroded this satisfaction. A scenario that assumes doubled rewards is tested here.

Figure 10.3 shows the result of the simulation with line 1 as the base run and line 2 as the doubled rewards. The increased value of the rewards pushed the total projects and indicated projects upwards but still maintained their general shape. Further investigation of the other graphs showed that doubling the rewards effectively removed the declining trend in the motivation due to rewards so that the level of motivation was maintained at its initial value of 1.0. The other variables were not significantly affected by this change in rewards. Thus, the constant upward shifts of total and indicated projects were solely due to the rewards motivation that did not fall.

In contrast, the participation level was affected in a different manner. The effect was concentrated on the decline side where the rate of fall was arrested. Because of the effective removal of the decline in rewards satisfaction, total

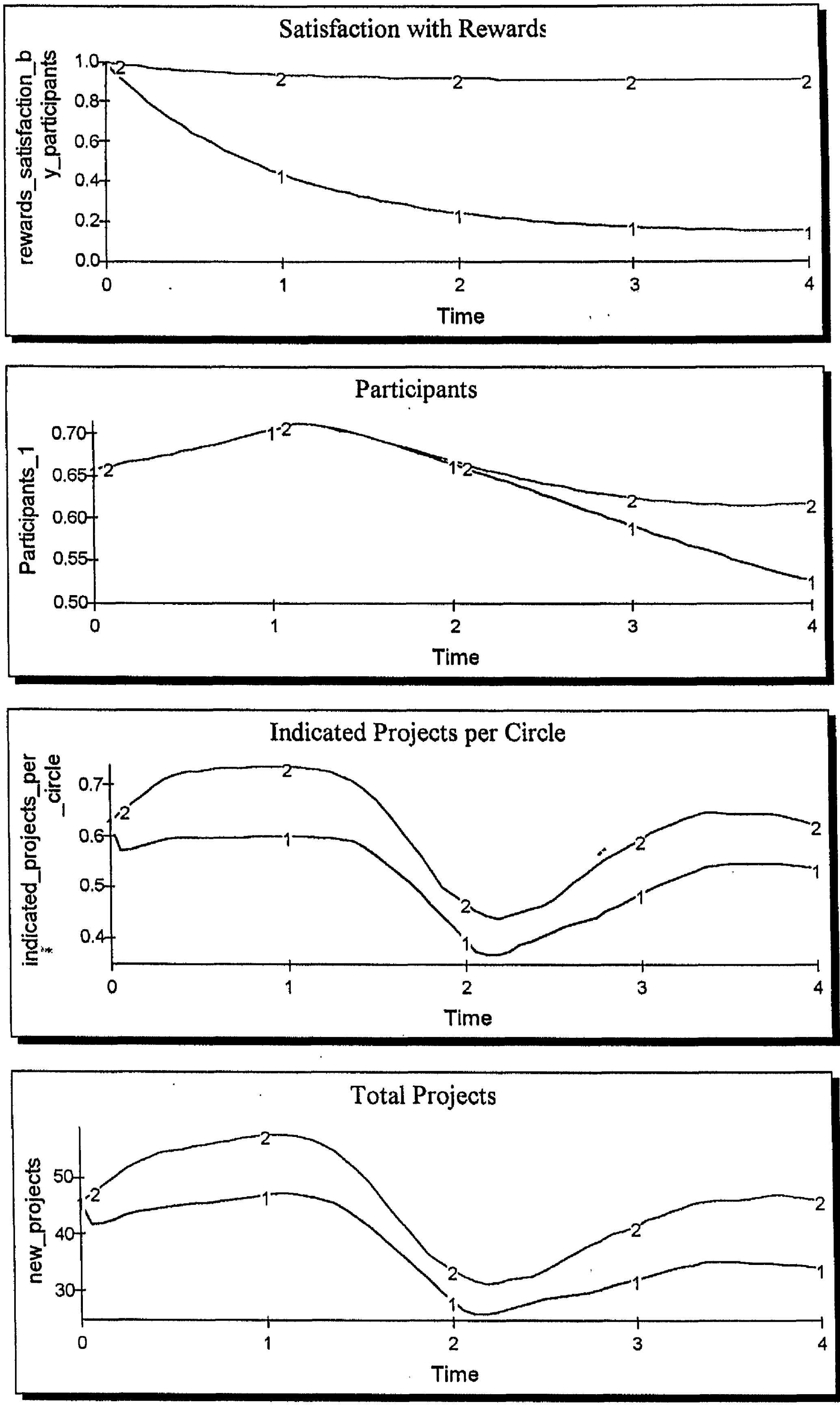

Figure 10.3 Results from doubling the rewards s

satisfaction improved on the earlier decline. The effect of this was to stabilise motivation to participate. However, the motivation to participate still reflected a trough, which was due to job insecurity. This negative effect of job insecurity halted the increasing trend in percent participation.

Table 10.3. Comparison of results from doubling the rewards

Actual Rewards	Total projects	Average motivation to participate	Average Indicated projects
4	150.46	0.11	0.52
8	184.46	0.37	0.62

The table above highlights the positive impact of increased rewards. The average motivation to participate was three times its value in the base run and explains the higher percentage participation. The test also encouraged the identification of more projects per circle.

10.1.4 No retrenchment

The effects of doubling the rewards were limited by the negative impact of job insecurity on motivation to participate. In practice, the negative effects of a retrenchment programme can be avoided. An official pronouncement of the details of this programme could be made before unconfirmed rumours cause unnecessary tension among the workforce[27]. These pronouncements may include some assurances that those who are effective workers need not worry about being fired. This section tests the base case without the negative effects of the retrenchment programme on motivation to participate.

Figure 10.4 shows the result of removing these deleterious effects on motivation to participate. Line 1 is the base case, and line 2 represents the secure-job experiment. The intended effect of improving participation is achieved as shown by its positive slope. However, even as there are more participants, a decline was still registered. This fall was due to the low satisfaction due to rewards.

Thus, a third run included the assumption that the rewards were doubled. This is represented by line 5 in the second graph of Figure 10.4. This time, the participation level kept on increasing. A closer inspection of total satisfaction showed that it fell in time 2 because of the satisfaction due to contributions. This behaviour was left unnoticed in earlier simulations because the effects of rewards obscured it. In any case, the effect of this slight fall was even slighter in the motivation to participate (line 3 top graph, Figure 10.4).

On the other hand, increased job security had some rather counter-intuitive effects on total projects and indicated projects. The increased number of projects yielded with improved job security has a proportional effect on workload. But higher workload diminished available time and resulted in less motivation due to it. This is reflected on the lower percentage meetings held and indicated projects starting from time 2 (line 5, third graph). Total projects, however, registered a greater number before time 2 owing to increased participation (line 5, bottom graph).

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[27]This was done in Company B. It assured members of the organisation that those whose services will be terminated will undergo special training of their choice to prepare them for other jobs in other companies.

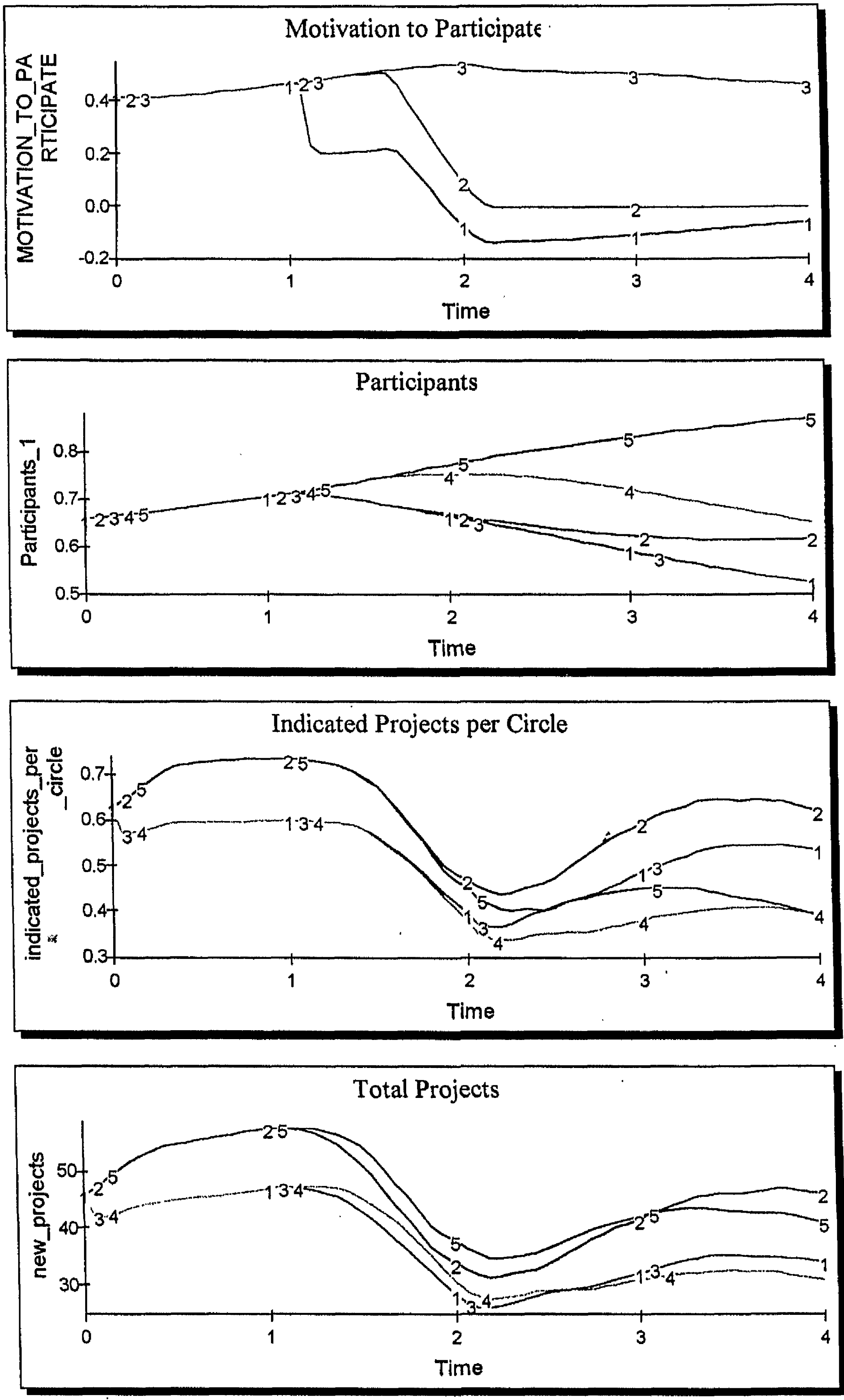

Figure 10.4 Results from no retrenchment and doubling the rewards

The doubling of rewards had a similar effect on percentage meetings held, indicated projects and total projects. It pushed the graphs at an almost constant value. A notable point about line 5 in the third graph is the decline at time 3. This was due to a further reduction of motivation due to facilitation and contribution. The comparison of simulated figures is shown Table 10.4.

Table 10.4. Comparison of the results from job security tests

	Total projects	Average motivation to participate	Average indicated projects
Base run	150.46	0.11	0.52
Base run without retrenchment	150.36	0.22	0.48
Doubled rewards and without retrenchment	186.77	0.49	0.56

10.1.5 Reducing initial participation

The preliminary parameter tests as documented in Chapter A3 showed that the system is sensitive to the initial participation level as it determines the amount of work load for the TQM staff, as well as places demands on top and middle management time. This section asks the question, "What if the programme started with less participants?" It is expected that fewer participants will relieve the TQM staff, top and middle management of the high starting TQM related workload.

Figure 10.5 illustrates the effects on the base run (line 1) of varying the initial conditions. Line 2 represents a higher initial participation of 80 percent, which is run for comparison. Its effect is to reduce the amount of time available to the TQM staff and top and middle management; so there is a lower perception of support from these sectors. In addition, reduced TQM staff time led to a lower motivation to hold meetings. This was due to lower facilitation support and the delay in the improvement of ability. However, participation was still higher than the base run although it indicates a slightly more rapid rate of decline.

In contrast, decreasing the initial participants resulted in marked changes in the behaviour of indicated projects and total projects. The more apparent change is the immediate drop of both variables. The percentage meetings held also fell at the outset because the fewer participants significantly reduced the bandwagon effect in holding meetings. Thus, even as the other variables were at the same initial conditions, there were fewer meetings held. This was subsequently reflected in indicated projects.

Eventually, these indicators recovered as ability improved with increased availability of time for training and facilitation as well as increased experience. Table 10.5 shows that the average indicated projects increased to five times the base run when the initial participation was reduced to 5 percent. However, it may also be noted that because of lower participation throughout the simulation time, the total projects went down to more than half of the base run.

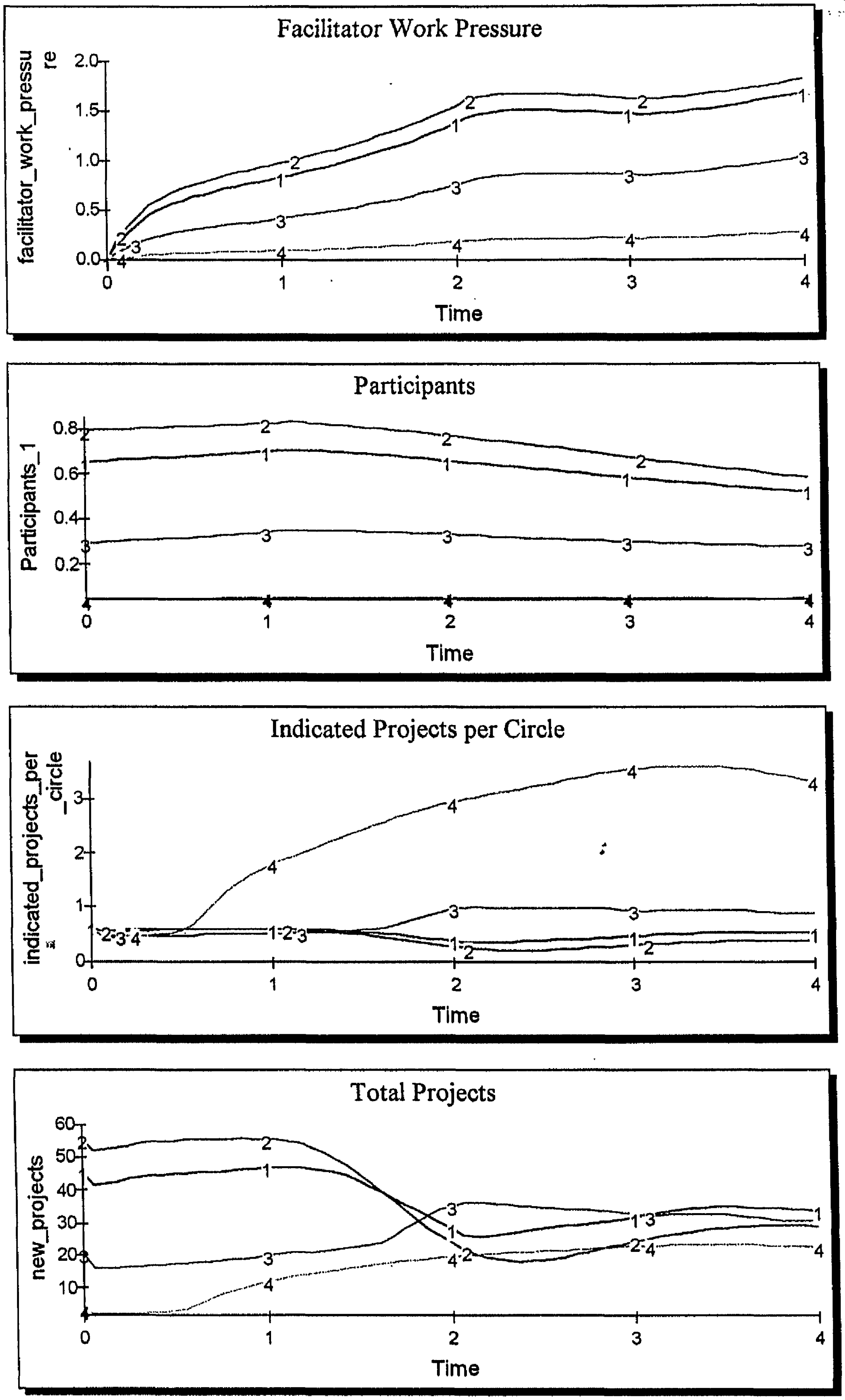

Figure 10.5 Results from varying initial participation

Table 10.5. Comparison of the variations in initial participation.

	Total projects	Average motivation to participate	Average indicated projects
Base run	150.46	0.11	0.52
80 percent	148.75	0.10	0.44
30 percent	110.78	0.12	0.78
5 percent	67.20	0.30	2.53

The effects of a 5 percent initial participation are further explored by improving other conditions. Line 2 in Figure 10.6 represents the system at this initial participation level without job insecurity. The average indicated projects followed an almost identical path as that of the unimproved run (third graph). In fact, there were slightly fewer indicated projects in the second half of the simulation. However, total projects were still higher mainly as the participants were significantly greater in number.

Line 3 represents the run that involved rewards that were doubled. The indicated projects per circle further increased although there was a decline at around time 3. This is due to a decreasing motivation due to rewards. Percentage participation is also observed to be increasing exponentially. Table 10.6 reveals that the total number of projects generated by this test are slightly more than the base run. Thus, even as the level of participation is low, the average contribution of each circle is huge.

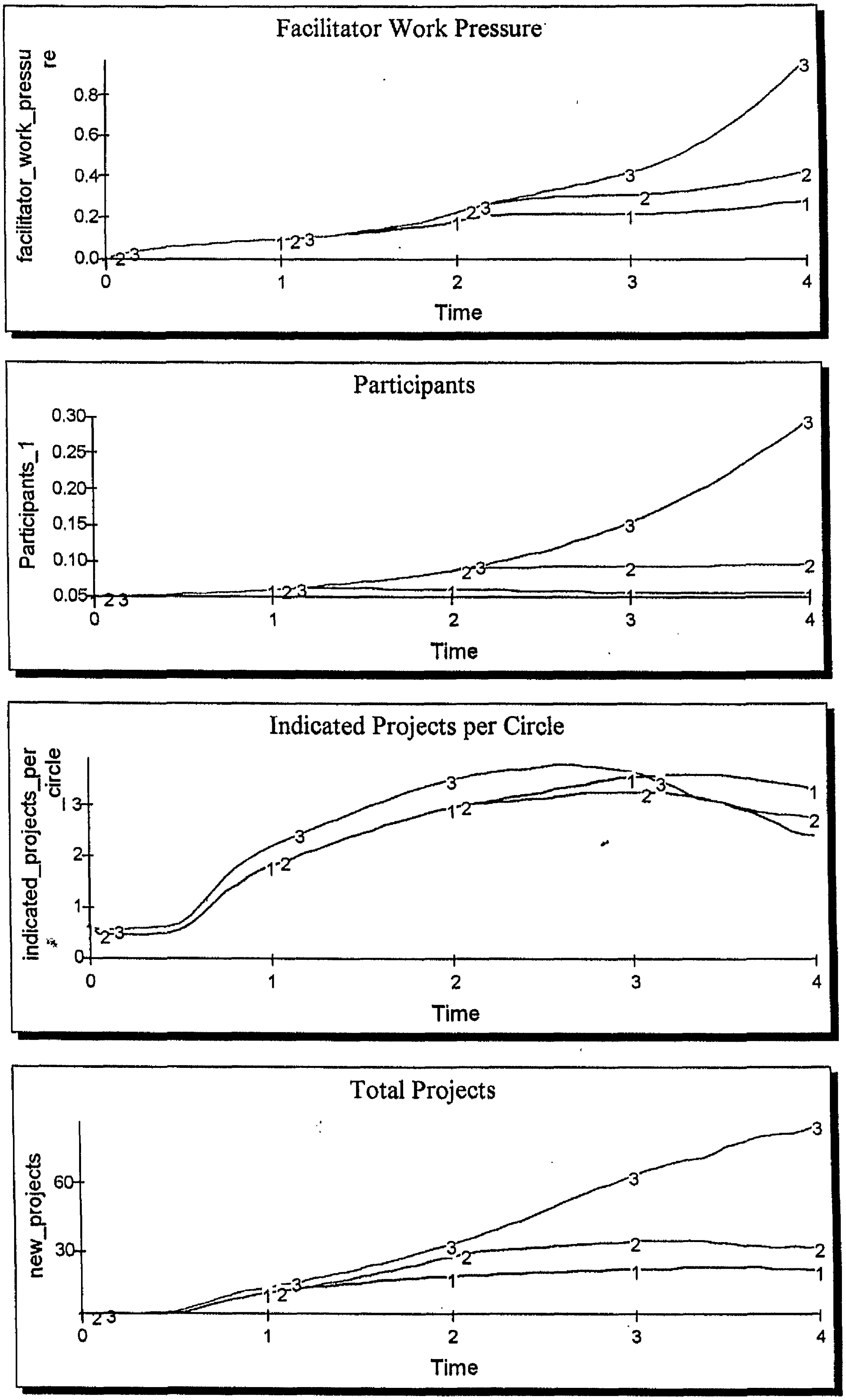

Figure 10.6 Results from 5% initial participation tests

Table 10.6. Comparison of the 5 percent initial participation runs.

	Total projects	Average motivation to participate	Average indicated projects
Base run	150.46	0.11	0.52
5 percent	67.20	0.30	2.53
no insecurity	91.34	0.36	2.38
doubled rewards	152.81	0.60	2.70

Discussion

The parameter changes that were implemented in this section were based on the causes of the problem as identified in Chapter 9. The declining trend was shown to be caused by inadequate allocation of resources. In the preceding experiments, this inadequacy was alleviated but shown to have contributed to relatively little improvement, or that such changes did not bring about simultaneous desirable effects on the three main indicators of the system.

Although doubling the rewards led to the most improvement in participation, indicated projects and total projects, the additional number of projects represented only 22.5 percent of the base run projects. Considering that the company does not favour financial rewards and would be reluctant to double the rewards, the present effort has already proved sufficient. The simulation also showed that whilst participation increased with the improvement in job security, this test did not yield more projects. Moreover, the declining number of TQM staff did not prove to be undesirable considering that only the high fixed TQM staff led to some considerable increase in total projects. The runs that involved lower number of staff did not fair as well as the base run.

Thus, the simulations showed that the company's implementation strategy was fairly good, and that greater resources would not have yielded more significant results. In particular, a large number of TQM staff at the outset of the programme was necessary to support the initial training efforts. If there were fewer personnel at the start, then ability would not have sufficiently improved as to yield this high number of projects. The simulation runs showed that sustaining this level of personnel did not generate any marked difference than the base run with reduced staff. Considering the expense of maintaining a large number of staff, and the not so impressive improvement in results, then it may be said that the reduction in staff is not as ineffective as pictured, or hoped for, in the interviews.

However, whilst the past strategy proved to be effective in producing satisfactory results, the downward trends in the participation levels indicate that the future is not as optimistic. Even as other variables seem to follow more positive trends, the declining trend in motivation to participate doesn't seem to abate. As this variable's waning is due to the satisfaction due to rewards, recovery and a positive trend is far from possible unless rewards are increased. The discrepancy between expected and actual rewards causes satisfaction to adjust to a lower level corresponding to this rewards ratio. In this case, participation levels will continue to fall as well.

One other possibility to sustain the motivation to participate is to improve the level of ability to offset the diminishing satisfaction due to rewards. However, because of the longer-term nature of ability development, this solution is not effective in the interim. The motivation to participate and participation levels will still continue to go down. Thus, the only remaining immediate solution is increasing the rewards.

The short-term nature of rewards helps alleviate the present situation almost immediately. However, in the longer term, when problem solving efforts increase, satisfaction derived from them begin to diminish too. Thus, increasing rewards is not a permanent solution and in fact requires regular adjustment to alleviate dissatisfaction.

The seemingly inevitable decline of satisfaction due to rewards is a symptom of the underlying feedback loops. The formerly dormant loops influence expected rewards so that the rewards ratio and satisfaction go down. The next section deals with these dormant feedback loops that pulls down the system in the longer run even when the resources are fairly adequate.

10.2 Scenario analysis - long term perspectives

The extended preliminary runs documented in Volume 2 showed that if the programme manages to overcome the short-term problems that mainly deal with resources, it eventually faces some longer-term problems that threaten its sustainability. Long-term declines were observed to occur despite the ideal conditions and significant levels of resources. Indeed, even in a very supportive top management policy that increases resources as a response to lower performance (Section A4.3), the main indicators still peaked then floundered.

Th theoretical runs in Chapter A4 showed that parameter adjustments, including resource allocation, failed to prevent the collapse of the participation level. This decline suggests the limits to growth archetype. The limiting resources are mainly based on difficulty of the later improvement projects to be identified and solved. Loop dominance shifts to the difficulty loops that undermines the progress established by the ability loops. However, in this case, there was no recovery. This section explores some possible approaches of preventing the decline.

10.2.1 Matching expected rewards

The earlier simulations, including the case study, had highlighted the negative effect of the dissatisfaction due to rewards. It had been revealed that rewards motivation has a rather short-term character as motivation due to it is bound to decrease shortly. When rewards expectations increase whilst the actual rewards remain constant, the rewards ratio falls and followed by satisfaction. It was observed that after some time the decline became rapid and participation levels and indicated projects also soon followed the decline.

This section tests a rewards policy that is based on expected rewards. This scenario conceptualises management as extremely generous. It monitors the expected rewards and adjusts the actual rewards the following year. The following tests assume that management provides 10 percent and 100 percent of the expected rewards[28]. Table 10.7 summarises the results and graphically presented in Figure 10.7.

[28] This is not an entirely hypothetical solution. Rewards as mentioned earlier are defined from a very general perspective and include year-end performance assessments and bonuses. As indicated in the interviews in the case study, workers expect that their year long quality activities are included in

Table 10.7. Comparison of results from generous rewards policy experiments.

	Total projects	Average motivation to participate	Average indicated projects
Base run	916.61	0.11	0.28
10 percent	1013.68	0.12	0.51
100 percent	1797.10	0.24	0.45

The 10-percent policy yielded a significantly greater number of projects than the base run even as it failed to effect an earlier recovery. The base run had a 100 percent rewards ratio at the start in contrast to this policy, which allowed only 10 percent of the expected rewards to be allocated. This difference explains the base run's higher peak in participation and total projects than those of the 10-percent policy. However, the higher peak also resulted in an earlier and steeper decline as the expected rewards were rising rapidly against the constant actual rewards. On the other hand, the 10 percent policy adjusted proportionally to increasing expectations. This allowed a slower fall of participation and total projects, and an accumulation of more projects in the transition.

The 100-percent policy, as expected, proved to be successful as it almost doubled the total projects of the base run. It encouraged a high participation level,

these annual performance reviews. By recognising these efforts, and providing for the corresponding bonus, the company is matching the employees' rewards expectations. In Japan, financial direct rewards are downplayed but more importance is placed on year end assessments that can include bonuses, promotions and seniority (Lillrank and Kano, 1989).

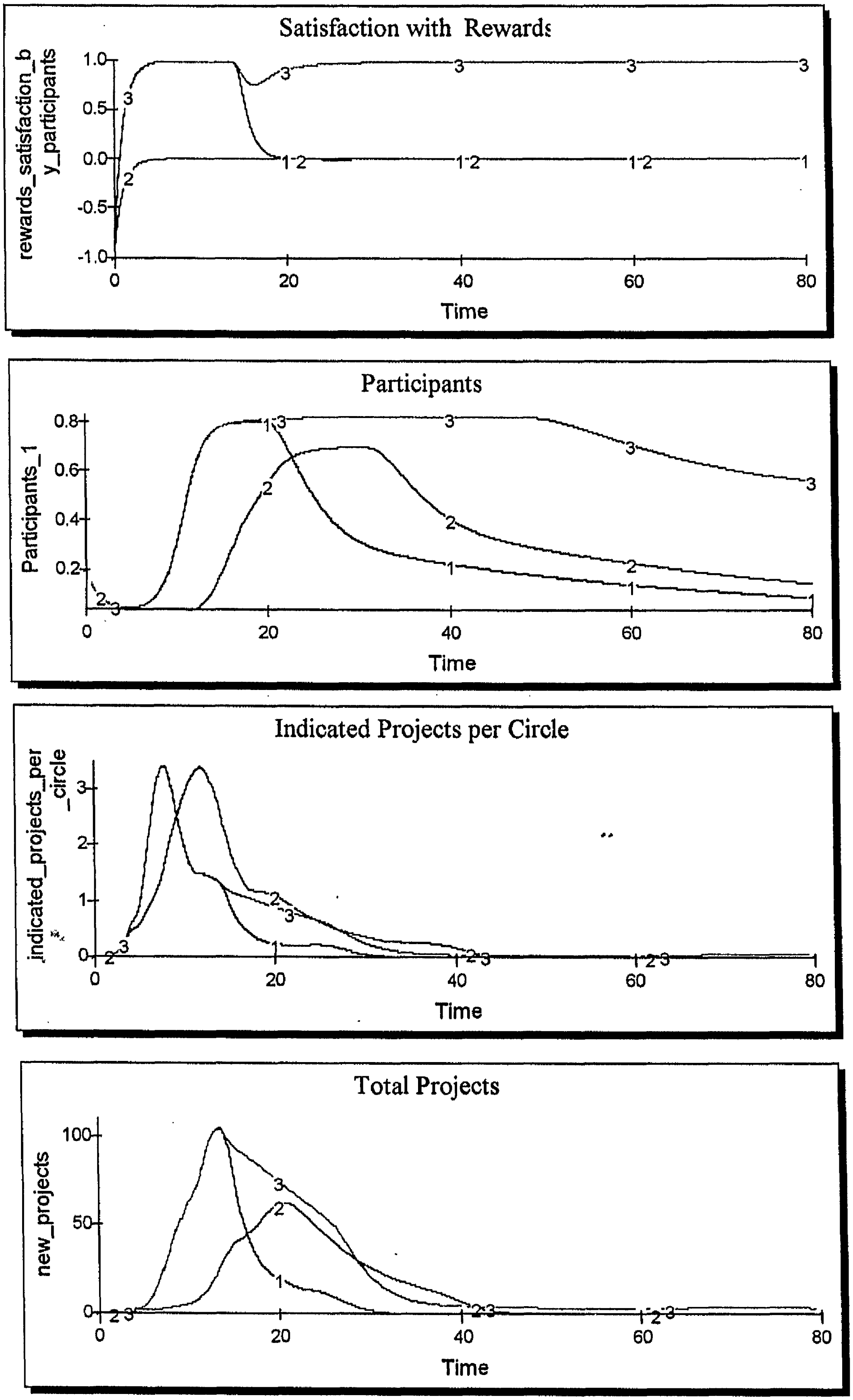

Figure 10.7. Results from matching expected rewards

which seemed to plateau. It eventually fell at around time 50, albeit slowly. The policy led to an improvement in satisfaction due to rewards, which supported the motivation to participate and extended its peak. In this case, the decline was not due to dissatisfaction with rewards, as rewards always matched efforts.

The cause of the fall was the diminishing level of ability. The lower level of ability yielded less satisfaction and motivation to participate. It also reduced the motivation to hold meetings. Furthermore, there was less ability to identify new projects and solve problems. The combined effects of these developments decreased total projects, which in turn, diminished learning through experience and further led to less ability development. Eventually, indicated projects fell to zero even as participation levels were still high. Thus, total projects went down to zero as well.

10.2.2 Controlling frustration

Further investigation of the efforts to match expected rewards showed that the collapse of indicated projects per circle was due to the diminishing ability, which approached zero. The level of ability affected the motivation to hold meetings, and more directly the generation of projects. Moreover, this decreasing ability also affected the motivation to participate so that the level of participation fell some periods afterwards.

The collapse of ability indicates that the outflow has dominated the inflow. The outflow, based on obsolescence, recognises that the part of the current level of ability is not appropriate or effective in dealing with new improvement ideas and projects. Its domination of the inflow based on learning, therefore, suggests that there is very little addition to new knowledge and skills that is necessary for these new projects. Further investigation showed that there was little or no learning at all, not because of the unavailability of the TQM staff, but because frustration discourages the acquisition and retention of new knowledge. This set of experiments, therefore, tests policies that control the sources of frustration.

The first test involves decreasing the rejection rate of proposed projects, as it represents one of the sources of frustration. In practice, this might be done by increasing the quota of acceptable projects, or by modifying the acceptance/rejection criteria as to allow the acceptance of more project proposals. However, this test is basically a parameter test as the percentage rejection is beyond the boundary of the present system. The results are represented by line 2 in Figure 10.8.

This test generated an additional number of projects in the early part of the simulation. This development had two opposite effects. The additional number of projects improved the contribution ratio, and thus, led to a higher motivation to participate. The participation levels peaked longer than the base run. The second effect was the increase of the level of difficulty, as there were more projects. This contributed to further frustration, and hence did not ease the negative effects on learning. Ability continued to fall. Moreover, indicated projects fell and brought down total projects with it. This occurred slightly earlier than the base run.

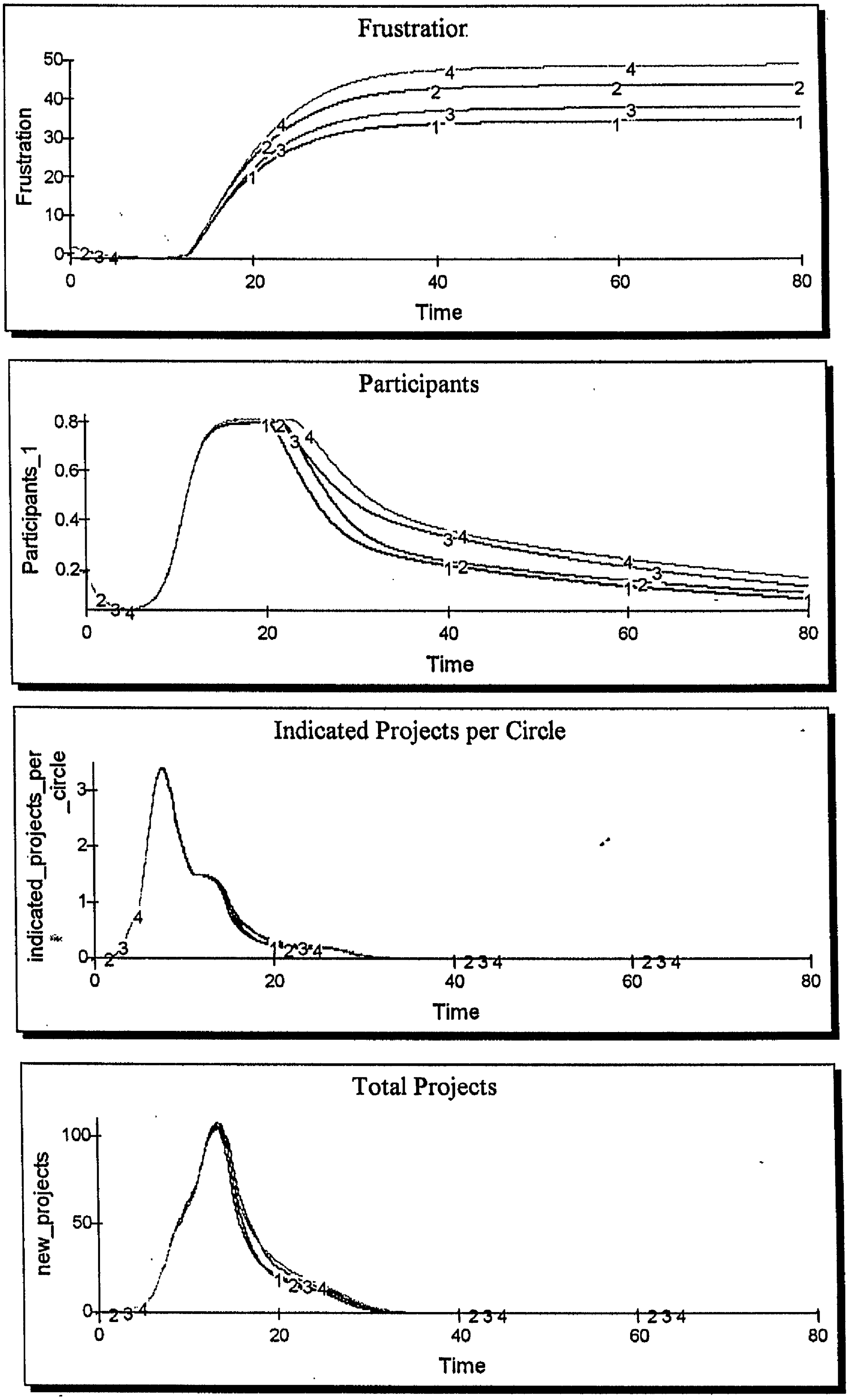

Figure 10.8 . Results from controlling frustration

The second test involves improving the implementation time to ease the frustration experienced from implementation delays (line 3). This is accomplished by additional top and middle management time to facilitate the execution of the projects. The results showed that participation improved in that it declined more slowly than the two earlier runs. This was caused by the increase in perceived support due to additional top and middle management time. Percentage meetings and indicated projects remained essentially the same with some tiny changes. Total projects also increased but still less than that of the zero rejection run. The top graph shows that the level of frustration for this run is less than the preceding experiment, but still higher than the base run.

A third run combines the zero rejection policy with increased top and middle management time. With increased acceptance rate, implemented projects rose resulting in higher satisfaction due to contributions. Coupled with more perceived support, the participation level stayed on top of the three other runs (second graph, Figure 10.8). Indicated projects per circle remained almost the same, but total projects increased slightly. As a result, difficulty rose together with frustration. The results are summarised in Table 10.8.

Table 10.8. Comparison of the results from the frustration experiments.

	Total projects	Average motivation to participate	Average indicated projects
Base run	916.61	0.11	0.28
no rejection	909.17	0.12	0.32
Doubled top and middle mgt time	1009.13	0.13	0.34
Combined run	1013.80	0.14	0.33

10.2.3 Controlling difficulty

The preceding set of tests showed that frustration becomes mainly a function of difficulty at some middle part of the simulation when difficulty exponentially increases with the accumulated accepted projects. It is at this time that the other factors (project rejection and implementation rates) are dominated and become relatively negligible factors. This accounts for their relative small improvement.

Apparently, the control of difficulty lies in the development of ability. The level of ability offsets the effects of difficulty in terms of effort exerted. In addition, ability controls frustration due to difficult projects. The first test involves reducing the learning delay by half. The results are represented by line 2 in Figure 10.9.

The improvement in learning time had very marginal effects on the behaviour. However, there was a higher level of ability, albeit slight, that motivated the identification of more projects and slowed down the rate of decline of participation. The combined effect of these two changes was the generation of more projects at the first part of the simulation. As a consequence, indicated projects fell earlier than the base run. Difficulty in this test was actually higher than the base run in the first stage of simulation. With the decline of total projects, the increase of difficulty slowed down. In the end, difficulty settled at a level that is lower than that observed in the base run. Frustration also settled at a lower equilibrium point than the base run.

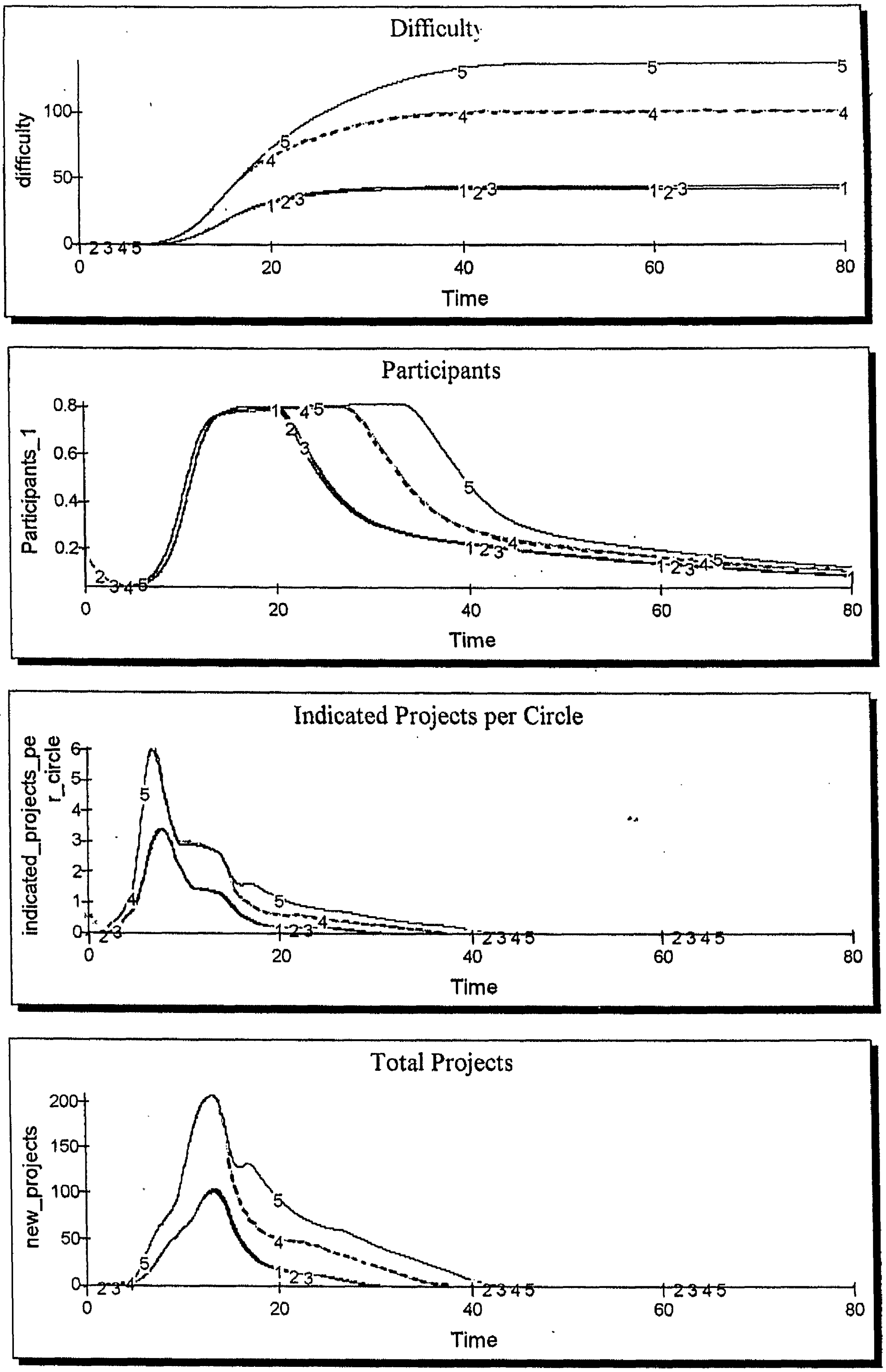

Figure 10.9 Results from controlling difficulty

An alternative way of improving ability is increasing time for training and facilitation. The third run tests the scenario where the monitoring task is removed from the TQM staff and this time is spent on facilitation instead. The results for this run, are represented by line 3. The behaviour was very to close to that of the base run. The additional time that was transferred from monitoring to facilitation did not have strong impact on the main indicators. Even the level of difficulty and frustration approximated the base run. Participation, indicated projects and total projects still collapsed by year 20.

A fourth run improved the third run by separating facilitation from training. The training and facilitation function are assigned three staff members each. The results are represented by line 4. Ability tremendously improved so that there is more sustained satisfaction as well as more indicated projects. However, the decline was still observed in the main indicators. Participation level similarly collapsed although at some considerably later time. Indicated projects and total projects peaked and fell at almost the same point in time as the earlier tests. Other graphs showed that difficulty and frustration were at their highest amongst the runs in this set. This is explained by the increased number of projects motivated by greater ability. More projects increased difficulty at a more rapid rate causing its loops to dominate the ability loops.

These simulations seem to suggest that the time allocated to training and facilitation is not sufficient as difficulty still rises exponentially. Thus, the fifth run assumes a very responsive organisation that assigns the necessary number of staff to develop ability that matches difficulty. This run produced the most number of projects with an average of 99 projects per year. However, total projects still declined even as percent participation stayed at a seeming equilibrium. Nevertheless, participation began to wane in the second half of the simulation. The collapse of total projects and indicated projects suggested the increasing effect of difficulty on the identification of new projects. In fact, ability actually fell after time 20 even as the number of facilitators tried to match the difference between ability and difficulty. This suggests the similar failure of this policy to contain increasing difficulty. The exponential nature of difficulty (based on reinforcing loops) was not balanced by the increased number of staff. The delay involved in adjusting staff resources allowed difficulty to increase further so that the difference also increased in time. Nevertheless, this policy is very unrealistic as the programme would have needed an enormous number of staff to cope with the increasing difficulty. At the end of the simulation, the total staff requirements would have been 38 thousand members!

Table 10.9. Comparison of the results from ability development experiments.

	Total projects	Average motivation to participate	Average indicated projects
Base run	916.61	0.11	0.28
learning delay at 3 mos	885.01	0.11	0.32
Monitoring function is separate	932.72	0.11	0.33
Training and facilitation as separate functions	2123.10	0.14	0.63
Number of facilitators as a function of ability and difficulty difference	7921.87	0.36	1.36

10.2.4 The Japanese solution

The preceding simulations showed the futile efforts to control the decline of the programme. They suggest that a TQM programme with quality circles is bound to wane at some time in its future due to the increasing difficulty. The simulations show that it can survive more than ten years but the first signs of decline begin to show in its fifteenth year. The length of its life is rather dependent on the adjustment times involved as well as the problem difficulty curve involved. These adjustment times represent their response time to changing conditions. On the other hand, the problem complexity and difficulty curve depends on the processes or activities that are subject to improvement (Schneiderman, 1988; 1998).

This leads to the question on how the Japanese are able to sustain their quality circle programmes. There are two possible explanations that are not entirely different. Ambali (1987) suggested that when quality circle improvement activities began to decrease, the area and topics covered by the problem solving groups were expanded. He noted that in the 1960s, the problems that were tackled were focused on product quality improvement. The area was expanded to cover process quality problems in the 1970s, and further extended to the broader, company-wide problems in the 1980s.

A second explanation is found in Lillrank and Kano's (1989) study of quality improvement in Japan. They found that the quality circles did not face any problem in finding improvement areas mainly as there is a continued effort to find even the slightest improvement in a single component or product. These small improvement, when accumulated, are perceived by the quality circle members to be clearly and closely associated with the company's business performance and competitiveness, and presumably encourages them in their continuous improvement efforts. They point that:

> There are no signs of QCC activities becoming obsolete in the manufacturing industries, where QC tools are easily applicable. There is no lack of problems to be dealt with: standards can be infinitely improved. Before a product or process is even close to perfection, it is time for a model change or retooling, and the improvement process can again start from the beginning. (p 253)

These two situations suggest a similar implication on the model. Expanding the area of concern and a new product or process, both indicate a different difficulty curve. This section tests this possibility.

Line 2 in Figure 10.10 represents the test that involved an indicator of ability and difficulty difference. When difficulty rose beyond the level of ability, the area coverage is expanded and difficulty level is set back to zero. For simplicity, the same difficulty curve is used.

The percentage participation is shown to have reached an equilibrium, sustained by a stable level of motivation to participate. Total satisfaction is also stable as all its three determinant variables indicate considerable satisfaction. However, whilst perceived support is similarly stable, its equilibrium is located below the halfway mark. It indicates the lower level of available resources that results from greater participation.

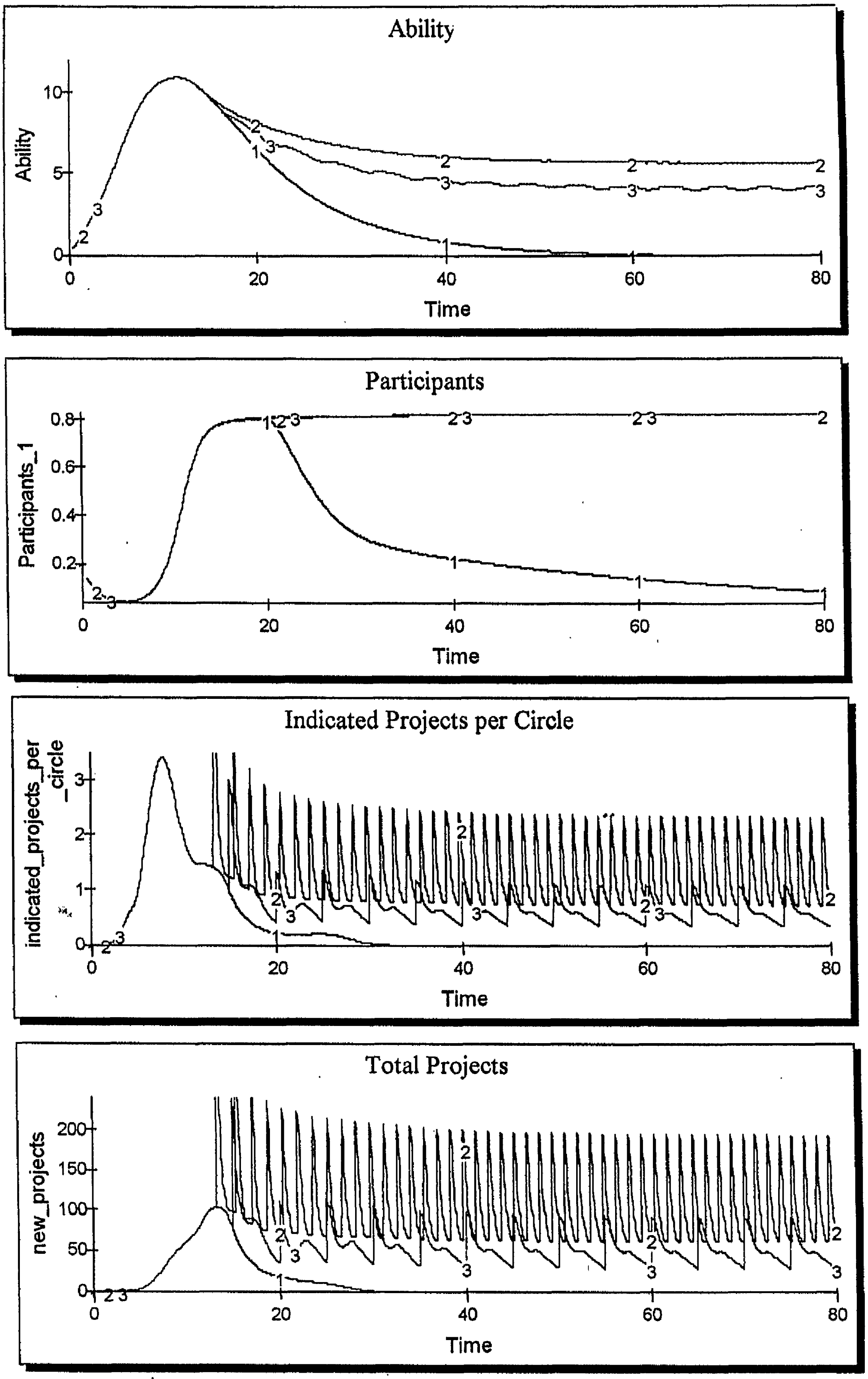

Figure 10.10 Results from shifting the difficulty curv

Both indicated and total projects show spikes in their time graphs. These spikes are caused by the expansion of the problem area and indicate the lower level of difficulty. The number of projects shoots up rapidly when the level of difficulty goes down because more participants are involved to identify the more obvious problems. In turn, the large number of problems identified leads to a rapid increase in difficulty. In other words, the next set of problems are doubly more difficult as more of the easier "low-hanging" fruits have been taken. This is reflected as a steep fall in projects. The interaction of difficulty and ability leads to a regular pattern of adjusting and expanding the problem coverage areas. Nevertheless, even as total projects fluctuated, participation rates were sustained and there are no indications that motivation to participate will decline.

The second test involved the introduction of a new product, process or tool. It is assumed that product/process development occurs every five years. Thus, a new difficulty curve is introduced every five years. The results show that participation levels were similarly sustained with motivation to participate settling down to a higher equilibrium level than the preceding test. This was mainly due to a greater perception of support. The test generated less total projects so that there was more available top and middle management and TQM staff resources.

The system acted on the same difficulty curve in between the introduction of a new product, process or tool. Thus, difficulty affected the system in these transitions and as a result, the level of ability fluctuated. These fluctuations are highly reflected in indicated projects, and eventually on total projects. Since the five-year cycle is longer than the fluctuation period of the preceding test, the total projects generated were less. Table 10.10 compares the results between these two tests.

Table 10.10. Comparison of the results of the Japanese solution experiments.

	Total projects	Average motivation to participate	Average indicated projects
Base run	916.61	0.11	0.28
Ability-difficulty indicator	7767.82	0.44	1.36
Product, process or tool introduction	4392.31	0.40	0.84
Ability-difficulty indicator with matched expected rewards	7765.76	0.44	1.36
Product, process or tool introduction with matched expected rewards	5347.43	0.50	0.99

Two other experiments were done to include another feature of the Japanese solution, the reward system. As mentioned in earlier (Footnote 2), the Japanese programme involves very low monetary rewards, and the Japanese workers have refuted monetary rewards as motivators (Lillrank and Kano, 1989). It is further observed that

> The sources of motivation are therefore sought in system rewards, such as wages based on total corporate performance, corporate welfare, seniority-based salary increases, or the unity of fate between the people working in the same "corporate island", where they are confined by the closed labour market that inhibits horizontal mobility between firms. System rewards are assumed to be motivators by inflicting a sense of fairness (Okuno, 1984). (p. 184)

Thus, the model is modified to include a policy for actual rewards that matches expected rewards. The results are shown in Figure 10.11.

The modified rewards policy did not reflect any significant changes in comparison to the original run based on expanding the area of concern. Expected rewards are rather controlled and do not increase considerably because the difference between difficulty and ability is monitored, and the solution is immediately implemented. Thus, matching the expected rewards resulted in little improvement as conditions were constantly improved. However, this tiny improvement in satisfaction due to rewards is reflected in the decreased number of total projects. Higher satisfaction encouraged more projects which increased difficulty, and eventually in the next cycle, fewer total projects.

On the other hand, the product/process development scenario with a matched expected rewards showed a 25 percent increase in total projects. The product/process cycle of five years allows the expected rewards to increase sufficiently, so that the constant level of actual rewards yielded some dissatisfaction until the new product or process is introduced. Thus, with the new policy of matching expected rewards, this dissatisfaction in between new products or processes is eased. This is reflected in the improvement of average motivation to participate from 0.40 to 0.50. In addition, average indicated projects also went up from 0.84 to 0.99 projects per circle.

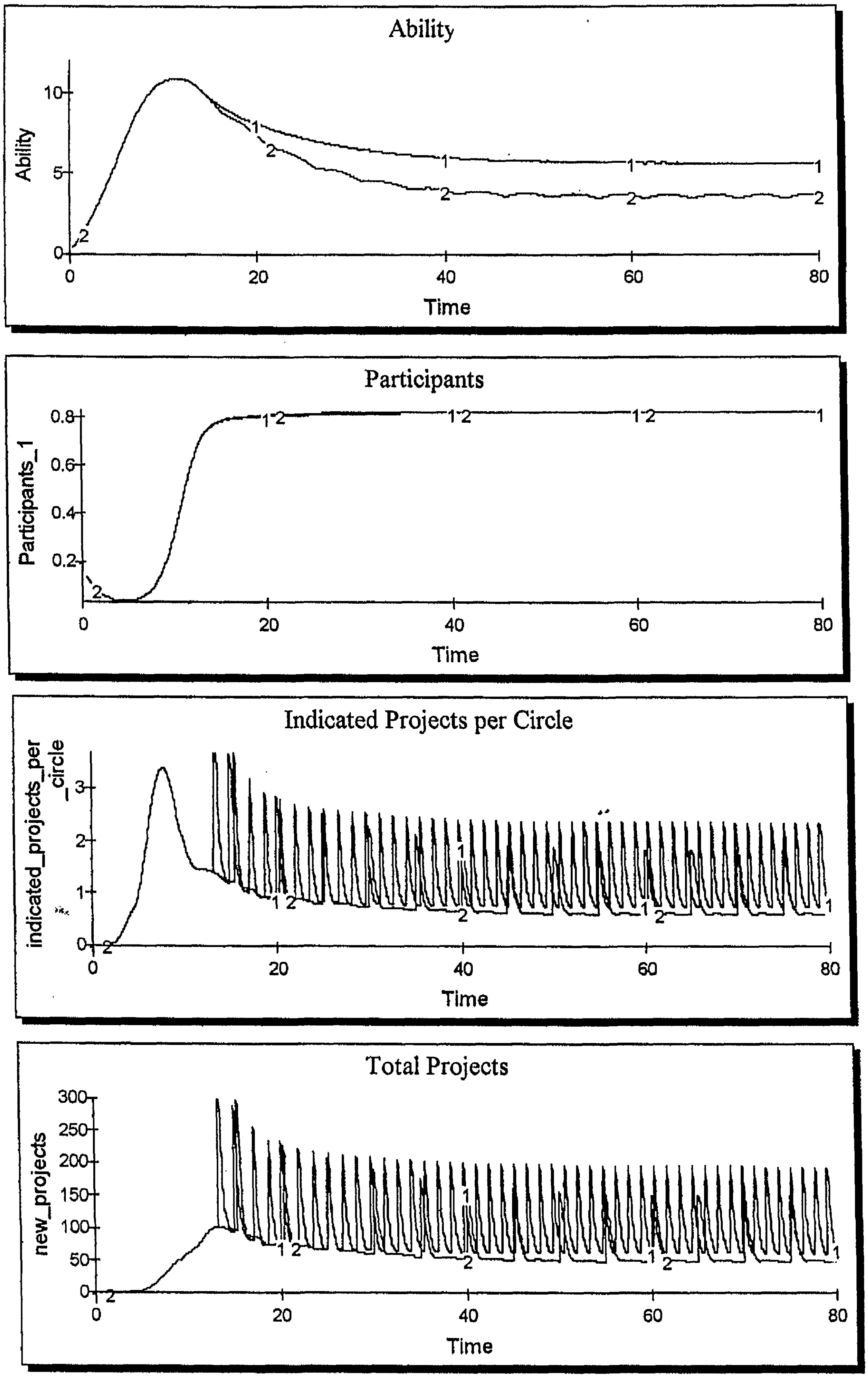

Figure 10.11 Results from shifting the difficulty curve with matched rewarc

Discussion

The simulation runs in this section attempted to control the variables that caused the decline of the system in the longer term. The first tests dealt with the more visible problems of reward dissatisfaction and frustration. Being symptoms of a deeper problem, solutions to these undesirable conditions have had limited success. The underlying structure continued to erode the system despite these adjustments.

Thus, the focus of the analysis was shifted to the deeper cause of these symptoms. It involved the level of difficulty of the improvement projects, either in identifying them or resolving them. The simulation runs in this section showed the inevitable effect of the increase of difficulty. It is an inherent characteristic of the system that the problems become increasingly more difficult to identify and/or resolve as more problems have been earlier identified and resolved.

Moreover, its own inherent exponential nature is amplified by the reinforcing loops to which it is attached. Difficulty is a function of the cumulative accepted projects, which in turn is based on total projects generated. The reinforcing loops, or the TQM engine, involve total projects so that accepted projects similarly increase exponentially. Therefore, the accumulated exponentially increasing projects are going up more rapidly. Finally, the assumed exponential relationship of cumulative projects with difficulty further amplifies the latter variable.

The main characteristic of reinforcing loops is that they change towards the same direction infinitely until there is another variable or loop that prevents, and reverses the action to the opposite direction. With difficulty being a function of total projects, the system is totally bound to its negative effects because the main objective of the programme is to maximise the generation of projects. In other words, the objective that drives and justifies the TQM programme is bringing the system to its ultimate collapse. Indeed, more vigorous efforts to increase improvement projects and the benefits derived therefrom counter-intuitively leads to an earlier and faster decline.

Thus, unless certain measures are taken to change its course, the quality improvement programme will collapse as its main indicators begin to decline. The experiments have shown that even measures to improve ability to control the rise of the difficulty level had also proved futile. This leaves the solution to shifting the difficulty curves.

The Japanese approach to the difficulty problem recognises the natural limitations of improvement activities as well as the quality circles themselves. Firstly, they recognise the importance of ability in sustaining an improvement programme supported by quality circles (e.g., Cole and Byosiere, 1986). The focus of TQM training on problem solving skills, in particular, the use of more systematic problem identification and problem solving approaches, has been one of the cornerstones of the quality circles programme. Indeed, it is one of the key features of the quality programme of the case study.

It may be reiterated that the importance of training does not lie in the short term but rather lie mainly in the long-run. The techniques and tools to identify and resolve improvement projects are not very necessary in the short term, especially at the start of the programme, because there are abundant improvement opportunities that have accumulated over the years due to neglect and unsystematic activities. These problems are not difficult to detect and the solutions may have been quite apparent and obvious. Only the lack of an opportunity and a system to correct them prevents any improvement action. Moreover, the level of expertise of the circles is still rather low at the beginning despite intensive training, mainly as ability improves only in time and with continued use. There is an observed inefficient use of these systematic problem identification and problem solving tools for first time users as they try to follow mechanically or haphazardly the steps to identify problems (Watson, 1976). The role of facilitation and support become essential at this time.

The strength of training is not simply limited to the introduction of tools and techniques but also in the development of discipline and way of thinking both to perceive improvement opportunities and resolve them systematically. Thus, as the level of difficulty rises in time, the quality circles rely more on these more inherent abilities than the procedural abilities to deal with more complex and interdependent problems. These characteristics which actually take time to develop are supported with the development of new tools and techniques, as evidenced by the new quality tools, to support their activities (Kim, 1990, Schneiderman, 1998).

A second point that may be made regarding the realisation of the inherent natural limits of improvement activities deals with the often criticised (at least in some of the interviews in this research) minor improvements identified by quality circles. The projects by quality circles or suggestion systems deals with seemingly insignificant or trivial matters, such as moving equipment to adding more light to the room, have been attacked by critics as not contributing to the bottom line figures. However, from the perspective of this model, identifying these small and insignificant areas of improvement may postpone the rapid increase in the level of difficulty of succeeding efforts because of their low-level complexity, and thus extending the programme's limits. At the same time, these contribute to the development and enhancement of the participants' technical abilities as well as discipline. This is not to mention other smaller benefits from such activities, which include, a better perception of top management support from implementing rather minor and not expensive projects, and a sense of satisfaction, pride, self-importance and well being with improved conditions. These small benefits do accrue in the longer term to become stronger bonds to the organisation. This, in turn, may well support the persistence necessary to find further improvement activities in the face of exponentially increasing difficulty and complexity.

These small improvement projects while providing the necessary ability for continuous improvement still do not prevent the increase of difficulty when they are accumulated. As shown in the simulations, increasing ability, even with the most unrealistic solution of providing all the necessary trainers, did not control difficulty. However, these simulations showed that higher levels of ability could delay the negative effects of difficulty. Thus, opening up new areas for problems and improvement activities expands the limits set by difficulty.

It may be argued that the history of expansion of improvement areas in Japan or the development of the new systems, products, components and tools must have been due to the constant search for improvement. Faced with increasing difficulty and diminishing projects in the work areas or products they were working with, they were forced to expand the problem boundaries. There could have been a gradual realisation that problems or defects are inherently related and connected with other parts of the system. This can be seen from the initial concern with improving inspection to quality appraisal to the business effects of what is now known total quality management. After improving the subsystem, which is the work area, or a department, or the production function itself, subsequent problems become more difficult to identify because their root cause might not lie within the subsystem of concern anymore, but in another related or connected subsystem. A process such as this could have expanded until the entire organisation is the area of concern. This was extended, again after much improvement, to include customers (as indicated by the development of QFD) and to suppliers with supply chain management and JIT.

In sum, the Japanese approach to quality circles was not constrained to its original design of improving the product quality. Their top management allowed sufficient freedom to explore the boundaries and later expand them. They were rather tolerant and supportive with these ideas rather than dismissive or defensive. Lillrank and Kano (1989) pointed out that "the Japanese approach has been first to create the parallel structure for continuous improvement and then let it improve the formal organization little by little" (p.252).

10.3 Conclusion

This chapter was mainly concerned with the search for solutions to the impending collapse of the TQM programme. This chapter highlighted both short-term declines that have been mainly due to inadequacy of resources, and the long-term decline due to complexity and difficulty. The simulations have shown that efforts to prevent both short and long term declines proved to be temporary solutions. Eventually, the indicators fell again.

Implicit in the model and the analysis is a certain consistent degree of top management commitment. Top management is assumed to have pledged support to the programme by providing for the necessary resources and other requirements of the quality initiatives. The provision for these resources not only directly makes possible the improvement activities, but also influences the perception of management sincerity and support.

However, two possible complications, which affect the short-term success of the programme, prevent this ideal relationship between commitment and the allocation of resources. First, the resources are not necessarily made consistently available. The competing uses for these resources in other organisational functions and the priorities given to these can constrain and limit the resources made available to the TQM programme. It is also possible that cost considerations that could have increased after implementation can require adjustments in the levels of available resource. In the case study, most of the important resources were kept fixed including top management time. An exception was the TQM staff members.

Second, even as the resources are available, the perception of their availability may not match because of an adjustment process. More possibly, this perception is based on other variables that indicate resource availability. But these indicators do not necessarily and totally reflect actual resource availability. A third possibility is governed by the limits to growth archetype where total requirements are accommodated, but attention to individual requirements is actually decreasing. All the other resources had suffered from these perceptions, including top management time, which had been claimed to be dwindling in time.

Thus, in many situations, the apparent mismatch between expected behaviour from the promised commitment and the actual or perceived behaviour causes some undesirable effects as to reduce satisfaction or perceived support. This eventually affects participation, indicated projects and total projects. In any event, the real experience or perceived experience of inadequate resources needs to be corrected by top management. In the short-term, the solution is typically the addition of further resources,[29] which is seen as an additional test that establishes true commitment to the programme. Thus, top management commitment is seen not only with respect to maintaining the level of resources but also correcting the unintended effects (although they may be mere perceptions) of the interaction of participants that require further resources.

Allocating these additional resources, not to mention the initial provision for these resources, require some strong commitment in the face of competing uses for these scarce or expensive resources. In the particular case of top management time, there is always a constant "tug-o'-war" between TQM activities and other corporate requirements. The head of the TQC programme in the company case study confided

[29] This research is mainly based on these important resources as causes of short term decline. The other short term threats to the programme that deal with inter- and intra- group dynamics discussed by Lawler and Mohrman (1985) are beyond the boundaries of the model in this research.

to this researcher of this constant strain on his time. This was made more difficult with additional assignments from his superiors.

> "But my commitment to the programme and its requirements are to the workers and all other members of the organisation. I must always find time, and I do, to visit the shop floor, like I use to when I had not yet been promoted to this position. This shows my commitment to the people. At the same time, I am in touch with their problems." (Agustin, 1996)

These short term pressures on resources poses regular threats on the programme. These pressures can cause the shift of resources to its other requirements resulting in further contraction of its availability for the TQM programme. This reaction only hastens the decline as demonstrated by the unsupportive policy experiments in Chapter A3. It is also possible that additional resources are withheld and not made available. In this latter case, the trend can continue to slide. Clearly, only unwavering commitment can resolve these persistent pressures. Otherwise, the programme will begin its collapse.

In the longer run, the pressures to dismantle the programme are higher as the cause of the decline is more obscure. In this scenario, availability of resources that cannot sustain the quality efforts is more incomprehensible and seem ironic to top management. But the simulation runs show that there must be a natural limit to improvement activities. Beyond a particular point, improvement becomes arduous and impracticable. The fact is that the Japanese have also recognised this natural limit in that implementation of quality circles in the service sector. Lillrank and Kano (1989) observed that

> "there is a human limit to how far it (delivery of services) can be improved; many improvements are achieved simply by intensification of work. After a certain standard has been reached, improvement in delivery will no longer produce results...".

This suggests that the improvement process can die a natural death and that the goal of sustainability is rather unrealistic and not achievable.

However, as shown in the experiments, various resource adjustments as well as policy changes can extend its life. Because of their short-term nature, these adjustments must repeatedly be applied to keep the programme going. The Japanese have shown this through the expansion of areas of concern of the quality circles. This proved to be beneficial to both the programme and to the organisation as whole.

The repeated evaluation and identification of ways to extend its life is a rather formidable exercise, and requires so much effort from an organisation's top management. This goes beyond providing the necessary resources (rewards, training, management attention and time) as such allocation of these factors prove to have shorter effects. As noted earlier, the Japanese top management must have had so much tolerance and forbearance as not feel offended by incursion of quality circle activities to corporate concerns. It has been noted in literature, as well as observed in the case study, that managers have a tendency to be insecure by the improvement projects of quality circles as they surface problems which are their main responsibility. It could be more demeaning for top managers to acknowledge the improvement efforts of subordinates that touches on corporate affairs. A quote from Hayes (1981) seems to explain this:

> Quality, to the Japanese, means error-free operation. Any defect in any part of the manufacturing operation, therefore, becomes a quality problem in management's view - another "grain of rice"[30] to be pursued and eliminated. High quality, after all, is not achieved by a few random management decisions but by a complex, all-encompassing long-term support of top management. The basis of this system is not simply an appropriate arrangement of people and machines. It is a way of thinking. (p 62)

These points suggest the totality of commitment of the Japanese organisation's top management to the programme. Their actions and support literally translates the definition of commitment, highlighted by Kiesler (1971), as "pledging or binding oneself to a course of action" (p 26) into reality. From this perspective, the search of ways to sustain the programme can be seen as management doing its part of the programme. Top management, thus, has a more active role to play in the programme. Its role is not passive and limited to evaluating and approving projects, as in most other implementation efforts. Whilst the lower ranks search for improvement projects, top management search ways to support and sustain these activities. The expansion of areas of concern and development of new tools (seven QC new tools in addition to the traditional seven tools, and QFD) represent some specific ways of supporting the search, identification and resolution of projects.

[30] Hayes notes that the there is a Japanese saying of "pursuing the last grain of rice in the corner of the lunchbox" which describes a person's tendency to be over scrupulous.

These actions of the Japanese organisation extend further the definition of top management commitment and support. It goes beyond what typical TQM literature suggests. Indeed, the inevitability of the collapse of the TQM programme requires more than courage and consistency from top management (Macdonald and Pigott, 1990). It requires much conviction (Ariola, 1996), and "much hinges on faith" (Wilkinson and Willmott,1995). They highlight a similar point made in relation to HRM:

> Belief in HRM is not based upon deconstructing theory or looking for proof, but on faith. The HRM prophets guide the way to business improvement, harmonious employee relations, customer care and societal well being: the promised land for advanced societies. Those who like the message and have faith, follow. (Noon, 1992)

They further suggest that the other possibility for dependence on the quality initiatives is not solely based on faith but also on politics, that is the continued control of the worker. No matter what the intention of the Japanese management is, their commitment to quality seems to be strong and unwavering.

This may be contrasted to the typical Western way of managing TQM. One of the main issues in the adoption of the programme is attitudes and behaviour of workers. Despite the exhortation of quality gurus (e.g., Deming, 1986) that management should take responsibility for the system, the focus of the programme is still placed on improving the thinking patterns of workers, and training them with the concept of "satisfying both internal and external customers". Beer, Eisenstat, and Spector (1990) observe that:

> The common belief is that the place to begin is with the knowledge and attitudes of individuals. Changes in attitudes, the theory goes, lead to

> changes in individual behaviour, repeated by many people, will result in organizational change. According to this model, change is like a conversion experience. Once people "get religion", changes in their behavior will surely follow. (p 159)

Taken from this perspective, when the participation process does not reflect the "conversion experience", top management interest wavers and wanes. Lawler and Mohrman (1985) observed from their experience that when the decline sets in, and when quality circles meet less frequently, and become less productive, the resources committed to the programme dwindle. Furthermore,

> As managers begin to recognize this, they cut back further on resources. As a result, the program shrinks. The people who all along resisted the program recognize that it is less powerful than it once was, and they openly reject and resist ideas it generates. The combination of the overt resistance from middle managers and staff, budget cuts, and participants' waning enthusiasm usually precipitates the decline of the QC program. (p 69)

Alternatively, the success of the programme is based on bottom line results, that is, benefits are measured in financial terms. Newall and Dale (1991) observed that measurements based on profit, cost reduction and lower costs have appeared to take on "a misguided importance as a result of senior management's inability to see TQM as a key business strategy for their organization". In addition, they note that,

> Many senior executives appear reluctant to accept that TQM embraces many organizational elements, preferring to concentrate on individual aspects of the quality improvement process such as statistical process control (SPC), failure mode and effects analysis (FMEA) and design of experiments. These road-blocks are largely symptomatic of Western management's unwillingness to let go of its traditional practices. While many companies want to change, they are unwilling to rethink their

> management style and develop an organizational culture which is conducive to improvement. .... Japan's original perception of TQC led to organizational structures that embraced all the scientific, technical and managerial issues of quality. In contrast, the West perceived disciplines such as science, technology etc, as separate entities ...(p 260)

If senior managers place much importance on these short-term goals, it is more likely that top management is totally dismayed and disappointed with the first signs of decline in the short term. In this case, commitment to the programme is dependent on short-term benefits. In other words, commitment is not towards the programme but towards the achievement of these financial targets. From this perspective, it is easy to understand the abandonment of the quality programme when it does not meet its financial objectives. However, the negative effects of dwindling available resources on satisfaction and perceived support remain with the members of the organisation even after the programme has ended.

Thus, given these short-term perspectives and the various threats that the quality programme faces in the short term, it is not likely that managers will sustain the programme over a long time (Lawler and Mohrman, 1985). Moreover, there is low possibility that they are going to reach a level of performance that is high enough, or a length of life that is long enough, to reach the natural limits of improvement activities suggested in this study.

CHAPTER 11
MANAGING TOTAL QUALITY MANAGEMENT: SOME CONCLUSIONS

At the beginning of this research, the issue that was being studied was the mixed and inconsistent results from the implementation of TQM programmes. The apparent question at that time was why some companies were successful in gaining the promised benefits of quality improvement whilst others have miserably failed after spending so much time, money and effort.

The initial literature review showed that many have attempted to answer this question. A variety of approaches have been used to explore the differences between successful and unsuccessful TQM companies. These ranged from in-depth individual case studies to broader and more representative surveys. Others, particularly consultants, relied on their experiences to generalise observations and prescribe certain actions and moves. Still others, mainly academics, evaluated TQM from a more theoretical and 'informed' perspective. The result of all these efforts is the myriad explanations and analyses that account for successes and failures of quality initiatives.

The review of this literature suggested that the various perspectives, that cannot seem to be refuted, provide answers that all seem correct. However, by accepting all possible analyses that do not seem to be connected poses a problem, even confusion, to both the researcher and practitioner. Thus, this final chapter attempts to integrate these diverse points of view in order to present a more comprehensive picture of the issues in the implementation of TQM.

It became apparent, even at the start of this research, that the issues on implementation cannot be separated from the issues of the conceptions of quality and TQM itself. The practice of TQM is anchored on an understanding, not only of what it is and what it consists of, but also its implications and extensions, mainly because it was introducing concepts and ideas that were not consistent, at times contrary, to accepted conventional and traditional knowledge. Indeed, the gurus such as Deming and Crosby include in their TQM programmes a step on education and training that aim to clarify meanings and develop understanding. Moreover, TQM research (e.g., Grant et al, 1994; Wynne and Lancaster, 1992) identified definitions in TQM as being problematic and that has been inadequately addressed to. The present research recognises that problems in implementation may be caused by problems in conceptualisation and understanding (Eskildon, 1993; Mintzberg, 1994; Reeves and Bednar, 1994). Thus, this research began with the review of the ideas, principles and other concepts of quality and TQM even as its main interest is the implementation process.

The first part of this final chapter deals with these conceptual issues. A brief summary of the issues on the meanings of TQM and related principles are presented in section 1. The second section summarises the findings from the interviews and cases and similarly integrates them with the issues of meaning and interpretations. Organisational events and activities were also found to affect the understanding of quality and TQM. Moreover, the discussions take a broader perspective and view these definitional aspects as related and interdependent. The analysis attempts to explain the elusive and slippery nature of quality and TQM from a systems perspective, first from an industry-wide perspective and then from a narrower organisational perspective.

The third section deals with the results of the simulation model. It highlights the findings from the runs as they imply on implementation issues. Section 4, on the other hand, discusses the search for ways of improving the problem behaviours. Similar to the earlier sections, a system perspective of the Japanese solution to the limits of TQM is presented.

The second part of this chapter identifies the specific contributions of this research to the TQM and system dynamics fields. It also explores the theoretical and practical implications of the findings of this research. Finally, the limitations of this study form the last section of this chapter.

11.1 The limits of TQM research

The early efforts of the research to review current literature immediately revealed a number of controversies and issues. The main research controversies dealt with the approaches and objectives in the study of TQM. Gaps in TQM research have been noted (e.g., Maani, et al, 1996, Wilkinson and Willmott, 1995) as most writings are characterised by generalised prescriptions. Moreover, earlier studies were methodologically flawed (Powell, 1995) and represented vested interests in the promotion of TQM (Hackman and Wageman, 1995; Powell, 1995; Wilkinson and Willmott, 1995). This is further aggravated by the disdain or hesitancy of academics to become involved in TQM research (Abrahamson, 1996; Dean and Bowen, 1994; Wilkinson and Willmott, 1995). Furthermore, Wilkinson and Willmott (1995) suggested that definitional problems have not been dealt with in these researches.

In another article (1996), the same authors explain the seeming unconnectedness among these observations:

> "In essence, this literature takes an evangelical line which excludes traditions and empirical data that fail to confirm its faith. Ideas and practices which deviate from the principles of quality management are interpreted as instances of irrationality that can be corrected through proper and systematic application of quality principles." (p. 61)

Such an observation reflects the simplistic nature of prescriptions by consulting firms (Gill and Whittle, 1992) as they neglect the underlying principles of TQM mainly to promote TQM as a panacea to increase their firms' revenues. However, the analysis of current TQM literature suggests that the factors that determine the successful implementation of TQM programmes are far from easy to operationalise.

Indeed, when broader literature was considered, these factors were found to be problematic in the sense that they are influenced by a number of contingency factors. This implies that even systematic and careful establishment of the critical factors, such as adopting a new philosophy (Deming, 1986) or establishing management commitment (Crosby, 1979), do not necessarily lead to a successful attainment of the objective of such a step. In other words, the implementation process is not a straightforward and linear set of activities but that there are situations and conditions that complicate the entire process. The reviewed related literature in management and organisation pointed to certain contexts that determine and affect the operationalisation of each factor (e.g. Morrison and Rahim's (1993) review of participation; Ferris and Wagner's (1985) review of quality circles). This highlights the 'it depends' character of the TQM factors.

Moreover, the evolving nature of quality and TQM points to the expanding notions and implications of TQM concepts. Such developments raise the questions as to what is to be implemented or when is TQM implementation complete. From research perspectives, these definitional issues create research difficulties in comparing TQM programmes in different organisations. Indeed, in the initial efforts to find organisations to study for this research, this researcher visited eight companies with seven different TQM programmes[31]! In the eighth company, the personnel manager pointed out that whilst they implemented all the elements this researcher suggested as part of a TQM programme, their company did not have a TQM programme.

Thus, TQM literature appeared to have skirted the issue of the complexity of the TQM concepts and the implementation process. The neglect of definitional issues (Wilkinson and Willmott, 1995), lack of recognition of contingency factors from organisation literature (Morrison and Rahim, 1993), and the lack of discussion of the subtleties of the TQM programme (Gill and Whittle, 1992) hid the complexity of TQM.

[31]Their differences were due to the quality related activities that they adopted: statistical process control (SPC), ISO 9000 or BS5750 accreditation, quality circles, corrective action teams, quality testing technology, suggestion schemes and total preventive maintenance (TPM). Some adopted all

Taken from a broader industry perspective, these seemingly disparate arguments all contribute to the definitional problems of quality and TQM. The actions of the main actors (practitioners, consultants and academics) seem to relate to each other through their interpretations of TQM and its concepts, which ultimately affect the implementation and practice of TQM.

A critical variable in the understanding of TQM is the consensus among the actors as to TQM's meaning. As indicated in the literature review, a variety of definitions have been put forward so that each has his own perspective and interpretation (e.g., see Table 2.1, p. 33). The variety of versions of the concepts and their implications, the numerous methods, tools and techniques that are available as well as the consensus among the actors lead to poorer understanding and appreciation of quality and TQM. Such inadequate understanding and confusion of the issues is pushed to the implementation phase and left to the implementers to resolve on the shop floor. Ultimately, implementation difficulties result. Conversely, better consensus among consultants and academics can offer fewer interpretations that bring less confusion on the meanings. These relationships make up the core of the feedback loops that determine the success of TQM practice (Figure 11.1).

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these quality related activities whilst others utilised only a few of them. However, all of them claimed to have a TQM programme.

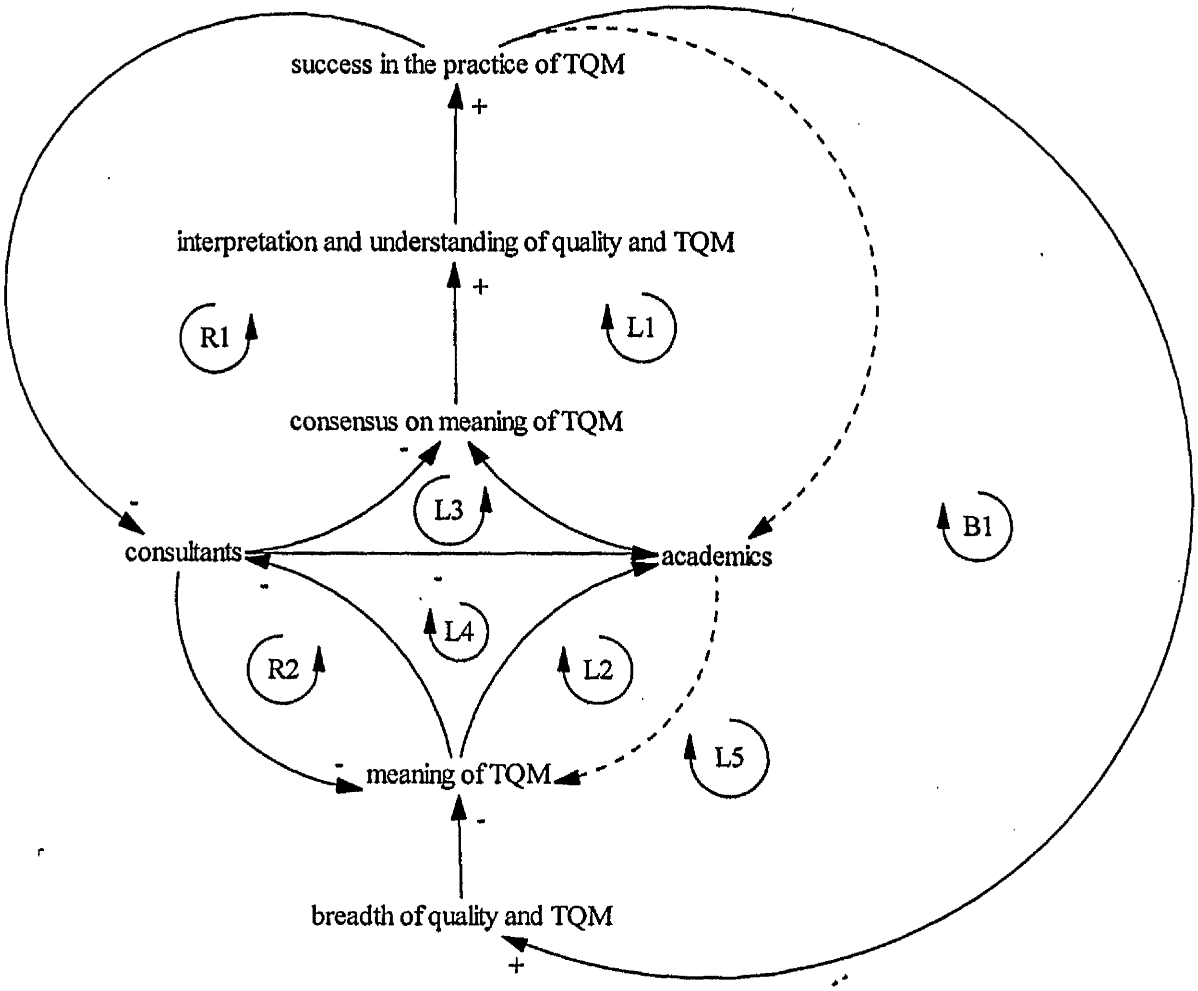

Figure 11.1. The dynamics of TQM interpretations due to consultants and academics.

The practice of TQM seems to close a loop with the number of consulants (or consulting agencies) involved with TQM (R1). The failure of a quality initiative indicates the need of more specialised and experienced advice of 'experts'. This need attracts consulting firms to become involved in TQM applications. As more consulting firms join the bandwagon, competition becomes fierce and differentiation of products and services result. This niche marketing approach develops new versions of TQM to corner a particular market segment. Moreover, others approached the marketing problem by appealing to managers' urgent need for programmes and their limited time to digest concepts by overly simplifying and distilling the TQM concepts (Gill and Whittle, 1992). This leads to further discord in the community of experts. Lack of consensus on meanings creates misconceptions, implementation failures, and reinforces the need for consultants and experts.

These factors form a vicious circle (R1) of unclear meanings, failed initiatives and dependency on experts for advice. Thus, this reinforcing loop does nothing to clarify meanings and improve the practice of TQM. Indeed, it can only bring the TQM concept farther from its original conception (Hackman and Wageman, 1995).

The adverse effects of R1 are further complicated by the other loops, albeit some are indeterminate. R2 relates consultants with the actual meaning of TQM. The analysis of Hackman and Wageman (1995) and Wilkinson and Willmott (1995) suggested that consultants have had a virtual monopoly on the meanings attached to TQM and quality concepts. Thus, as more consultants become involved in this field, the meanings attached to TQM become more diverse. As the number of definitions increase and become ambiguous, other consultants could become attracted[32] to it as it offers a market opportunity with a differentiated product. This unduly increases the number of experts in the area and further reinforces the effect of R1.

L3 similarly reinforces R1, especially if the effect of the involvement of academics is to clarify meanings and settle controversies and therefore correct

[32] It is also possible that the ambiguous meaning of TQM does not attract consulting groups to become involved with TQM practice. In this case, L1 is de-activated.

disagreements[33]. In this case, the active participation of consulting groups discourages academics as they avoid being labelled 'snake-oil salesmen'. With this reaction, consensus further goes down, leading ultimately to dependence on consultants, as there are more failed initiatives. Eventually, academics are further frustrated with the consultants' active involvement and meanings are more ambiguous than ever.

A balancing loop, B1, seems to control the exponential rates of failed (or successful) TQM practice and dependence on TQM experts through the breadth of TQM meanings. The history of quality and TQM in Japan suggested that the meanings were evolving as needs of industry and customers change. This is represented by the arrow coming from the practice of TQM to the breadth of quality and TQM. As quality efforts become successful, the scope of TQM needs to be broadened as to cover other possible areas of improvement or the use of new tools and techniques. This leads to ambiguity in TQM meanings, which attracts more consultants who might develop differentiated products. New controversies could develop from the introduction of new versions of TQM. Inadequate understanding leads to implementation failures which presently controls the areas of application of TQM. When the meanings become more concrete and clearer, consultants stay away from TQM and consensus and understanding improve. Moreover, the withdrawal of some consultants from the TQM field might encourage academics to analyse the

[33] If more academics put forward different analyses and perspectives, this could lead to less consensus rather than clarity of meanings. This might be case where some academics are TQM advocates whilst another group are cynics. In this case, the loop become balancing (negative) but its effect might not offset the strength of the consultant loop, R1.

failure of implementation efforts and contribute to the clarification of meanings and issues[34] (L4 and L5).

In sum, the dynamics of the development of meanings and definitions due to consultants are dominated by a reinforcing loop (R1) and a balancing loop (B1). SD dynamics suggest that the resulting behaviour from this structure is an oscillating curve for successful practice of TQM, or in some instances, a slow rise, a peak and a permanent decline without recovery. Thus, whilst the reinforcing loops of the consultants can bring the system to its collapse due to unclear meanings, unsuccessful initiatives and dependency on experts, the balancing loops can bring the system some success as it allows for time to reflect on the meanings as consultants withdraw. There is an alternating strength of the reinforcing and balancing loops, thus, alternating patterns of success and failures. Indeed, these loops can account for the faddish nature of TQM (Jackson, 1995) and the assumed life cycle of TQM (Gill and Whittle, 1992).

The broken lines in Figure 11.1 represent the limited participation of academics in TQM research. In theory, the practice of TQM should encourage academe to be involved in scientifically investigating TQM performance. However, L1 is rather indeterminate as loop polarity depends on the reaction of schools to TQM practice. If academe is attracted to TQM failures, then L1 becomes a balancing loop that can help B1 control the vicious circle of R1. On the other hand, if successful TQM application encourages theoretical studies to clarify meanings, then L2 becomes a virtuous circle. This virtuous circle should discourage

[34] This was suggested by Collins (1994). According to her, the failure of change programmes attracts PhD candidates either to look for ways to correct weaknesses and improve success rates, or as a post-

consultants from exploiting the market, and dominating R1[35]. In other words, the participation of academe could help improve the performance of TQM programmes. However, the present disinterest of these researchers allowed the domination of the system by consultants.

In sum, the evolving nature of quality and TQM may be traced to its natural development in practice, as suggested by Shiba, et al (1993). However, the problems faced by companies adopting the quality philosophy may be traced to inadequate understanding and appreciation of its principles. This may be traced further to the confusion brought about by the numerous possibilities and choices in terms of gurus' teachings and philosophies, consulting practices, approaches and techniques, and theoretical and practical considerations. Moreover these factors form self-reinforcing feedback loops that could only add complexity to the situation. One possible solution would have been the involvement of academics. As they are arguably more concerned with the search for truth rather than economic gains, they would be in a good position to clarify meanings and unify the TQM field. Unfortunately, many of them have stayed away from TQM research, and attempts to resolve conflicts and controversies have been largely minimal or rather delayed. The result is the domination by consulting groups of these concepts (Wilkinson and Willmott, 1995). But more alarming might be the domination of the reinforcing loops that could bring the TQM field to its collapse.

The next section looks at the same definitional problems from the narrower perspective of the organisation.

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mortem of an abandoned change programme.

[35] This analysis assumes that the involvement of academics corrects definitional problems and improves consensus. Otherwise, the resulting loops will be similar to that of R1. That is, academics could compete with consultants for clients.

11.2 Integrating research with the practice of TQM

The main objective of the interviews and case studies was to confirm the dynamic view of the TQM implementation process. What was remarkable about the interviews and cases was that each interviewee presented a different version of TQM. Whilst acknowledging the parts and interactions of the TQM integrated model, each of the interviewee chose to focus on a particular element of the model. It was suggested that each interviewee had a particular bias on a TQM element that may be due to his or her own experiences in the implementation of quality initiatives, or more probably, with respect to his or her role in such quality improvement efforts. The focus on certain parts of the entire TQM programme generally implies the centrality of certain elements of TQM. On the other hand, such narrow focus can also overlook the role of the other aspects of the entire TQM programme.

Thus, the interviews gave another perspective to problems of definitions and meanings of TQM. The experience in the cases showed that the organisational actors have their own understanding of quality and TQM so that their expectations are not necessarily the same. For example, in Company B, middle managers expect a change in policy that is consistent with TQM principles before they act, whilst top managers see middle managers as the bottlenecks of the programme. Its workers perceived their management as violating TQM principles when managers used expensive cars or met at expensive hotels. At Company C, workers argued that their activities in quality circles should be credited to their annual performance and should be compensated with bonuses. Another example was Lindsay's (1995) expectation from his former organisation that his excellent services be recognised through security of his tenure in the spirit of total quality.

These and other examples from the fieldwork highlight the subjective nature of meanings and expectations. It would seem that the interpretations of the members of the organisation vary from each other, more particularly, those of management differ from the rest of the organisation. Moreover, individual managers were seen to place varying emphasis on the objectives of TQM (e.g., quality improvement, cost reduction, teamwork, employee morale, etc.) depending on their own interpretations of TQM. This could be reflected at Company C, where participation and involvement of managers varied. The more diverse these interpretations are, the least likely that the quality efforts will succeed.

Such consensus within the organisation was observed to be determined by top management. Like commitment at the top levels, personal management style, management committee membership and organisational politics affect the meanings attached to TQM and quality. As such, consensus within the organisation is also a dynamic variable. The related variables and loops are shown in Figure 11.2.

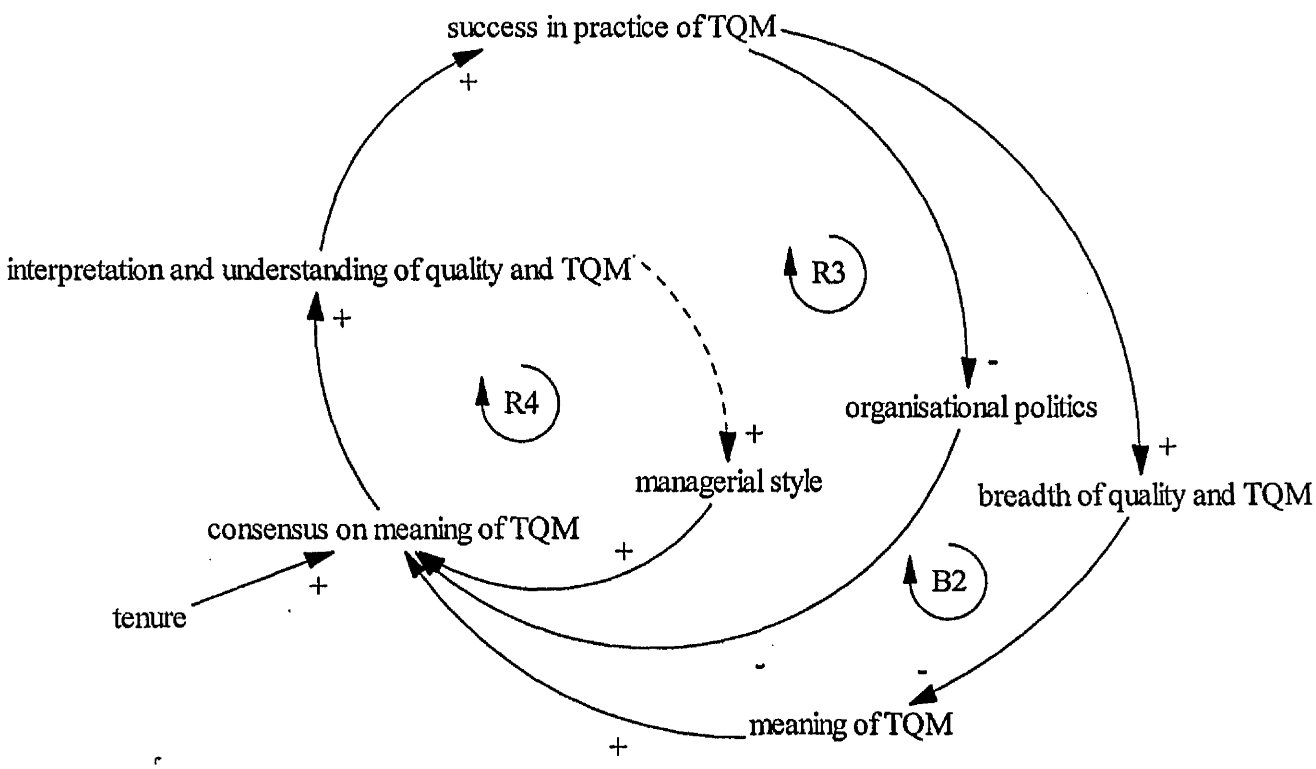

Figure 11.2. The dynamics of TQM meanings in the organisation.

Consensus is driven by tenure, personal managerial style and organisational politics. Tenure and personal managerial styles may be viewed as constant variables. However, organisational politics is rather dynamic as it is affected by performance of the TQM programme (R3). Politics in the organisation, which may be due to personal interests as in Company A or otherwise, usually breeds disagreements on policies and strategies, and therefore meanings and understanding. This limits the chances of the quality initiatives to be successful. When the programme fails to achieve its intended goals, politics may rise with the diverse explanations for the failure. It is also possible that, as Lawler and Mohrman (1985; 1987) suggested, the dissenters and 'non-believers' in the TQM efforts could become more powerful with evidence of their arguments. Nevertheless, understanding the concepts of quality and TQM become further muddled with this development. The result is a vicious circle of failure or a virtuous circle of success when success eliminates dissenters and politics.

The figure implies that within the organisation the meanings of TQM and related concepts are also evolving over time. B2 suggests a continuous re-definition of TQM. Success in TQM initiatives expands the scope of TQM. This in turn clouds the meaning of TQM, which also breeds individual interpretations and versions. Understanding becomes problematic and the next cycle creates implementation difficulties. These difficulties hold TQM development so that the scope of TQM stays at its present status. This allows for re-evaluation and clarification of meanings that can lead to better implementation performance. This could lead to changes that would support consensus rather than discord.

Two excellent examples are found in the case studies. In Company B, the decrease in the number of suggestions led to the re-evaluation of the system, which found that middle managers and supervisors were the bottlenecks of the suggestion approval system. As a result, the responsibilities of these managers and supervisors were modified to accommodate these responsibilities. In Company C, the rejection of the first batch of exports to Japan led to the evaluation of the quality control, packing and handling procedures at the plant. In both cases, the definition of quality and the scope of TQM had been adjusted to these specific situations. And more fundamentally, the earlier unsuccessful experience with quality circles led to a realisation that the narrowly focused programme needed to be expanded. The TQM programme that replaced the old quality circle was extended to accommodate not only all production personnel but also the auxiliary service departments and even suppliers. Moreover, top and middle managers' responsibilities were modified to reflect the focus on quality.

On the other hand, if understanding does not encourage learning and changes in styles, then politics might dominate the system. This must have been the case with Macmillan (1995) when she reported that one of her top managers refused to co-operate and take documentation responsibilities for their ISO accreditation application. Indeed, the manager did his assigned task only when another top manager intervened. Atienza (1995) told a similar situation from his projects. Politics was also reported in the three case studies.

The resulting structure involves a reinforcing loop that is offset by a balancing loop. As discussed earlier, this is the limits to growth model that leads to alternating domination by the loops. The results will be alternating success and failure in TQM efforts.

The broken lines leading from understanding to managerial styles represent a possible learning cycle that can control the vicious effects of politics. Consensus can develop interpretations that can encourage reflections on the suitability or compatibility of the managers' style to the concepts, principles and practice of TQM. This was exemplified in Espino's (1996) organisation where her top managers shared the same managerial styles that were consistent with TQM. As a consequence, tenure does not pose as a problem since the managerial styles of top managers were reportedly uniform and consistent with TQM.

In sum, the meaning of quality and TQM in the organisation similarly evolves from learnings and experiences within the company. This puts constant pressure on the organisation to make the necessary adjustments to conform to the needs of the new definitions. However, the interpretations of the new conception of TQM as well as its implications and adjustments are rather subjective and are open to personal biases. What is necessary is the unity of these perceptions to support the implementation of the TQM programme and politics and managerial learning would be important moderator variables that support or hinder the development of single interpretation and perception of quality and TQM.

Nevertheless, this understanding only provides the foundation for the programme as the ultimate determinants of the success of the quality efforts are the actions and reactions in the organisation. Indeed, the learnings and understanding are intangibles that do not serve any purpose until they are made concrete through behaviour, decisions, policies and actions.

The cases revealed that eight factors or actions were important determinants of TQM implementation success as they impact on the meanings attached to involvement and participation in TQM activities. These are top management visibility, middle management involvement, TQM staff training and facilitation, budget allocation, rewards provision, contribution factor and learning opportunities. These factors represent financial and temporal resources that management can allocate in the organisation as an indication of its commitment and support for the programme.

The organisation responds to the allocation of these resources as they assess management's sincerity and support for the programme and their improvement activities. The availability of these resources is an indication of top management commitment and support for the programme, which in turn encourages employee participation in the continued search for improvement. The interviews indicated that both the actual scarcity and perceived inadequacy of financial and temporal resources discourage employee involvement.

It may be noted that such discouragement from the inadequacy or unavailability of resources stems from an expectation that the proper allocation of resources is a pre-requisite to the practice of TQM. Thus, expectations are inherently related to the conception of the quality and TQM. The cases revealed, for instance, that employees were extremely sensitive to top management's visibility and personal involvement in the programme. They were also observed to be very critical of the incentive system and preferred financial rewards. A more interesting example was the perception of employees at Company C that the company president's failure to smile and greet ordinary workers was contrary to the practice of TQM.

These observations, when taken together, form a feedback loop. Top management is committed and allocates resources and behaves accordingly as to encourage participation. Employee activities can identify improvement areas that can lead to internal and external improvements, which can engender further commitment and allocation of necessary resources. This cycle can be literally called 'continuous improvement'. However, this simple feedback loop actually involves other contingency factors and moderating variables, which are integrated into the Dynamic TQM model.

11.3 The dynamics of TQM implementation

The definitional controversies, as revealed from the literature review and analysed in the preceding section, occupy a strategic role in the success of TQM efforts. While there are possible leverages that can improve understanding of its concepts and principles, such as the involvement of academe and the adjustments in management styles, a more concrete step to learning is the development of a model. Indeed, Eskildon (1994) argued that the models that are currently being used are inadequate and superficial. These, he contends, account for the inconsistent results of TQM efforts.

The difficulty in understanding quality and TQM, as earlier noted, is rooted in the constantly changing and expanding notions of its concepts. Moreover, as the broader management and organisation literature review suggested, TQM involves a number of factors that are contingent and dependent on other organisational factors, which are not necessarily free from controversies. The dynamism of these factors further adds to the complexity of the concepts of quality and TQM. Thus, the use of models, particularly system dynamic models, helps organise these diverse principles, factors and issues into one comprehensive statement.

Senge (1990) suggests that models "offer a potentially powerful basis for a language by which management teams can deal productively with complexity" (p. 268). Indeed, the present model explicitly accommodated all relevant variables and factors, suggested by the interviewees in an effort to bridge the gap between the breadth of quality and TQM and their meanings. The model included all organisational actors: top management, middle management, TQM staff and employees. Hidden and implied assumptions such as the relationship of effort to expected rewards and the effect of job insecurity, and intangible variables such as satisfaction, frustration and ability were represented in the model to make a more comprehensive model of the real system.

The use of the model can also improve on organisational conflict, and perhaps politics, as it "objectifies" discussions with the focus on structure of the problem rather than personalities. Specifically, the declines in participation rates and total projects can clearly be attributed to specific loops and a set of factors rather than mistakes of particular personnel. In the longer term, the model shows that there is a natural tendency for declines that are not related to improper allocation of resources.

Furthermore, models can be used to challenge mental models as they reveal inconsistencies in assumptions. The simulation results, indeed, offered a number of insights that clarify some beliefs about the implementation process. First, rewards and TQM staff are strong factors whilst the more commonly cited important factors due to top management visibility and middle management involvement proved to be weak factors. It was shown that the combination of strong and weak factors could improve results further. Moreover, rewards was a strong factor in the short term whilst TQM staff and the development of ability were stable factors in the longer term.

Second, the experiments revealed some counter-intuitive behaviour patterns. Improved conditions, such as higher levels of resource availability or better perceptions of organisational support, can lead to a good TQM performance, but that the inevitable declines came earlier. As a result, the total number of projects generated were less than in less favourable conditions. Efforts to control difficulty and frustration also proved futile as they yielded more frustration and fewer projects. The policy tests on the actual conditions in Company C also showed that if the problems and management errors cited by the interviewees were corrected the company would not have done better. Except for doubling the rewards, the other strategies including keeping the same number of TQM staff, increasing management time, implementing a no-downsizing policy and reducing initial participation had little impact on increasing participation and project generation in the immediate future.

Other important findings were also generated from the simulation runs. The performance of the TQM programme in the early years is due to the prevailing initial conditions in the organisation. The effects of the allocation of resources become stronger only after the effects of the initial conditions wore off. Another finding confirmed the effectiveness of a supportive top management in improving TQM performance. The tests showed that the resulting behaviour were numerically and behaviourally insensitive to changes in parameters. On the other hand, the non-supportive policy revealed that arbitrary target setting could prove a hindrance to improvement as performance is assessed against a wrong standard at the wrong time. Moreover, wrong target levels can constrain the availability of resources prematurely as to bring the system down earlier.

11.4 The search for a sustainable TQM programme

Success of a TQM programme is defined in this research as the sustained operation of a TQM programme. This is founded on the central goal of continuous improvement in quality efforts. The sustained search for improvement can only be achieved by participation efforts that do not wane and flounder. In system dynamics terms, participation, and therefore, the generated projects, should be maintained at an equilibrium level.

However, the simulation experiments revealed that such an equilibrium condition is not possible. In the short run, it was possible to have an immediate attrition of participation levels. This was mainly attributed to low initial perceptions of support and low expectations of satisfaction from the programme. The falling performance of the programme indicators (participation, indicated projects and total projects) cannot meet the organisation's expectation \s of the benefits derived from the programme as there is minimal, if no improvement at all, from the TQM efforts. Moreover, the cost of implementing and supporting the programme could easily these limited programme outcomes. In this situation, the organisation's top management may be forced to dismantle and abandon the programme. This abandonment of TQM at this stage with unrealised benefits may be referred to as "proframme failure" as the programme cost the organisation more than it del;ivered.

However, the simulations showed that constant availability of resources can reverse this initial declining trend but it was also possible that, in less than ten years, participation efforts will slip. In this latter case, the reasons involved the lower perceptions of support as available resources begin to be used up. Participants are discouraged and begin to abandon their quality efforts.

At around 15 years or so, an inevitable fall of participation activities appeared. This was caused by the effects of increased complexity and difficulty of the remaining improvement projects (Schneiderman, 1988; 1998). Difficulty in problem solving raised frustration levels that negatively affected the acquisition and retention of ability. Lower levels of ability, in turn, diminished one of the determinant factors of satisfaction with the programme leading to less motivation to participate. The decreasing satisfaction with rewards due to higher efforts expended in increasingly complex and difficult improvement activities also contribute to lower satisfaction with the programme and motivation to participate. Nevertheless, the continued decline of the programme at this time could similarly make management decide to give up the programme despite the earlier positive results.

While the programme indicators showed declining patterns at this time, the programme cannot be said to have failed. In contrast to "programme failure", this condition did not fail to achieve its objectives of quality improvement. The level at which total projects stayed up for some time would have delivered a level of desirable improvement. However, these benefits, as well as the activities that generated these positive outcomes, were not sustained. What seems to have happened in this situation is that TQM has outlived its usefulness and has reached a point of diminishing returns as more efforts cannot generate a large proportion of improvement as it used to. Thus, this abandonment of TQM after it has yielded some improvement over some years can be referred to as "programme exhaustion".

The literature suggested that the Japanese appear to have recognised the idea of "programme exhaustion" as to search for creative ways to sustain their quality programmes. The study showed that the Japanese solution to the problem, where there was a sustained level of participation and project generation, involved the expansion of areas of concern for the quality circles. This implied that the quality circles can begin with a new set of improvement projects that are relatively less complex. Interestingly, this expansion in areas of concern is exactly the expansion in the scope of the meaning of quality and TQM discussed in the preceding sections. Indeed, the effect of this loop is to balance out the adverse effects of the consultant's self-reinforcing loop.

The success of the Japanese solution in arresting the impending decline of the main indicators proves that the theoretical analysis suggested in the preceding sections are indeed realistic and effective. First, the active involvement of academics, particularly W. Edwards Deming and Kaoru Ishikawa, in the TQM movement in Japan proved beneficial to the development of understanding of quality and its principles. Whilst the former introduced the basic concepts of quality using statistical process control and supported by a new management philosophy, the latter is recognised for his work on tools with quality circles and their problem solving tools including the Cause and Effect diagram (also known as the Ishikawa diagram). Senge (1992) also reported that as late as 1979, a committee of the Society for QC

Technique Development in Japan, which included an anthropology professor, was tasked with studying how managers think and act. They were concerned with developing better communication and common understandings of complex issues, and relating that understanding to operational planning. The output of this research was the seven management tools. These tools are used to help clarify interrelationships, establish priorities, and think through and plan the complex tasks required for achieving targets.

Moreover, training is given a special and important role in the quality movement. Indeed, the initial efforts to introduce the quality in Japan were centred on seminars and training for managers. Later, learning groups were organised for foremen, which later organised the first quality circles. Weekly publications on the concepts and techniques of quality activities were provided for these foremen to study. Hayes (1981) noted that Japanese managers think 'quality in' by training workers to deliver consistently quality products supported by established standards. Lastly, in efforts to uniformly spread and explain these ideas and their benefits, national and company promotion structures were established.

Second, Figure 11.2 suggested that the change to quality-consistent managerial styles can help improve the problem of lack of consensus on meanings. An empirical study that compared American supervisors with their Japanese counterparts (Garvin, 1986) showed that the Japanese firms displayed a strong commitment to quality, organised their thinking around process control and production management, and had workers who demonstrated a concern for quality improvement. Garvin also reported that managers emphasised quality as their primary objective, policies were formulated and communicated focusing on that objective. He observed that "In Japan, a single unequivocal message was communicated to supervisors: product quality is a critical goal that all members of a firm should support" (p. 668).

As for the third approach to clarifying definitional and understanding issues, the receptivity of some interviewees to the models developed for this research indicates some degree of its success in bridging the gap between the scope its meaning and its understanding. At Wyman Gordon, Reid (1996) commented that the model indeed represented his experiences as a quality manager. In some aspects, he did not realise that these factors were related and interdependent. He said the model was useful in his work. The models were also shown to managers in the case studies. At Company B, the models were discussed at their annual management review. Although they were slightly modified as to reflect their own ideas and experiences, the models were useful in "objectifying" the managers' discussions.

In sum, the approaches described in this research are about learning and adjusting to the continuing evolution of quality and TQM. Deming was reported to have been offended with being referred to as the father of TQM. He said, "The term is counterproductive. My work is about a transformation in management and about the profound knowledge that is needed for the transformation. Total quality stops people from thinking." (Senge, 1992). Indeed, as the evolution of quality and TQM has shown, new techniques, solutions and ways of doing things are required to deal with the changes in the meanings of quality and TQM. These adjustments will be based on learning ability. C. Jackson Grayson Jr. said that "Japan's greatest long term comparative advantage is not its management system, Japan, Inc., or quality. It's the Japanese commitment to learning" (Senge, 1992).

11.5 Contributions of the study

The present efforts to study the TQM implementation process are seen to contribute to two areas of study: TQM and system dynamics.

With respect to TQM literature and research, the study is firstly an attempt to address the issues that have not been given sufficient attention. These issues, which include definitional problems (Wilkinson and Willmott, 1995; 1996) contingency factors and neglect of existing management and organisational literature (Morrison and Rahim, 1993; Wilkinson, 1993) and lack of discussion of the underlying assumptions and subtleties of TQM (Gill and Whittle, 1992), have been examined in the literature review of the present study and found to impact on the implementation process. In addition, this study heeds the call for research that integrates TQM with organisation and management fields (Dean and Bowen, 1994). Furthermore, the typical linear and static assumption by many previous studies was also examined and corrected in the present study. By addressing these issues, a number of TQM elements (i.e., variables and relationships) were identified and were later integrated into the simulation model. In other words, this study acknowledged the limits of TQM literature and corrected this gap by offering a more integrated and dynamic model to represent the TQM process. By accounting for the weaknesses that TQM literature had largely neglected, the resulting model improved on the poor and inadequate TQM models which Eskildon (1994) argued contributed to many unsatisfactory and abandoned implementation efforts.

One ironic but interesting finding from the analyses in the study points that the definitional problems on what constitutes quality and the boundaries of TQM seemed to be the key in sustaining the TQM programme. The broader definitions adopted by the Japanese (Bounds, et al, 1995; Gehani, 1993; Imai, 1986; Ishikawa, 1985; Shiba, et al, 1993) allowed them more freedom to define their concerns and responsibilities and thus, they are not restricted by definitional boundaries. Specifically, the narrow definitions of TQM and its attached activities did not constrain them from attending to the needs and limitations of the TQM programme. The expanded notion of quality and TQM, therefore, led them to apply the concepts of continuous improvement on the problem solving techniques themselves through the development of new tools and identifying new areas, tools, techniques and processes to study. This necessitated the re-definition of functions of the workers, as well as top management, as responsibility extended to and overlapped with other functional areas.

Perhaps, pragmatism led the Japanese to be more concerned with the goal of continually satisfying the customer through continuous improvement than being concerned with semantics. Understanding the needs of the customer would have meant exploring all possibilities, and which includes expanding the areas of concern. This wider perspective of TQM allowed them to view the longer-term limitations of TQM with an open mind, and search for better ways instead of accepting the limits of TQM as a natural boundary that cannot be crossed.

The study also identified a few areas that have not been identified or have not been amply discussed in TQM literature. First, the present research found that top management commitment is not a controllable variable as usually implied in TQM writings. Even the quality gurus frequently prescribe it, as if it were a simple task to be carried out. The interviews suggested otherwise, as it is affected by a number of situational variables. One of these factors, continuity of tenure in the top management team has not been mentioned in any of the reviewed materials, suggesting the assumption that commitment is constant even with changes in management.

Politics and consensus, as another situational variable, has received little attention in literature mainly because of the rational perspective of prescriptive and normative literature[36] (Wilkinson, 1993). The empirical findings from this study showed that consensus at the top can have an impact on perceptions of support and involvement by the rest of the organisation, and thus affects the long-term viability of the programme.

In contrast, factors affecting employee participation have been rigorously investigated and analysed (e.g., Allen, et al, 1997; Dean, 1985; Lawler and Mohrman, 1985; 1987). Nevertheless, many of these studies, as they are founded on organisation behaviour methodologies, have not viewed employee involvement from a more dynamic perspective. The case studies bore out the dynamism of interest in participating in TQM activities as this interest fluctuated over the years depending on perceived support and satisfaction.

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[36]McCabe (1995) is one of the few studies of politics in top management.

The findings of the research also point to the limits of rewards in motivating employees to participate in TQM activities, an observation that has not been mentioned in the reviewed literature. This study found that rewards have a short-term impact as long term increases in expectations diminishes its motivating strength. Such recognition of the weakness of incentive systems is important in the light of the debate on the use of rewards as motivation tools. TQM literature seems to be unmindful of the running controversy on the use of rewards within TQM literature itself and general organisational behaviour literature[37]. The findings here suggest that it is important for TQM to acknowledge this controversy and examine the literature written about rewards so that its simplified prescriptions will not be misleading to practitioners.

As for system dynamics, the present effort to study TQM adds to the growing system dynamics literature that studies TQM. In particular, the System Dynamics Group at MIT in the US has embarked on a programme to investigate TQM practice. The difference of the present study from the earlier papers, as mentioned earlier, lies in its focus. Whilst previous studies traced problems with TQM difficulties to the highly coupled interactions in organisational functions (Kofman, et al, 1994), the present model adjusted its lens (Wolstenholme, 1990) more closely to the interactions of management and employees. Thus, the present model enriches earlier models as it investigates the dynamics of motivation to participate in TQM programmes.

[37]Within TQM literature, TQM gurus such as Crosby (1979) and Deming (1986) take the contrary position to financial rewards whilst some consultants prescribe the use of monetary incentives. In the broader organisation literature, the use of rewards as motivating tools were debated in a Harvard

Furthermore, the model simulation found a number of results that have not been identified in other system dynamics studies, or in TQM research, in general. The theoretical findings on counter intuitive behaviour, the impact of initial conditions on the early years of the programme, the hidden effects of the contribution factor and the unanticipated negative consequences of maximised participation and project generation, among others, provide a better understanding to the dynamics of TQM implementation. The simulation experiments, as they show these unintended outcomes, should provide managers and practitioners a guide to more realistic expectations from TQM. Moreover, the tests suggest the simple linear thinking that commitment directly leads to success and positive benefits, is fallacious and unfounded.

A more specific contribution of the simulation experiments to TQM research is the finding on the criticality of the TQM factors. The series of tests showed the relative importance of the different factors and their impact on the quality initiative. Furthermore, the tests demonstrated that there is some compatibility among the strong and weak factors. These observations go beyond the typical statistical approach using correlation and similar measures and relying on quantified opinions. In contrast, the present study derived its conclusions from the effect of the factor's presence (or absence) to the future of participation and improvement efforts. This methodology represents, at least to this researcher, a different, if not novel, approach to understanding criticality of factors. This strategy offers a more objective way of confirming and evaluating factors, as opposed to the subjective, perhaps biased, opinions of participants, managers or consultants.

Business Review article (1993) that focused on Kohn's (1993) arguments why incentive plans do not work.

Finally, the study added to the small literature that bridges the gap between behaviour and structure that typically characterised writings in TQM. Pasternak and Berry (1993) and Atkinson (1991) drew the behaviour of some variables of a TQM programme without clearly explaining the structure underlying such trends. On the other hand, Lawler and Mohrman (1985; 1987) and Chevalier (1991) explored some details of the interaction of factors but did not explicitly draw the expected behaviour. The present efforts attempted to integrate both positions (mainly as this is part of system dynamics approach) and even found other behaviour patterns. This must be a significant contribution as the behaviour patterns provide a simple, concise visual tool for practitioners and managers to temper their high expectations of TQM, as well, as understand their roles in the programme. Moreover, the study showed that TQM could lead to both success and failure depending on the management of resources as well as the balancing loops.

11.6 Toward a contingency theory of TQM: some research possibilities

One of the criticisms against TQM is the universal appropriateness of its principles (Dean and Bowen, 1994; Jackson, 1995). The prescriptions of quality literature assume that their ideas and principles are free from context and conditions within the organisation (Crosby, 1979; Deming, 1986; Juran, 1988). Indeed, the history of TQM showed that the original production-based quality principles have been adopted in the service and government sectors (Tuckman, 1995). Jackson (1995) suggested that those who propagate management fashions, including TQM, "appear to know the answers before they actually do research" (p. 36). Moreover, Sitkin and his colleagues (1994) noted that advocacy of the universality of TQM without attention to the nature of uncertainty faced by the organisation can lead to inappropriate and ineffective implementation. They further suggested that indeed TQM failures reported in the popular management press might be explained by this assumed universality of TQM. They also argued that "TQM is not a panacea that can be unthinkingly used, but that it must be implemented with a clear sense of the degree to which context is characterised by uncertainty, non-routineness, and/or instability" (p. 538).

Indeed, TQM may be found to be successful in some organisations and not as effective in others because of certain contexts. These may be explained by the underlying principles and assumptions of TQM and how they relate to organisational and external conditions. The review of literature in Chapter 3 particularly those written by Allen et al (1997), Morrison and Rahim (1993), Ferris and Wagner (1985), and Miller and Pritchard (1993) suggest the contingency factors that determine the participation of employees in organisational programmes. Kekäle and Kekäle (1996) proposed a model that matches a version of TQM to the cultural assumptions prevailing in the organisation. Sitkin et al (1994) suggested certain conditions about the task, product/process or organisational conditions call for the use of two versions of TQM, Total Quality Control (TQC) or Total Quality Learning (TQL).

The findings of the present research also suggest a contingency perspective. The early years' performance of a TQM programme is dependent on the prevailing conditions at the launching of the programme. These conditions, which are primarily, perceptions and expectations of the programme largely drive the initial efforts of participants. These perceptions and beliefs are mainly shaped by past experiences with earlier programmes and interactions with management. Thus, it is suggested that poor initial conditions such as perceptions that management is implementing another 'flavour of the month' programme, will lead to immediate failure or a declining pattern of behaviour for participation at the outset. High expectations and positive belief in management initiatives will encourage participation and lead to fair performance in the early years. Thereafter, the real involvement of top management and the availability of resources will determine further performance.

The effect of initial conditions, perceptions and expectations on the performance of the TQM programme in its early years should be investigated further. As far as this researcher can determine, the question as to how influential the preconceptions and expectations of employees on the initial quality efforts has not yet been investigated. Some of the studies that considered initial beliefs and assumptions about TQM have been carried out to determine if there were changes in attitudes as a result of adopting TQM (Guimaraes, 1996; Harber, et al, 1993; Hill, 1993). However, their effects on the success or failure of the programme were not considered. Indeed, the study of initial conditions will contribute to further understanding of TQM implementation efforts.

The literature on employee participation and motivation (Miller and Pritchard, 1992; Allen et al, 1997) can guide the research into this field. A number of instruments can measure initial attitudes such as Hill's (1993) use of the Minnesota Satisfaction Questionnaire (MSQ) to determine attitudes of quality circle members and Company B's regular use of the Organisation Climate Survey (OCS) to monitor employee attitudes to TQM (Macapagal, 1996; Mendoza, 1996). Some TQM measurement instruments have also been developed by Benson and his colleagues (1991) and Flynn et al (1994).

However, it is recognised that proving the effect of initial perceptions on the success of the programme is not an easy task considering that the research will have to be conducted prior to the launching of the TQM programme. Some caution on the validity of the collected data must be exercised if the attitude measurement were done after the start of the programme.

Other contingency research possibilities are suggested by this study. One of the more important research areas that can be explored is the development of top management commitment. Literature has not given much attention to top management commitment as in "binding or pledging of oneself to a particular course of action" (Kiesler, 1971). An earlier review of literature revealed that "commitment" is defined in organisational literature in relation to employees' intention for continued stay in the organisation. In other writings, it is related to organisational citizenship behaviour or loyalty and sometimes to absenteeism. Indeed, Gilbert's (1990) research revealed that there is no common definition for the term 'commitment'. This is yet another issue to be added to the long list of ambiguous and unclarified meanings in TQM.

Some writers have suggested a few contingency factors that affect top management. An earlier paper indicated that one contingency factor that determine the need for top management involvement is the size of the organisation (Boerstler, 1996). Motwani et al (1994), on the other hand, suggested that distance from operational control does not require top management involvement.

However, this thesis argues that research should focus more on the determinants of commitment, the continuity of commitment and the politics of commitment mainly as top management commitment is a necessary foundation variable of TQM. Even Boerstler (1996), who observed that management involvement may not be required or important in some cases, admitted that eventually top management support became necessary, especially in interdepartmental improvement activities. The study of the determinants of top management commitment can clarify the prescriptive literature's implied belief that commitment is a stable variable that can easily be achieved as well as clarifying top management's role in TQM. The study of politics in top management teams, as they determine actual commitment as well as visibility and involvement, can indicate that the management of TQM is not a straight linear process but does involve conflict and consensus. Thus, managing the TQM programme is not a necessarily easy task even as it involves self-reinforcing feedback loops. These loops still depend on the consistent and uniform top management attention as well as other resources. Lastly, the study of continuity in top management levels raises the issue of TQM being able to replace leadership in the organisation.

Although not a specific domain of TQM, a study of the reward systems may help improve the implementation of TQM. In particular, the short-term effectiveness of rewards as a motivating factor can be explored to identify better and more effective incentives for participation. Nevertheless, this thesis recognises that TQM as an advocate of the non-use of financial incentives is directly involved in a debate on the uses of incentives as motivational factors. The contrasting position of gurus with the positive view and desire of employees and workers with respect to monetary rewards may better be viewed with more researches into this area.

Another area that may prove to be interesting and useful is a detailed study of Schneiderman's (1988; 1998) half-life concept of improvement and the complexity and difficulty it entails. The simulation experiments pointed to the inevitable decline of the programme in the long term due to these variables, and efforts to reduce their effects can prove to be important in the search for sustainable TQM.

An interesting question that deals with the non-uniformity of implementation of TQM in the different departments and functions was raised during the conduct of the fieldwork. It was observed that in two of the case study sites, the marketing department did not perform as well as those in production and other departments in organising quality circles or making improvement suggestions. A suggested research topic would be the investigation of the effect of differences in degrees of internalisation of the quality principles, or motivations, or functional need to implement TQM.

Finally, the simulation model presented here can be extended to include organisational processes that were suggested by Bong (1993), Kofman, et al (1994) and Özgökmen (1995). The dynamics introduced by the variables suggested in this research can interact with those of product development, production, marketing and the market. A second possible extension of the present model will involve relaxing the assumed constant top and middle management time allocation and new feedback loops be included to model the time requirements of other managerial tasks. Minztberg's (1973) classic study on managerial work may be useful for this model. Added dynamics are expected as management time become variable and interactive. A further possibility is the development of the model as a 'management flight simulator' (Morecroft, 1988). It may be used particularly for training top managers to understand the underlying assumptions, conceptions and processes of TQM.

In sum, the studies that are suggested here should highlight the contingency and holistic perspective of TQM. It is recognised that a number of variables in the practice of TQM are dependent on conditions and contexts that will consequently have an impact on the success of the implementation efforts. The implicit assumption that these variables are context free simplifies the complexity in which the organisation, the environment and the TQM system interact. This simplification is seen as not improving and contributing to the chances for success and sustainability of TQM efforts. Rather, the diverse and numerous factors that impact on improvement efforts can discourage practitioners and managers into adopting the programme. However, a contingency-based holistic model can organise these various ideas and concepts to contribute to better understanding and appreciation of TQM. Lastly, future work on this area should weigh their research objectives and consider Hackman and Wageman's (1995) observation that much of TQM literature includes "simplistic before-and-after evaluation studies that may be of more use politically in promoting TQM (or, for sceptics, in debunking it) than they are in building knowledge about TQM processes and practices" (p. 343). Moreover, to truly contribute to the development of TQM as a field, researchers should be concerned with clarifying meanings and resolving controversies regarding quality and TQM. Ultimately, the unity of meanings can improve the practice of TQM.

11.7 Toward better implementation of TQM: some implications for practice

The present efforts to study TQM aimed at examining the underlying principles and interactions of quality efforts in order to gain a better understanding of TQM. The literature review showed that the failures of prescriptive writings to explain and deal with the deeper assumptions of TQM have led to misconceptions and misunderstandings that, to a certain extent, caused the collapse of some quality initiatives. A better appreciation of its implications and consequences can contribute to proper implementation of TQM.

The identification of strong and weak variables in this study can guide practitioners to focus their attention either on establishing the strong variables, or combining strong and weak variables, especially in cases where there are limited resources. The experiments showed that improving the level of weak resources (i.e., the rates of implementation and managerial attention and time) do not significantly lead to more participation nor generate more total projects. Thus, practitioners should take advantage of the considerable effects of the strong variables instead.

The tasks of the TQM staff in developing new skills can not be underestimated considering its strength in establishing the motivation to participate as well as the motivation to hold meetings and propose projects. In other words, it is a key variable that triggers the TQM engine of core reinforcing loops. Perhaps, the thrust that can be adopted in TQM programmes should be toward the development of learning organisations as recognised by previous system dynamics studies (Ambali, 1987; Bong, 1993; Kim, 1992; Senge, 1990; 1992).

On the other hand, despite the relative strength of rewards in motivating employees, its limited and short-term effectiveness requires caution and more careful planning. This weakness of incentive systems highlights the need for the proper design of reward systems. One way to extend the effectiveness of rewards is the constant enhancement of the novelty of the incentives. In one of the case studies, the novelty of rewards was maintained by a constant change in rewards and prizes. The non-announcement of each month's reward and the thought that this month's prize is more valuable contributed to the continued excitement of participation. This could be related to the expected satisfaction with the outcomes of participation, or the valence or preference for participation.

Nevertheless, efforts to improve the allocation of resources, such as increasing top management time involvement or controlling the negative effects of participation on middle managers or even raising rewards, should be viewed with caution because of their counter intuitive effects. The simulation showed that improved conditions and higher allocation of resources, indeed led to higher peaks or earlier recoveries, but actually generated fewer total projects over the entire simulation time. Moreover, the decline of the programme was observed to be earlier. Indeed, these counter intuitive results can discourage, even disillusion, managers and implementers of the programme.

The effects of initial conditions should also be considered in the implementation of TQM. The first years of the programme were shown to be dependent solely on the initial conditions. This suggests that the early efforts to introduce TQM in the company should be focused on improving perceptions of employees. Past unfavourable experiences must be corrected through better communication, improved systems and procedures and training. In the companies that were studied, these initial perceptions were improved through discussions with the union leaders and constant assurances about management sincerity and support for the programme. Moreover, the training sessions highlighted the benefits and outcomes that can personally accrue to the employees; most important of which was that continued existence of the organisation could ensure their jobs.

Similar attention and equal importance must be given to middle managers as the rest of the organisation. After all, these operational managers will deal with the daily problems and difficulties of the teams and individuals. Their own perceptions about the programme (e.g., the importance of the programme, top management sincerity and support, the security of their own positions and tasks, effects of their subordinates' participation on their responsibilities and assessment of their performance) and their understanding of their roles in supporting improvement activities must be clarified and corrected. Otherwise, there could be incongruence between actual and ideal TQM performance.

The awareness of the initial effects of preconceptions on TQM performance can contribute to the design of monitoring systems, the setting of targets and the corresponding policies. Targets must not be too high as to discourage the allocation of resources, particularly at the outset of the programme when members of the organisation are beginning to learn new skills and are not yet as effective. The simulation experiments demonstrated the disadvantages of unsupportive policies and highlighted the effectiveness of supportive policies. The lesson from one of the case studies can be emulated: the programme was monitored but not assessed against expected outcomes and targets in its early years. The data that was gathered was used to further identify the weaknesses of the implementation efforts in order to correct and improve on them and to allow additional learning through trial and error. Moreover, such learning developed in the workers additional confidence in these new activities.

The observed inevitable slide of participation and total projects in the longer run can be viewed with more optimism. It can be seen as a challenge to expand the operations of improvement activities, just as the quality circles programme was expanded to TQM. Indeed, Lawler and Mohrman (1987) argued that quality circles should evolve into ways as to maximise benefits that can be derived from them. They can expand the kinds of decisions they make into the areas of strategy, design and operations as task forces; delegate authority downwards to work teams; or restructure the organisation as to integrate and support the quality circle as the basic building block of participation.

Another alternative is to identify more effective means of handling and resolving problems. Schneiderman (1998) observed that there are certain types of problems that are highly complex, interactive and dynamic. The typical 7 QC tools and 7 management tools are found to be ineffective in dealing with these type III problems. He suggests that simulation modelling can be used for analysing and improving Type III processes. Furthermore, he proposes simulation modelling as "a means for further extending the boundary of applicability of TQM" (p. 45). Kim (1992) is more specific as he offers the system dynamics version of the 7 QC tools.

Thus, the management of the TQM programme is not a straightforward and easy task. Like general management, it suffers from both short term and longer-term threats to its maintenance and continued existence. If the organisation manages to hurdle the short term problems and difficulties that involve resource availability and effectiveness, then it will face a future that is threatened by inevitable negative effects of increased complexity of improvement areas and consequent frustration. Therefore, it is suggested that management not only be responsible for efforts to sustain the programme through proper resource mobilisation but that management commitment be re-conceptualised and expanded to include the continued search for new areas for improvement activities, the search for new techniques that can facilitate problem solving, and the co-ordination of functions as to handle interdepartmental problems and concerns.

Evidence from literature and the cases indicates that initial efforts to identify the areas of operation for quality circles are not very difficult.[38] What may be problematic is the adjustment that is required after the initial years. First, the failures of some circles to identify new problems and the inactivity of other circles may

[38]Some controversies actual occur in the introduction of quality circles. In one company that this researcher observed, the first quality circles insisted on choosing low wages as their problem. A long argument with the facilitator ensued. Apparently, the objectives of the quality circles were not adequately explained nor fully understood, nor the exceptions to issues to be tackled by circles, including wages and other labour union issues, clearly specified. Nevertheless, most comprehensive

not be clearly and explicitly recognised as being caused by the increasing complexity of the remaining improvement areas. The 'blaming' culture may point the reason to lazy and unmotivated circle members, leaders or facilitators or to higher workload and pressure. Second, top management may not have time to reflect on these difficulties of the quality circles, not to mention the time to act on these. Nevertheless, the Japanese showed that it is possible to handle both short and long term threats to TQM.

The experiments in this study suggest that the problem of managing TQM is rooted in a reinforcing loop that is made up of participation activities, difficulty and the search for new areas of concern. As participation activities and projects increase, the level of difficulty rises to trigger management to evaluate the programme and find new areas of concern or new products, processes and tools to improve on. This, in turn, will lead to the identification of more projects and later new levels of complexity in problem areas are reached. This requires further adjustments to the programme.

The reinforcing nature of this cycle puts management in a constantly more difficult situation. There is an increased challenge for it to find new ways for its quality circles or teams to operate and identify improvement areas at each cycle. But given the numerous tasks that need management attention, there is a rather high possibility that top management will miss the succeeding cycles of this loop after the launching of the TQM programme. Once the cycle is broken by inattention to the difficulties faced by its teams, the loop will tend to shift toward the opposite

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training programmes, including those cases in this research, were successful in explaining the limits of quality circles, making their introduction smooth and uncomplicated.

direction leading to a spiral of decline in participation activities and management attention. Ultimately, the programme collapses.

Indeed, there are problems in dealing with reinforcing loops. They are either positive and virtuous circles or negative and vicious circles. One weakness of prescriptive TQM literature is that it highlights only the positive side of quality improvement and participation so that it would seem that employees will ceaselessly be interested in involving themselves in the quality improvement efforts. TQM literature overlooks the situation where the reinforcing loop can also work in the opposite direction. As seen from the preceding discussion, the change in direction that turns the loop to a vicious circle is due to a limiting variable: top management time and attention. Once the limit is reached, negative signals will be sent to employees as to become disinterested in participation efforts.

Furthermore, what makes managing TQM more challenging is that apart from this reinforcing loop in its 'driver' (management), it also involves another three reinforcing loops of ability and satisfaction in its 'engine'. Thus, when the driver fails, it brings down with it the entire engine. This must be an appropriate analogy for the centrality of top management commitment and involvement. This should also emphasise the necessity of top management's involvement as it cannot neglect nor abdicate its responsibility to quality, not even once. Otherwise, the negative spiral of these reinforcing loops will altogether bring the system down.

To sum up, the managerial implications of the study seem to echo the prescriptions in TQM literature. However, care has been taken not to emphasise the 'correct' actions but more focus is placed on the consequences of such actions. More importantly, the negative undesired outcomes are highlighted to help managers and practitioners make more realistic goals (as opposed to the ideal goals suggested in prescriptive literature[39]) as the achievement of these goals are moderated by other contingency factors and time delays. Furthermore, the more comprehensive picture of the implementation process, which includes the usually dormant loops and the latter virtuous/vicious loop involving participation and search for new areas and applications, should provide management with a guide to the complexity and dynamism of TQM. These characteristics of TQM should encourage practitioners to be on constant guard against complacency. The pursuit of continuous improvement, indeed, requires unending continuous activity, focus and involvement.

Thus, the central argument of this research lies in the irrelevance of linear thought processes. The simplified linear cause-and-effect thinking is not appropriate to complex problems such as the management of a TQM programme. The interdependencies and interactions of variables, functions and goals make direct linear thinking inadequate and ineffective in predicting outcomes of the TQM programme. As a result, unfulfilled expectations cannot properly guide the development of good decisions and policies that will fully support the improvement activities. With the Dynamic TQM model, the relationships between TQM and organisational factors become explicit as to help in understanding this non-linear outputs and unanticipated effects. Moreover, the simulation model contributes to further learning by experiments and tests, without the necessary time delays in real system implementation. In addition, more appropriate policies that are compatible to

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[39] This is mostly applicable to the counterintutive results from improved conditions and adequate resources. Practitioners will find it ironic that more managerial support will lead to a lower number of

TQM practices can be designed, and later tested for efficacy and effectiveness before actual implementation.

11.8 Limitations of the study

This research recognises that its findings and conclusions are limited by some simplifying assumptions and weaknesses of its methodology. Thus, this section presents these limitations as caution to the uses and implications of its recommendations.

The first weakness of this study lies in the limitation of the software package, Powersim™. The possibility that there are computational errors can weaken the theoretical findings and their corresponding implications. The weakness involves the computational errors that might have been introduced by unseen operations of the software. These computational errors include rounding off of figures and division by zero. Unlike the older versions of Dynamo™, Powersim™ does not flag up division by zeroes. The simulation and computations are continued without concern for these possible computational errors. The only way these errors can be detected was through manual checking of the variables. Although it was difficult to manually check all the variables, care has been taken to investigate and minimise the occurrence of these errors.

The second limitation of the research involves assumptions on the exogenous constant variables, as well as other parameter values. These constant variables include top and middle management time allocated to TQM activities, relative value

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total projects and earlier decline of the programme.

of the rewards and target number of contributions. The assumption that these variables are constant have been inferred from the interviews in the case studies, and in some instances, the interviewee asserted that the factor is indeed a constant and unchanging over the past years. What the interviews suggested was that the perception to these factors were variable. However, it is still possible that these factors are variable and can introduce other dynamics and behaviour patterns.

As for other parameter values, care has been taken to adjust the figure as to reflect the actual conditions and situations, especially for the initial values of the level variables. The assumed values were confirmed with the interviewees. Moreover, a series of runs were devoted only to estimating, as close as possible, these values. As shown in the summary statistics, the model using the assumed values closely reproduces the actual historical behaviour. Nevertheless, it is recognised that since these parameters are intangibles and usually not measured, then there is still some degree of error that is introduced.

Corollary to this limitation, the third weakness of the methodology deals with the boundary of the problem. The boundary, as suggested earlier, was chosen to reflect the concerns of the company case study. Thus, it did not consider the dynamics that might have been introduced by departmental interactions and market dynamics. Moreover, the dynamics introduced by variable management factors may also alter the results of the study.

It is also possible that a different set of variables and their interactions can reproduce the same behaviour patterns. Whilst this observation applies to most modelling approaches including system dynamics, TQM makes the identification of the relevant variables less comprehensive because of its encompassing nature. The totality of TQM makes most organisational and management variables part of its implementation structure. Areas such as leadership, interdepartmental co-operation, and performance appraisal, to mention a few, are inherently part of TQM and would have introduced other variables to the model. The evolving nature of TQM would have added still a number of variables. Nevertheless, the study asserts that the interaction between management and employees are sufficient to explain the observed patterns of behaviour in participation, total projects and indicated projects as shown by its ability to replicate observed behaviour patterns. In other words, the assumed relationships and values endogenously reproduced historical patterns.

Overall, despite these possible sources of errors, there is a high degree of confidence on the results of the study mainly as the approach taken closely grounded the model to literature and empirical data, and that accepted tests of confidence were conducted on the resulting model.

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THE DYNAMICS OF TOTAL QUALITY MANAGEMENT IMPLEMENTATION: A COMPUTER SIMULATION-SUPPORTED CASE STUDY

VOLUME 2

BY

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CHAPTER A1
INTRODUCTION

This second volume of "The Dynamics of Total Quality Management Implementation: A Computer Simulation Supported Case Study" is intended for the researcher who is interested in a further understanding of the model developed and presented in the first volume. The first volume was designed as an essential reading for the design and main findings of the thesis. This second volume, on the other hand, presents the details and insights into the development of the model as well as the tests conducted to establish theoretical validity of the Dynamic TQM Model. The level of detail as well as technical nature of the discussions were thought to affect the clarity and flow of the discussions in Volume 1 so that they were presented in a separate volume.

The first part of this second volume aptly presents a closer look of system dynamics models of TQM or its parts. It examines the structures of the TQM models and delves further into the weaknesses of these studies. Some of these weaknesses, which were found to be important in the literature review as well as in the cases, represent the gaps that were addressed by the Dynamic TQM Model, as presented in Chapter 8.

The next two chapters deal with tests that form part of steps in the system dynamics methodology. Chapter A3 discusses the initial runs of the model developed in Chapter 8. These initial runs intended to study the behaviour resulting from the proposed interactions in the model. It thus tests the consistency of the structure to the generated behaviour pattern. Later, these behaviour patterns were compared to the general behaviour patterns suggested by Atkinson (1990), Marchington, et al, (1992) and Pasternak and Berry (1994) as presented in Chapter 4. These comparisons represent the initial test of the model's ability to replicate generalised behaviour patterns.\

Chapter A4 further tests the model by applying varying levels of inputs. This is intended to test the consistency of the model's ability to generate the expected behaviour. These tests are also intended to identify weaknesses and inconsistent outputs from the simulations. Although not explicitly discussed in the chapter, the tests were used to fine tune the values of some of the parameters as well as closedly examine the assumed relationships.

The appendices form the last part of this volume. The first deals with the popularity of TQM as a topic for articles indexed in the BIDS catalogue. The second appendix presents the major steps advocated by three leading TQM gurus: Philip Crosby, W. Edwards Deming and Joseph Juran. The last appendix shows the model details: the stock flow diagrams of each module of the Dynamic TQM Model followed by the equations relating the variables.

CHAPTER A2
SOME SYSTEM DYNAMICS STUDIES

The review of literature in Chapter 3 and 4 in Volume 1, discussed and examined general studies that dealt with TQM. Chapter 3, in particular, identified the more common factors that hindered or supported TQM initiatives and efforts. On the other hand, Chapter 4 showed that some TQM analyses, indeed, support the thesis that TQM is a dynamic process and involves interacting and interdependent factors such as those discussed in Chapter 3. Chapter A2 continues a review of literature and deals specifically with studies that integrates some of these factors as suggested. These studies which utilised the system dynamics approach identified a specific problem behaviour, proposed a dynamic hypothesis, or the problem generating structure, and simulated the model to replicate the identified behaviour.

This chapter was placed as part of Volume 2 as it deals with some technical terms specific to system dynamics field that could disrupt the understanding and flow of the thesis in the first part. The discussions in Chapter 4 were deemed sufficient to highlight the point that the dynamic nature of TQM and the interdependence of factors can be modeled using equations have also been recognised in fields other than system dynamics. In this chapter, a more specific review of system dynamics studies is presented to identify their limitations as well as strengths.

A2.1 System Dynamics Studies

A simple model on employee participation involving only two major feedback loops (Mutuc, 1994) generated some cycles of increasing participation, peaks, declines, then recovery. It was suggested that these could be similar to the predicted cycles by Ramsay (1977). However, this paper offers an alternative explanation to the 'cycles of control' theory. In this simulation model, the cycles were due to perceptions of diminished resources allocated to the employee involvement programme. Although there is a fixed budget for the programme, increased interest and participation proportionally uses up the available budget. Thus, there are less available funds for new participants and new projects. The participants see this situation as lack of management support for the programme. Once other employees stopped participating, some resources begin to be available. This encourages employees to become involved again and the cycle continues again. However, the model is largely simplified and suggests that there are other loops that are operative in the participation programmes. Thus, more comprehensive models are needed to explore the reality of cycles of managerial interest in employee involvement initiatives.

One of the earlier works using the system dynamics approach on quality related issues is Ambali's (1987) study of quality circles. The quality circle programme was conceptualised using innovation diffusion and organisational behaviour theories. Innovation diffusion theories suggest the interactions between potential adopters, adopters and rejecters of the innovation. In this study, potential adopters become adopters (quality circle members) when they recognise the positive impact of joining circles from their association with current members. Testing the model on an organisation that exhibited a growth and collapse of its quality circles, Ambali concluded that technological constraints caused the decline of the circles. The increase in problem solving time caused demotivation of the quality circle members who later stopped meeting, indicating that adopters became rejecters. He also found that rewards and increased training did not substantially improve the situation, nor prevent the collapse of the programme.

One weakness of the Ambali (1987) model was that the motivating factors that encouraged participation were limited to two factors. The first factor, effectiveness of quality circles, reflected the ability of the quality circles to identify and solve problems and was modelled as a function of problem solution time. The second factor, organisational support to the programme, was represented by the ratio of adopters to non-adopters, indicating acceptance of the programme by the workers. Ambali's model did not include a number of variables that TQM literature (Fabi, 1992; Hill, 1991; 1995; and discussions in Chapter 3) has found to be very critical in the implementation process. Among these variables are top management commitment, middle management involvement and, resource allocation that also indicated support for the programme.

More recent system dynamics studies on TQM have accommodated these variables and further set the TQM programme within the wider organisational perspective. Bong (1992) developed a model of the interactions of marketing, production and inventory, quality improvement and finance, and sequentially added some aspects of the TQM programme. These aspects included management aggressiveness in pursuing quality objectives, quality of design, economic quality of conformance, learning ability and employee motivation. He found that these TQM aspects did little to improve the 'limits to growth' behaviour of the interaction of the organisation's functions. However, the simulations and analysis showed that learning could lead to a more sustainable commitment to quality. He concluded that "they (organisations) should ease off relying on quality improvement packages but attempt to create an organisation incorporating conscious day to day decisions directed toward maintaining a quality conscious organisation" (iii).

Kofman et al (1994) investigated and replicated the unanticipated side effects of a successful TQM programme. Analog Devices Inc.'s quality initiatives resulted in improvements in product defects, yield and cycle time. However, in the same period, its share prices and return on equity fell, and the company was forced into its first-ever layoff. The model they developed was more comprehensive than the Bong (1992) model as it further included product development, research and development spending, a stock market sector and an aggregate competitor sector. Its TQM sector included quality improvement, process improvement, and workforce commitment and management support. They explored the paradox of unforeseen outcomes through simulation experiments and found that the TQM system with its product and process improvements can interact with prevailing accounting systems and organisational activities to create excess capacity, financial stress and pressures for layoffs, which eventually undermine commitment to continuous improvement. Moreover, the study highlighted the effects of unbalanced impact of improvement activity on the different parts of the organisation. Improvement rates depend on the technical and organisational complexity of the processes. The problem behaviours have been generated by this uneven improvement as activities with low complexity, which tended to be capacity augmenting, rapidly improved, in contrast to demand generating activities such as new product development and customer needs assessment which had high complexity and were slow to improve. One noteworthy simulation experiment dealt with the situation where the organisation did not adopt TQM and market conditions were the same. The simulation showed that as a result, the company would have lost its market share as competitors adopt TQM, revenues would have fell by 80 percent, stock prices would have sharply declined and the layoff would have occurred earlier.

Özgökmen's (1995) model, which was calibrated using data from a telecommunications company in Turkey, also involved marketing research, product and production design, market, cost management and production. The relevant TQM sectors included self-commitment by employees, top management commitment and goal formation and assessment. The experiments supported TQM literature that suggested critical importance attached to the top management commitment, adopting a long-term perspective, minimum resistance to change and updated competitor knowledge. The model also tested two versions of TQM, the traditional TQM and the extreme version in two different settings: a quality conscious market and a price conscious market. The simulation experiments showed that the extreme TQM company performed well in both market conditions. On the other hand, the traditional TQM company may not perform well. The author suggested that in the traditional TQM company, quality improvement efforts result in significant cost increases that could ruin the entire system.

These studies all recognised the importance of top management commitment and employee motivation as reflected in the centrality of the variables as they drive all improvement activities. Bong (1992) integrated top management commitment by the management aggressiveness variable. He defines this variable as "managerial characters of top management levels who practice leadership in daily managerial tasks" (p 21) in order that the organisation will perform well and achieve the target. Management aggressiveness drives the quality improvement activities as they aim for improvements in quality of conformance. It also affects the internal motivation of employees to pursue the quality goals.

This management aggressiveness is a negative function of market share, recognised quality of conformance and cash ratio. Thus, positive changes in these variables lead to lower management aggressiveness to push the quality improvement programme. In other words, management loses its interest when quality reaches higher levels or where market shares improve.

Kofman et al (1994), on the other hand, represented top management commitment as effort by management to push the programme. Its direct effect is on training, which, in turn, drives employee commitment. Management effort is a function of the adequacy of resources (advice and support from quality experts) and the effects of financial stress. The adequacy of resources is further shown to be dependent on the results achieved by the quality efforts. Thus, this variable is rather similar to Bong's 'recognised quality of conformance' variable.

Unlike the two other models, Özgökmen's (1995) model conceptualises top management commitment as an accumulation. This level of commitment determines the level of emphasis for quality improvement activities. But similar to the other models, management commitment is based on short-term financial stress and the effect of results of improvement activities. In addition, the effect of goal achievement also encourages more management commitment. A fourth factor, management attention to TQM, indicates the maximum possible management commitment level.

A comparison of the three formulation of top management commitment shows that they are governed by the same factors. Management is assumed to be affected by financial concerns and the need to justify their commitment by concrete results. However, the Bong (1992) model included the ultimate goal of the TQM programme, market share improvements. This objective may introduce more dynamics into top management development because market share improvements involve longer delays than improvement activities or financial positions. Thus, it is possible that the commitment by top management to the TQM programme may decline mainly as the results of the current efforts on market share will be felt only after several years. This omission by the two other models may possibly affect their results.

Another difference among the three models is the representation of commitment as an auxiliary variable in Bong (1992) and Kofman et al (1994), instead of an accumulation in Özgökmen (1995). The implication is that commitment of top management instantaneously changes depending on the influencing variables. This formulation implies a rather fickle-minded management that shifts its commitment as quickly as results change. This quick-changing management is contrary to the kind of management that prescriptive TQM literature envisages - to be steadfast in its philosophy and constancy of purpose (Deming, 1986). Özgökmen's formulation as an accumulation follows this perspective better in that the present level of commitment is a function of past commitment. Any changes in the determinant variables only incrementally affects current commitment, depending on the length of the adjustment time.

The second important aspect of the TQM aspect of these models is employee commitment. Bong (1992) identified two sources of motivation. The first, external motivation is solely driven by the cash ratio. This implies that a company's favourable financial condition will provide better compensation packages to its employees. The second source of motivation is internal motivation. It is driven by recognised quality of conformance and recognised quality of design, both of which are results of employee's quality improvement efforts. A third factor that contributes to internal motivation is management's aggressiveness in pushing the programme. Both external and internal motivation positively influences quality improvement activities and learning ability.

In the Kofman et al (1994) model commitment to TQM is conceived as "constrained to the zero-one interval, ... defined as the percent of the workforce that is currently using TQM methods and tools at full capacity" (Repenning, 1994: 81). As in Bong's formulation, commitment here is an accumulation that integrates two effects. They utilise Shiba et al (1993)'s push and pull effects. Thus, management "pushes" the programme through training which is supported by top management commitment (as earlier described) and results "pulls" and attracts new participants. The change in commitment from results is determined by the fraction of the workforce not yet committed and the experience of those who have already become committed. The experience of the committed are spread by word of mouth, which influences the uncommitted workers to become committed. The indicated fraction of uncommitted workers that may become committed depends on perceived improvement resulting from TQM, adequacy of support provided by management and the security and stability of the workforce.

Özgökmen (1995) similarly represented employee commitment as an accumulation. However, the rate of change is an adjustment of the current level to the current potential commitment. Results, job security and goal realisation are the factors that encourage employee commitment.

Özgökmen (1995) has the simplest formulation involving direct factors only. The employees in this model are rather isolated from top management. Similar to Ambali's (1987) model, the employees are motivated by their own accomplishments and are not dependent on managerial support. Bong (1992) and Kofman et al (1994) in addition include a management factor. Bong suggested that management aggressiveness directly affects internal motivation to be involved with the programme whilst Kofman and his colleagues integrated management commitment through training provisions. This difference between the two models is interesting because it highlights their differing assumptions. First, the indirect effects of management commitment in Kofman et al suggests that top management does not have any direct influence on the organisation's employees, except through the formal training programme. On the other hand Bong's model indicates that top management can indeed influence subordinates directly through a rather aggressive show of commitment. On the surface, this difference may perhaps reflect a democratic and an autocratic managerial system. Training then represents a subtle way of influencing subordinates in a democratic system. However, Bong's management aggressiveness variable does not suggest use of authority to develop employee involvement. Rather it represents top management leadership, visibility and involvement, a factor that TQM literature also found to be important in encouraging employee participation. Thus, the Kofman et al model missed the direct impact of this important variable.

An interesting aspect of the Kofman, et al, model is the conceptualisation of commitment. Its formulation suggests two different motives for employees to be committed: those who are "pushed" by management through training and those who are "pulled" and motivated by results and experience. The result would be a percentage of the workforce who is completely motivated and competent. This allows the commitment percentage to be directly used in improvement activities and does not need any other weighting factor to indicate differences in motivation or skills.

On the other hand, this simplified formulation does not explicitly account for the dynamics of learning, as does the Bong model. He suggested that learning ability forms feedback loops with quality improvement activities, that is, learning ability contributes to these activities, and experience and practice in improvement tools and techniques further enhances ability and skills. A similar feedback loop is formed with the use of production technology. Bong later concluded that this learning ability, more than any of the other variables, is an important factor that contributes to a more sustained TQM programme.

A2.2 Conclusions

This chapter reviewed some SD studies on TQM. It showed that each of the three models whilst comparable, have their own uniqueness. This may be explained by the different objectives that the model was set to achieve. The Bong model was a theoretical model that aimed at testing the effectiveness of individual aspects of TQM, and later, integrating all factors together. Moreover, it was concerned with TQM's ability to alleviate a 'limits to growth' behaviour, that is, a growth and collapse pattern for sales. The Özgökmen model had similar objectives even as its parameters were calibrated against a real company. However, an additional simulation experiment involving different market conditions and TQM assumptions were carried out to determine the effect of market conditions. The Kofman model had a more specific and practical objective: to explain the paradoxical results of a successful TQM implementation. Having achieved its main objective, other experiments were done to further understand and gain more insights on how the TQM system works.

The comparison of the models also showed that each had different components and connected in various ways, not exactly in the same way. This did not undermine in any way the analysis of each model. As each model is able to reproduce the reference mode, the analyses were made with respect to the assumed and included variables and their relationships. Thus, all models were useful in their own way, especially as they have accomplished what they were set to do. From the SD perspective, despite their differences, they are equally valid models (Forrester, 1961; Forrester and Senge, 1980).

The interactions of the TQM programme with the other organisational processes have been aptly modelled and investigated. Kofman et al were most successful in understanding these interactions as they focused their experiments on this more than the other two models. However, this researcher finds the effort on understanding of the role of employees wanting. Two of three factors considered in their motivation to participate are focused on the long-term results of their efforts and do not show any immediate outcomes. It would seem that employees see their efforts from an organisation's perspective, not unlike that of management. As observed from the review of literature in Chapter 3, employees also expect immediate rewards or recognition for their efforts, both of which are absent in the Kofman and Özgökmen models. Thus, this raises the question on whether employees really wait for organisational outcomes to evaluate the success of their efforts. More probably, employees act beyond business results, job security and support from the quality improvement sector.

The distance and lack of direct participation by top management in quality improvement activities does not seem to conform to TQM literature's prescribed necessity of their involvement. In the Özgökmen model, top management's activities are limited to establishing the goals. In the Kofman model, top management influenced workers through goals and through training. These were in contrast to

Bong's assumption that top management aggressiveness can influence internal motivation of employees.

In any case, justifications for the factors included in the model lie in the researchers' own analysis as well as the empirical evidence. The members of the organisation observed may have deemed these factors to be the only important variables to explain employee motivation. Nevertheless, they were still successful in generating the desired behaviour pattern.

In the present research, the factors related to employee involvement and top management commitment were found to be very important not only in the literature review (Chapter 3) but also in the interviews and case studies (Chapters 6 and 7). In particular, the issues pointed out in the review were reflected and became important issues for circle participants in Company C. For instance, quality circle members were not quite motivated by quality improvements achieved by organisation, in contrast to those suggested by Kofman et al (1994). Thus, these weak points of the model were included in the Dynamic TQM Model as they reflect the important variables and interactions in Company C for the which the model was finally tested for validity.

CHAPTER A3
TESTING STRATEGIES: THE DYNAMICS OF TQM IMPLEMENTATION

Chapter 8 in Volume 1 of the thesis presented the important aspects of the Dynamic TQM model. The assumptions, conceptions, theories and principles that guided the model building process are an intricate part of the model's structure, and their detailed presentation has very important purposes to serve. First, the in-depth discussion of the theoretical, practical and logical bases of the model establishes the firm grounding of the model structure to accepted theories on quality management (Crosby, 1979; Dean and Bowen, 1994; Deming, 1986), motivation (Vroom, 1964; Lawler and Porter, 1970) and innovation (Ambali, 1987; Homer, 1987; Koffman, et al, 1994), and real company experiences from the cases in this research as well as other published sources, and closely guided by modelling procedures from system dynamics (Barlas, 1996; Coyle, 1976; 1997; Forrester, 1961; Graham, 1980; Richardson and Pugh, 1981; Saeed, 1992; Wolstenholme, 1990).

But more importantly for this chapter, the explicit definition of the main variables of the model and their interactions acquaints the reader with the inner working and the boundaries of the model. The system dynamics principle argues that it is the structure that generates the behaviour pattern (Coyle, 1976; 1997; Forrester, 1961; Richardson and Pugh, 1981). Thus, appreciation of the behaviour patterns of the TQM system lies mainly on the understanding of the underlying assumptions regarding both tangible and intangible variables, their assumed structure and the resulting feedback loops.

In effect, the model is *not* a black box where only inputs and outputs are observed. On the contrary, the model aims to surface many of the hidden and tacit assumptions, and thinking processes that influence variable interactions in the real world. Indeed, Forrester (1961) suggested that these hidden agenda need to be studied as they greatly influence the resulting actions and decisions, and over a time period, a pattern of behaviour emerges. Thus, Chapter 8 has opened the black box (or the engine) that operates in a typical TQM implementation programme so that it can be investigated and tested for its strengths and weaknesses. The learning from the model development will form the foundation for the analysis of the simulation runs in the present chapter.

Chapter A3 is devoted to exploring the reactions and outcomes of the causal maps developed in Chapter 8 as preliminary efforts to test the model[1]. Simulation experiments are conducted to explore and examine the variable interactions of the implementation process. The simulation runs will attempt to replicate different scenarios representing various implementation strategies through changes in parameter inputs. The implementation strategies involve the input of different combinations of the important resources (as discussed in chapters 7 and 8) necessary to make the implementation process successful[2].

[1] The tests in this chapter were actually conducted before the replication of the data from the case study as discussed in Chapter 9. In system dynamics methodology, the present tests represent efforts to internally validate the robustness and consistency of the model.

[2] The goal of the TQM implementation process is to involve everyone in the organisation and to generate as many improvement ideas and projects as possible. Thus, it is the objective of the programme to maximise both participation levels and total projects proposed. However, a longer-term goal is the sustainability of the programme. That is, in addition to maximum participation and projects, an equilibrium level needs to be maintained. This represents the continuous improvement goal of TQM.

The model processes these changes in inputs and self-generates the reactions of the various variables in each sector. All these variable interactions impact on the more tangible outcomes such as total projects generated, percentage participation and meetings held. The intangible variable, motivation to participate, is also simulated. Powersim™ graphically presents the interactions and greatly facilitates the observation and analysis of behavioural patterns of both the tangible and intangible variables over time.

The chapter concludes with several observations and implications of the conducted tests.

A3.1 Initial conditions and other model specifications

The hypothetical scenario that will be used in the following simulation tests assumes some rather pessimistic conditions. These conditions may indicate a very resistant organisation[3] that does not want any changes. Furthermore, the experiments conceptualise top management as being consistent and persistent with its initiatives, and unaffected and unmoved even by low results. Top management is assumed to continue allocating the resource at the same level despite unfavourable results[4].

[3] This research takes the position that resistance to some managerial initiatives is a symptom of an underlying problem. Resistance in the TQM sense has been expressed in terms of non-participation in the programme. But as the Vroom's (1964) theory suggests, there is only an avoidance of the task at hand mainly because of the attached valence, instrumentality, and expectance to the task. This research extends Vroom's theory by making valence and instrumentality dynamic and influenced by constant interaction of variables. (Expectance is made constant because of the open policy for circle participation.)

[4] This assumption is relaxed in the next chapter where an additional policy structure is introduced that varies the level of the input resource.

The organisation does not see its management as being supportive to the quality improvement initiatives, typically, as an indication of failed initiatives or disappointing experiences in the past. Thus, the variables, perceived support by participants, memory of adequate visibility (of top management) and middle management support ratio, are all initially equal to nought. The memory for inadequate budget is assigned a value of 1.0. This indicates that members of the organisation perceive a maximum probability that management will not provide the necessary financial resources for projects and other needs.

The organisation also is not satisfied with past and present conditions. The variables satisfaction by participants, satisfaction with rewards, satisfaction with contribution, and average motivation to conduct meetings are initially set at -1.0 to denote aversion to the task at hand.

The initial participation is initially set at 20 percent. The time unit is in years and the simulation runs for 30 years. The length of the simulation reflects the long-term perspective of the TQM programme and allows the study of the programme in the longer run, which is not usual in real systems.

A3.2 Implementation Strategy Tests

The thrust of these experiments is to test the reaction of a management initiative-averse organisation. This set of simulation runs explore the responses of the organisation over time to the consistent and unwavering efforts of its management to introduce quality circles as part of the TQM programme. The programme is implemented through the steady allocation of one or more of the required resources.

The implementation strategy[5] refers to the various allocation possibilities and combinations of the important or critical resources. As suggested in Chapter 7, this thesis views the implementation of a TQM programme as the proper allocation of the financial and temporal resources necessary to undertake, support and sustain the TQM activities. These tests are intended to represent the differing ways in which TQM has been implemented, or can be implemented.

The factor inputs, as they are allocated, drive the core[6] or engine of the TQM programme. Each of these factors influence parts of the engine so as to activate these reinforcing loops. However, by their nature, reinforcing loops can lead to a spiral of success as virtuous circles, or move in the opposite direction as vicious circles. This depends much on the changes in the variables that influence them. The tests in this chapter are conceived as being added onto this engine. The resulting interaction and behaviour is then examined and compared

The following experiments were designed to identify the effects of a singular factor, or a group of factors. These tests are intended to highlight the contribution of each variable, or set of variables, on the behaviour of the system. To a certain extent, the simulation runs also deal with gauging the criticality of each variable by

[5] However, the term 'strategy' by no means suggests that the allocation of these resources is always done in a conscious and rational way, as in the adoption of a strategy. In this chapter, the term also acknowledges the possibility of the absence of rationality, or more possibly, the lack of a conscious and deliberate decision to make the resources available. For instance, implementation time may easily be controlled on the shop floor by middle managers and supervisors, and even top managers, who are not wholly supportive of the programme, usually through delays in decisions.

comparing the resulting behaviours. Here, criticality refers to the strength of the factor's contribution to the improvement in the desired outcomes. In other words, the tests determine how successful, or otherwise, are the factor inputs or their combination in starting and driving the TQM engine.

In order to generate a maximum reaction from the system, the value assigned to each factor or resource were designed to be optimistic and rather high, but nevertheless realistic and practical. Table A3.1 shows the values used for the tests.

Table A3.1. Test values for the TQM factors

Reward	=	10 value units
Implementation time for contributions[7]	=	5 months
Budget ratio	=	1.0
TQM staff	=	3 facilitator-trainers
Middle management time	=	4 hours per month per manager
Top management time	=	2 hours per month per manager

A3.3 Single factor experiments

The single factor experiments are basic experiments that may not necessarily be logical strategies in the implementation of TQM programme. They involve the provision for only a single resource to support the quality improvement efforts. These tests explore the possibility, however remote or ridiculous, that management

[6] This core is made up of three reinforcing loops as presented in Figure 8.14 and discussed in Chapter 8.

[7] To represent the allocation of resources that impacts on the contribution factor, the average implementation time is adjusted. By decreasing the average implementation time, actual implementation time is also decreased. This results in relatively more implemented contributions.

may decide to consciously or unconsciously allocate only one resource for the programme. This provides a platform for comparison with other experiments.

A second purpose of these single factor simulations deals with the basic ability of each factor to elicit some responses from the organisation. In the absence of other factors, the capacity of the factor to drive the TQM engine is highlighted. The learning from each single factor test can then be used for the rest of the tests, as the others are merely a function of these interactions. Thus, each of these experiments will be examined and discussed in detail, whilst the rest of the experiments will be treated as sets of simulation runs.

A3.3.1 Contribution only (X1)

The experiment deals with the improvement of normal implementation time (referred to as NIT from hereon). To represent an organisation that does not have a quality improvement programme, the NIT was initially set to 1000 months. In other words, projects are hardly implemented, as it takes 1000 months before projects are undertaken. In this experiment, the normal implementation time was substantially reduced to a more realistic time frame of 5 months. To support the execution of projects, the budget ratio was assigned a value of 1.0. This indicates the availability of funds necessary to implement the projects. The other input factors are assigned 0.0 values. The major feedback loops affected by this parameter change are presented in Figure A3.1. The results are graphically presented in Figure A3.2.

The effects of the implementation time improvement can be studied by following the arrows and loops of Figure A3.1, beginning with the boxes of NIT and

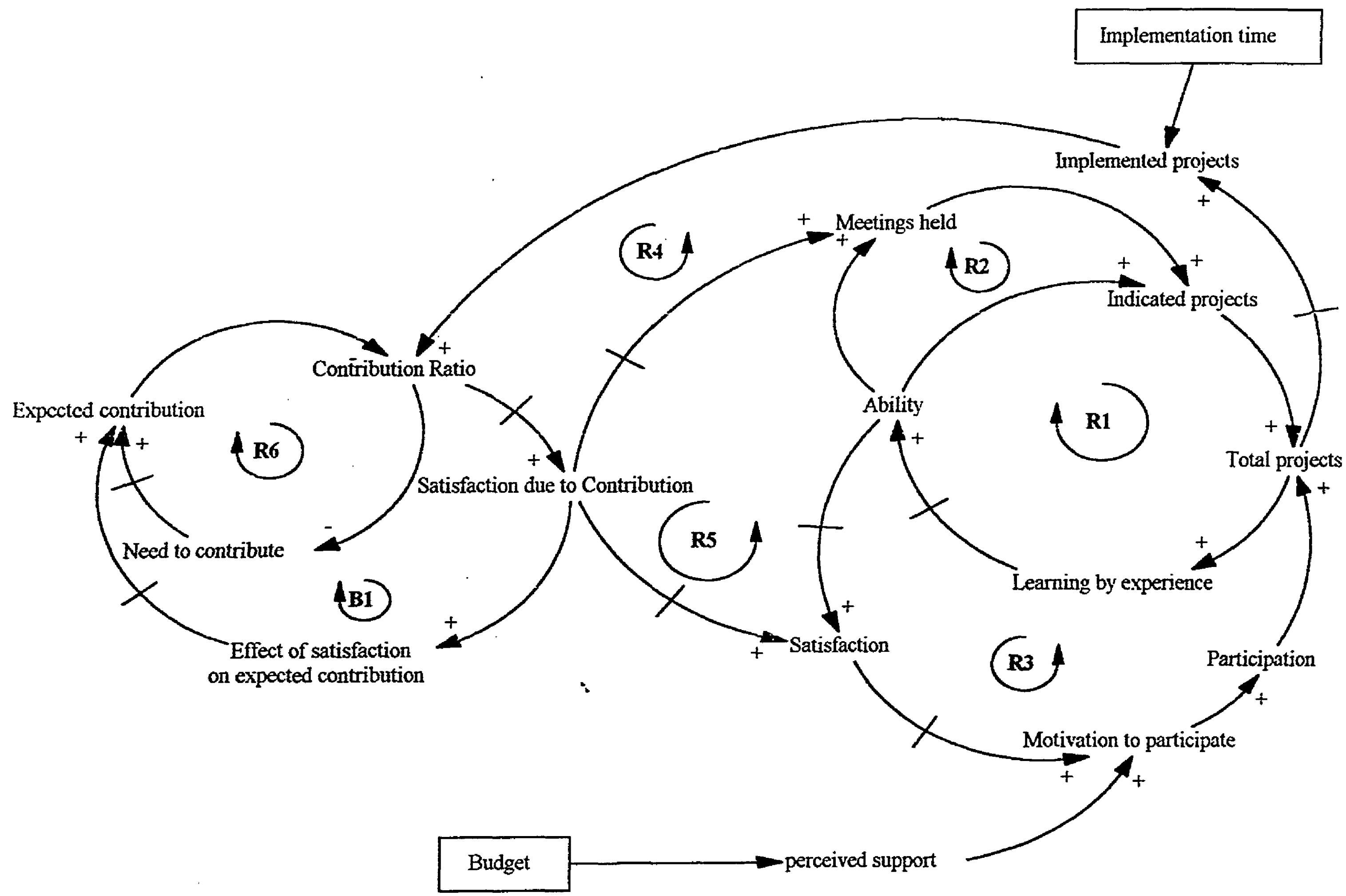

Figure A3.1 Active loops involved in the contributions only experiment budget ratio. When the NIT was set to the realistic 5 months, the number of implemented projects increased. This led to an improvement in the contribution ratio. The higher contribution ratio improved the satisfaction due to contribution (which represents an average satisfaction over the years). Present changes in the contribution ratio result only in fractional changes in this average satisfaction. Thus, the big jump in implemented projects did not necessarily result in a big jump in this satisfaction variable.

Satisfaction due to contribution influences two variables leading to total projects. First, it touched on the average percentage meetings held. As satisfaction due to contribution rose, the motivation to meet and the actual percentage meetings held increased. In the absence of the other factors, and the very limited effect of the initial ability, the percentage meetings held improved only slightly. Thus, the indicated number of projects per circle similarly had a tiny increase. This led to slightly more total projects as shown in the sharp increase in Figure A3.2 (lowest graph). Because of this minimum improvement in indicated number of projects, the declining trend of percentage participation (top graph, Figure A3.2) dominated their product, resulting in a decreasing trend in total projects.

The number of participants was falling because more people were quitting and rejecting the programme than those who are joining. This can be traced to the zero motivation to participate and the considerably higher motivation to reject. Both motivation variables are based on the product of perceived support and satisfaction. Perceived support takes some value greater than zero as a reaction to availability of funds for the programme (from the budget ratio). However, satisfaction takes a

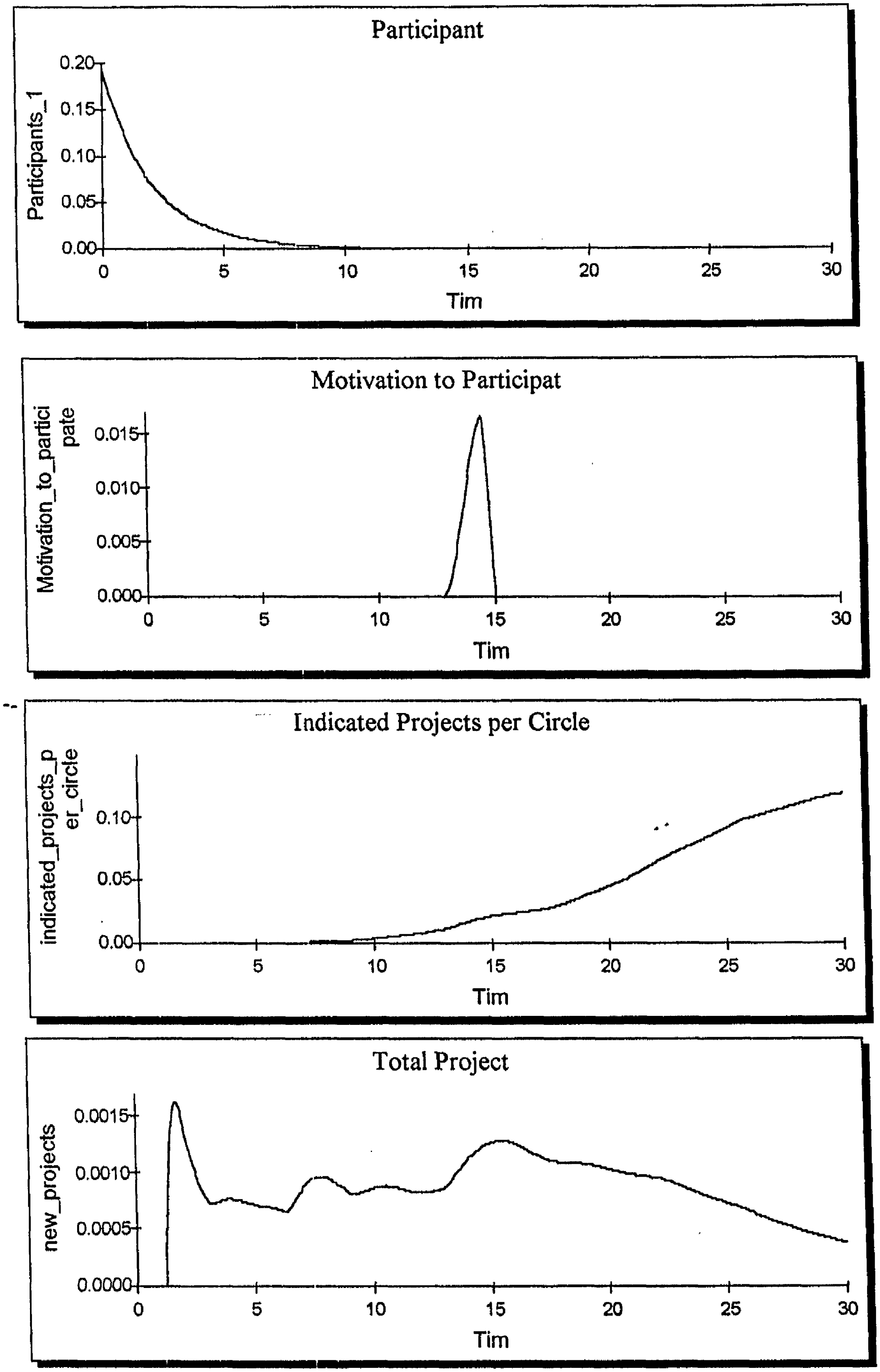

Figure A3.2 Results of the contributions only experiment negative value because, the satisfaction due to contribution is not sufficient to improve it. As there are negligible effects from minimum ability, and the rewards are absent (as there is no rewards input), improvement in satisfaction is singularly dependent on contributions satisfaction. Thus, the negative product of satisfaction and perceived support triggers the motivation to reject, and switches off the motivation to participate, resulting in more quitters and no new members.

To close the major loops, the dwindling total projects led to fewer implemented projects and thus, a lower contribution ratio. The contribution ratio was further reduced by the higher expected contribution from improved satisfaction due to contribution from the previous time period. Less satisfaction due to contribution further slowed down the improvement of satisfaction, which failed to control the motivation to reject. Consequently, participants continued to become discouraged. At the end of the simulation, the percentage participation was almost 0.0 percent (top graph, Figure A3.2).

Nevertheless, whilst there was lower satisfaction due to contribution to improve the motivation to hold meetings, ability was slightly improving as it accumulates the learning from experience from the total projects generated. Thus, the increasing ability pushes both the average percentage meetings and indicated number of projects per circle on an upward trend (third graph, Figure A3.2).

Whilst the increasing trend in indicated projects per circle is due to the accumulated ability, the swings or oscillations are due to the satisfaction due to contributions. The left-hand portion of Figure A3.1 shows the structure behind the dynamics of satisfaction due to contribution that stems from expected contributions.

The expected contributions is also a long-term average of the product of the effect of satisfaction due to contributions and the need to contribute. The increases in the satisfaction due to contributions result in greater expected contributions. As expected contributions are inversely related to the contribution ratio, the ratio goes down and leads to lower satisfaction due to contributions. This loop, as Figure A3.1 indicates, is a balancing loop (B1) that keeps the system to its implicit goal. Thus, when total projects began to decline, expectations were adjusted to a lower level and began to approximate the implementation rate. This increased the contribution ratio and contribution satisfaction, and later reflected a sharp rise in motivation to participate. This was short lived as total projects continued to decline, whilst expectations rose again.

The other factor that determines expected contributions is the need to contribute. This variable indicates the perception that the organisation indeed requires new ideas from its members. This is assumed to be related to the contribution ratio. When the contribution ratio is low, the need to contribute is high. Conversely, as the contribution ratio increases, the need to contribute falls. The need to contribute amplifies the expected contributions at the lower values of the contribution ratio, and equals to 1.0 when the contribution ratio is 1.0. Thus, when the need to contribute is high, expected contributions rise leading to a lower contribution ratio. This, in turn, creates a further need to contribute and raise further expected contributions. In other words, the resulting reinforcing loop (R6) will continually amplify expected contributions. The combined effect of a balancing loop with a reinforcing loop will show damped oscillations that ultimately reaches equilibrium as a balance is achieved[8].

The over all result of all these interactions on total projects is shown in lowest graph of Figure A3.2. The average number of projects proposed over the 30-year period was a very low 0.0008 projects per year.

A3.3.2 Middle management time only (X2)

This experiment involved an input of 4 hours per month per middle manager. The other input variables were set to 0.0, including budget ratio, as the allocation of time from middle managers does not involve additional funding requirements. The NIT was set back to the initial 1000 months. In this experiment, the top management time was also set to 0.0 and did not contribute to the dynamics of the present experiment. The analysis begins with the box of middle management time in Figure A3.3, whilst the simulations results are shown in Figure A3.4.

Figure A3.3 shows all the active loops in this experiment. It will be noted that the contribution loops are also active. The generation of projects implies their implementation. However, since there was no adjustment in the initial normal

[8]The oscillations are due to the shift in dominance between the loops. The reinforcing loops amplify any reactions from the balancing loops whilst this latter loop controls the amplification. To illustrate, as the need to contribute amplifies expected contribution and pulls down the contribution ratio to further raise the need to contribute, the lower satisfaction derived from the low contribution ratio prevents expected contribution from going up. As a result, contribution ratio is pushed up . This dampens the need to contribute (beginning a downward spiral for R6) and reduces expected contributions. Again, B1 opposes this trend as satisfaction due to an improved contribution ratio will generate higher satisfaction and lead to more expected contributions. The resulting behaviour will either be damped oscillations, where an equilibrium is reached after some time, or undamped oscillations where balance between the strengths of the two loops is not achieved.

implementation time of 1000 months, then there are virtually no projects that are implemented. Whilst middle management time has some influence on the normal implementation time, the influence is not sufficient to effect large improvements[9] on implemented projects. These loops are not explicitly shown to simplify the diagram and facilitate analysis.

When middle management time was inputted, the first variable to be affected was the level of perceived support. Like other levels in the model, perceived support is a long-term average, so that full effects of the middle management time are not immediately felt. Perceived support positively influenced the motivation to participate. However, the other factor that determines motivation to participate is satisfaction. In this case, satisfaction took the initial negative value, indicating avoidance and rejection of participation. It continued to take the negative values because there were no significant inputs from the satisfaction factors. The 32
satisfaction due to rewards was zero; satisfaction due to contribution was practically zero because of the long normal implementation time; and satisfaction due to ability was low because ability level was at its minimum. Thus, the motivation to reject is activated throughout the entire simulation time, whilst the motivation to participate remained at zero (second graph, Figure A3.4). This led to an increase in the percentage of those leaving the programme, and fewer participants (top graph, Figure A3.4).

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[9] The formulation of actual implementation time is based on the product of the normal implementation time and the influences from top and middle management and budget availability. As such these influences can only fractional change the normal implementation time. In effect, the actual implementation time will still be more than 800 months! In more realistic scenario, the involvement of middle management and for that matter, top management, cannot drastically improve and break the tradition of a long-standing system that does not implement projects. In this research, the only way to significantly improve the normal implementation time is through a new system that provides for it, as the one conceived in the preceding experiment (X1).

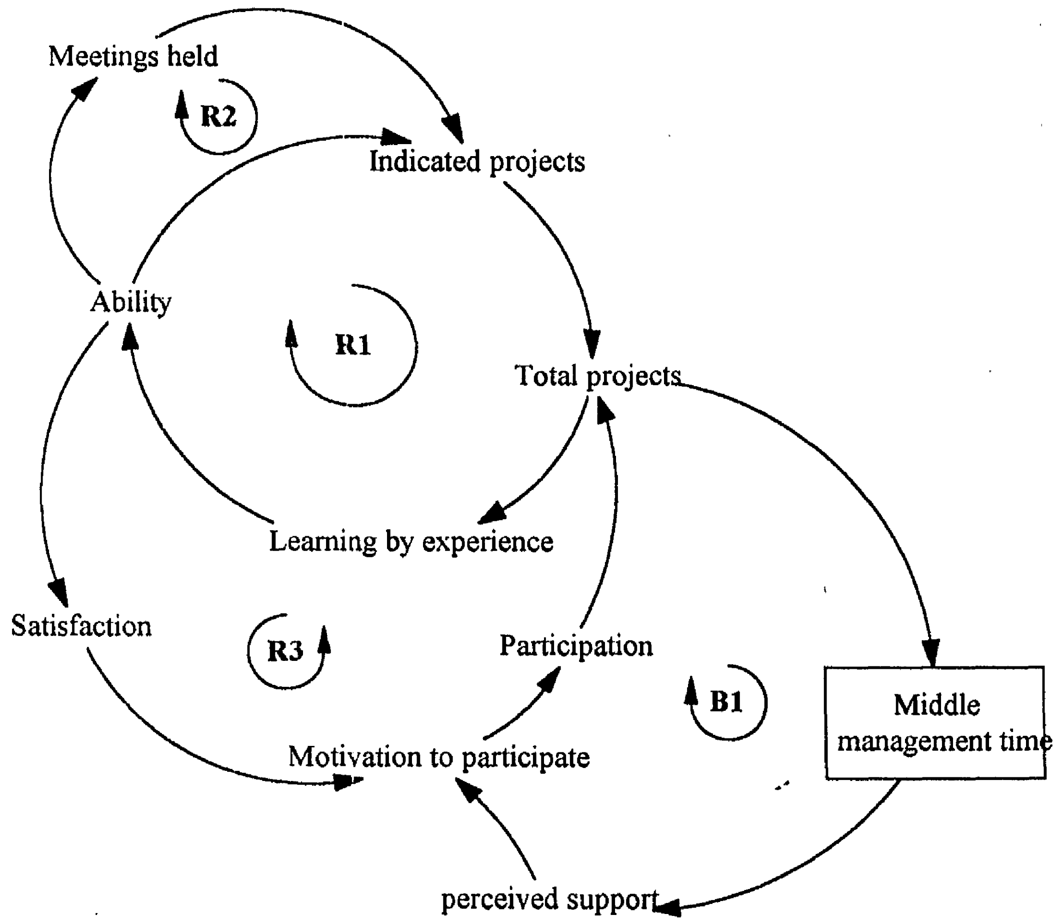

Figure A3.3. Active loops of middle management time only experiment (X2)

The average number of meetings held was not initially affected by the input of middle management time. However, the resulting projects generated were due to some learning by doing, which accumulated as ability. This level of ability encouraged the holding of meetings, and eventually increased indicated projects per circle. As a cumulative function, ability was increasing, albeit slightly. This increasing ability accounts for the positive slope of indicated projects (third graph, Figure A3.4).

Overall, the number of total projects did not amount to a significant number, averaging only 0.014 projects per year (bottom graph, Figure A3.4).

A3.3.3 Top management time only (X3)

This experiment involved the input of top management time of 2 hours per top manager per month. This time is conceived to be spent for the regular meetings, presentations of quality circles and other TQM activities, and visiting the shop floor to show top management's involvement and support to the programme.

This experiment is similar to the preceding test on middle management time. The active loops involved in this experiment are the same as those in the middle management only experiment. However, the influence of top management on middle management created two additional balancing loops. This influence of top management on middle management became visible in the middle of the simulation as middle management itself allocated time to the programme as well. This additional support offsets some of the motivation to reject the programme.

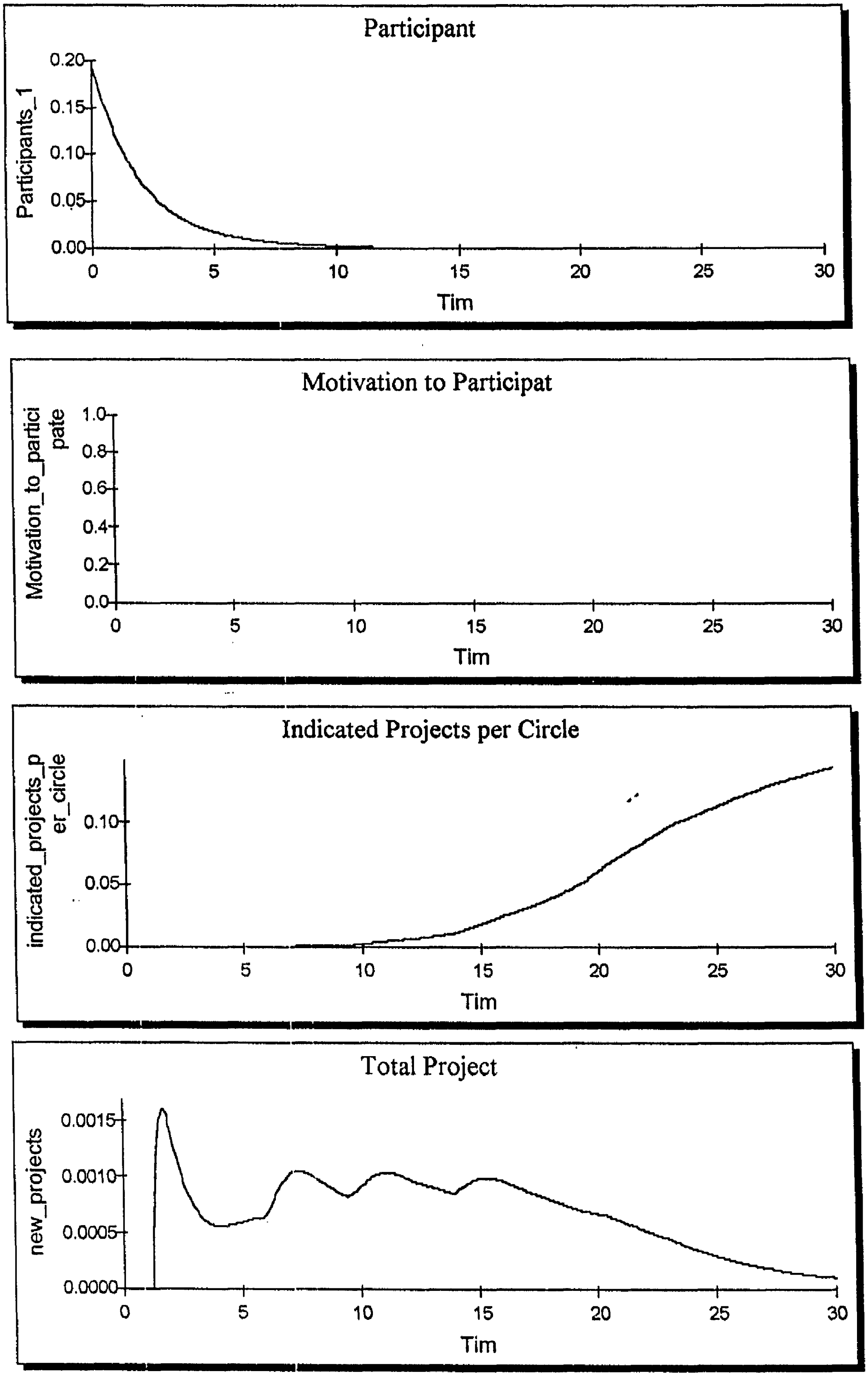

Figure A3.4 Results of the middle management time only experiment

Nevertheless, this experiment similarly resulted in an exponential decline in percent participation (top graph, Figure A3.6) following the same dynamics. That is, whilst there was an increase in perceived support, satisfaction had negligible effects from the contribution satisfaction that is sufficient to lift it from its initial negative values. This resulted in the continued rejection of the programme. However, the involvement of middle management initiated some small improvement in perceived support whose positive trend was sustained to register some considerable motivation to participate towards the end of the simulation (second graph, Figure A3.6). The ending value of indicated number of projects was almost thrice that of the preceding experiment even as their trends were identical. Total projects in this experiment had less fluctuations than its counterpart from the middle management only experiment. However, the total projects were fewer, at an average of 0.0006 projects per year.

A comparison of the percentage participation from these three experiments is shown in Figure A3.7. Whilst the graphs indicate the same decay pattern, the rates of decay are different. The comparison shows that the 'top management only' experiment (line 3) declined more quickly than the other two runs. It will be recalled that the decay rate is directly related to the motivation to reject. Thus, the 'top management only' experiment had the highest rejection motivation, an observation that seems ironic in the face of emphasis in TQM literature on top management involvement.

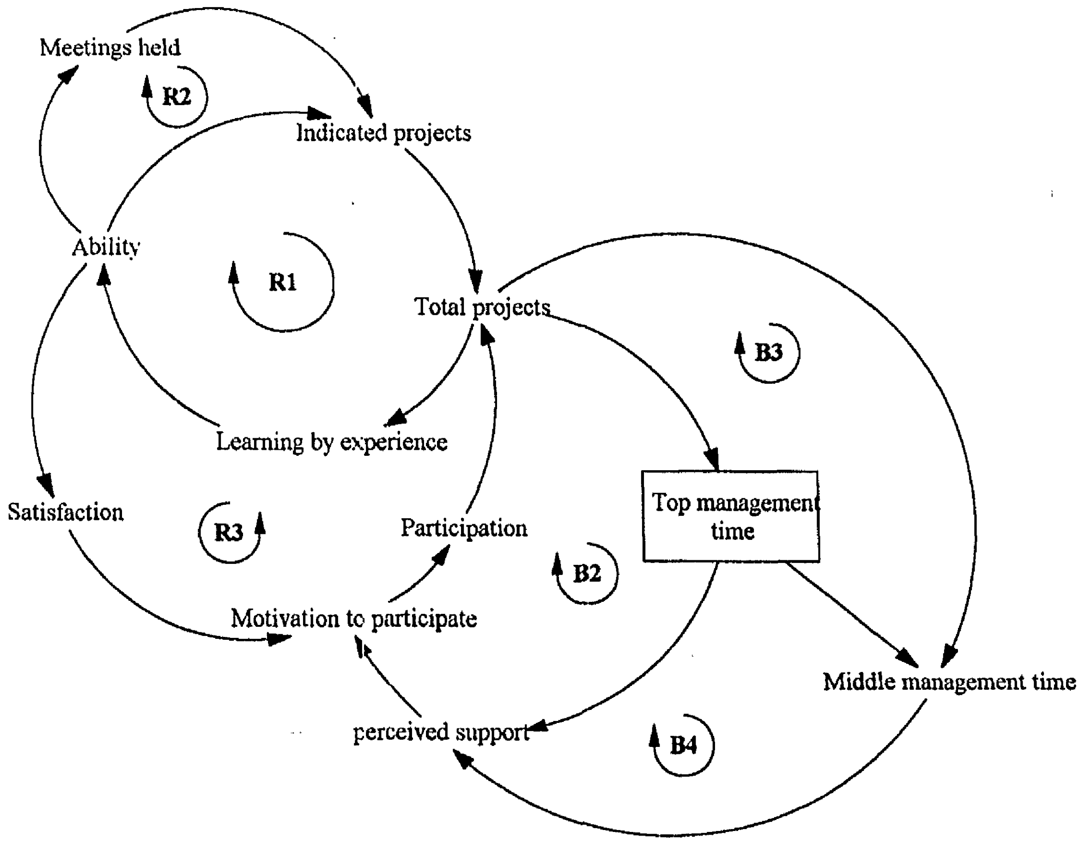

Figure A3.5 Active loops of top management time only experiment (X2)

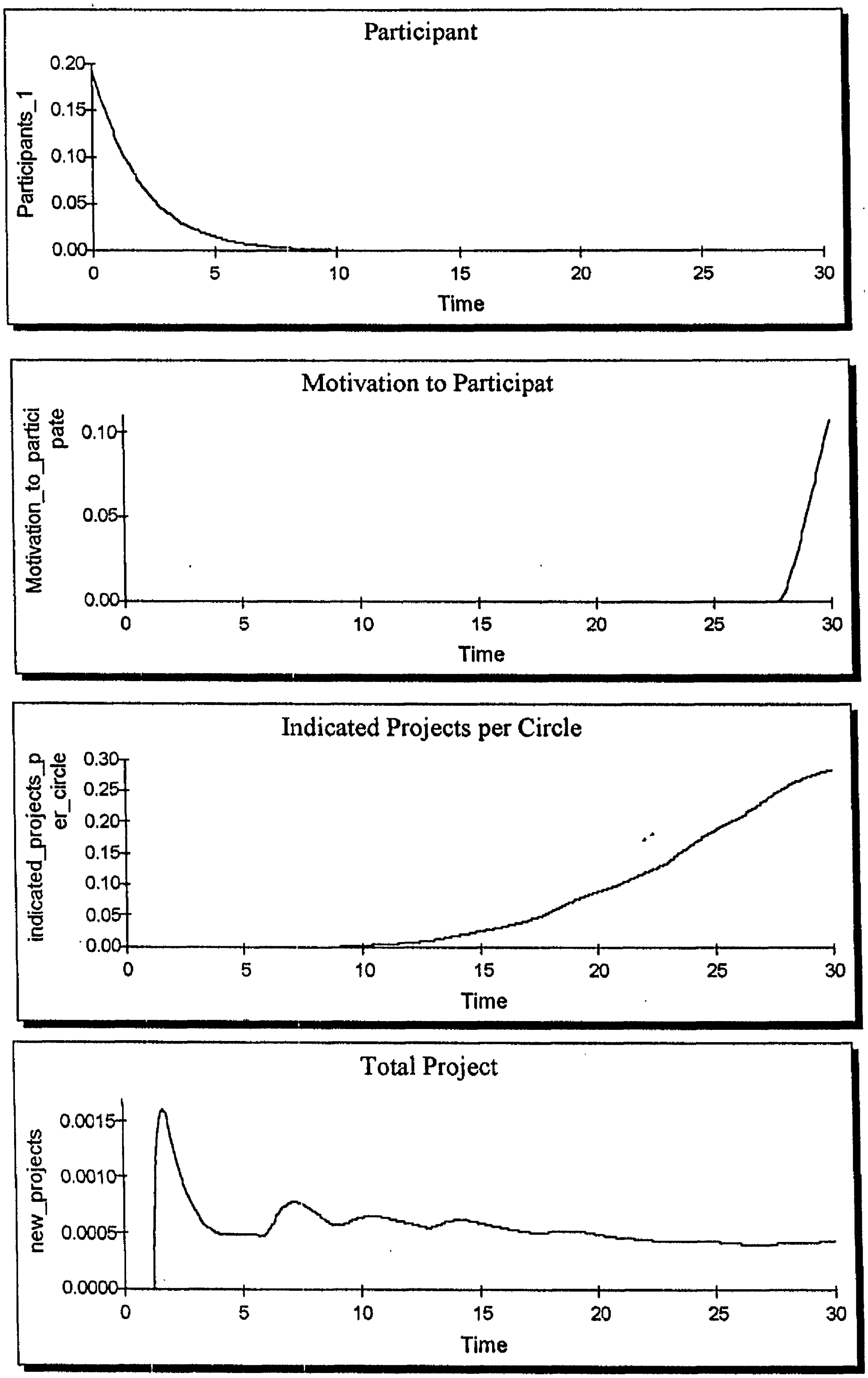

Figure A3.6 Results of the top management time only experiment

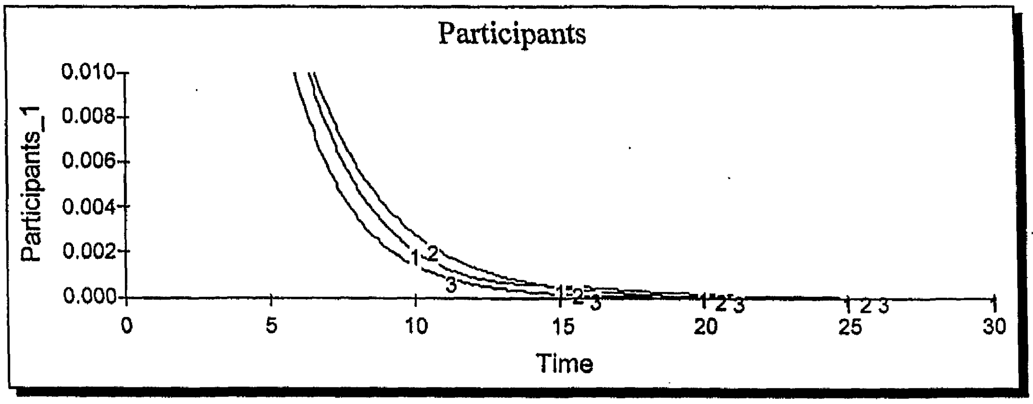

Figure A3.7. Comparison of participation behaviour of the first three single factor experiments.

The motivation to reject is influenced by both satisfaction and perceived support. A comparison of the satisfaction level for X2 and X3 shows they are almost identical. The difference, therefore, was in the level of perceived support. The top management time input generated a higher level of perceived support. This higher level of perceived support is due to the additional contribution of middle management involvement. As top management showed its sincerity and commitment through the constant allocation of time for TQM activities, middle management began to invest some time as well to the programme.

Mathematically, the product resulting from the same negative number and a higher positive number will result to a more negative number. This negative value for the product of satisfaction and perceived support indicates more rejection of the programme. Thus, in a scenario where satisfaction is negative, higher perceived support leads to greater rejection.

In more practical terms, when people are not satisfied, further expressions of support, especially from management, may be interpreted as further pressure to accomplish the task. Such pressure will lead to more aversion and rejection of the task. Thus, top management's expression of its commitment, in the absence of satisfaction factors, only led to more quitters from the programme.

A3.3.4 Rewards only (X4)

This simulation run involved the introduction of rewards (actual rewards box in Figure A3.8). Rewards are conceptualised as a general incentive for participation in the programme that includes both monetary and non-monetary incentives. This experiment also included the setting of the budget ratio to 1.0 to indicate the availability of funds for these incentives.

The value of the input was set to equal the initial expected rewards of 10 value units, to make the rewards ratio initially equal to unity. Because of the averaging process, satisfaction due to rewards adjusts to the maximum value 1.0 only after 12 months. Moreover, significant improvement in satisfaction is felt only after a longer time period as this variable itself also involves another adjustment process. In the interim, whilst satisfaction is still adjusting to its maximum level, satisfaction remains negative. This corresponds to zero motivation to participate and an active motivation to reject. As a result, the level of participation was declining throughout the time these two satisfaction variables were adjusting to reflect the higher reward ratio.

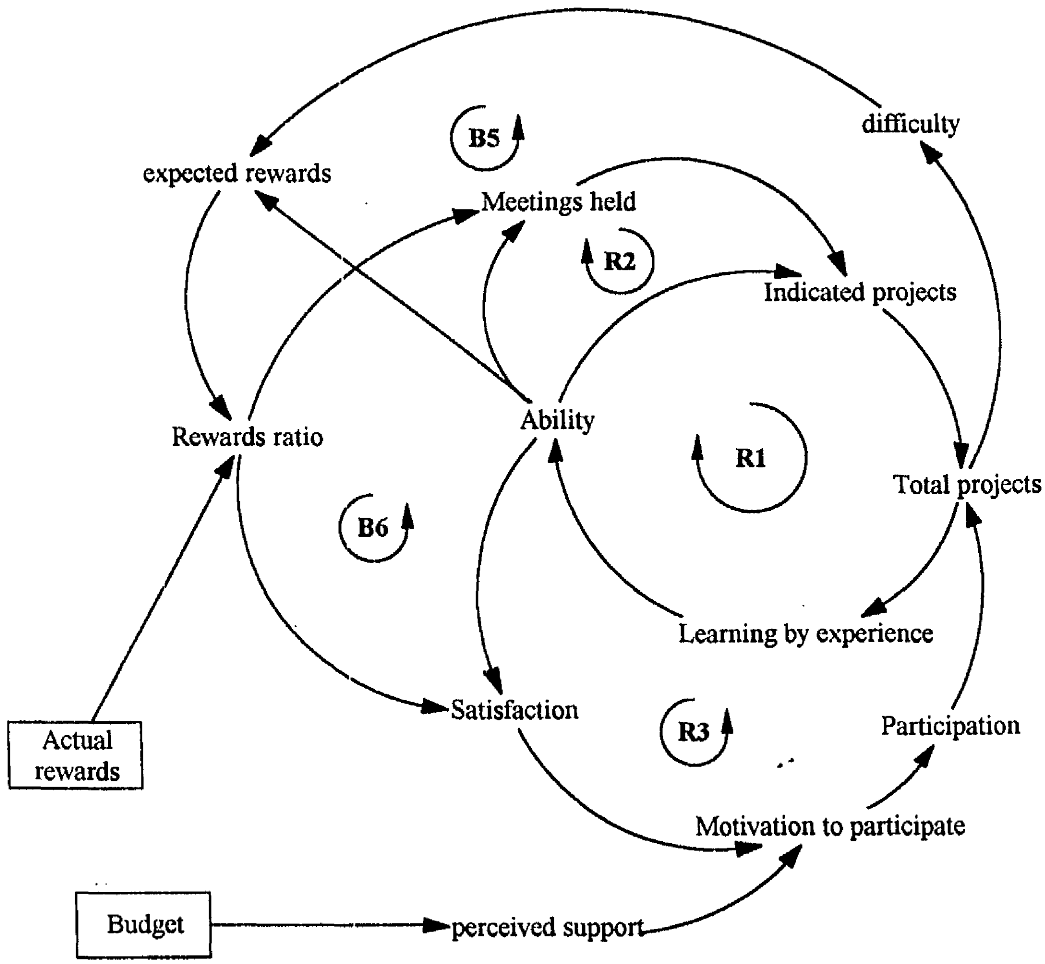

Figure A3.8 Active loops of rewards only experiment (X4)

The satisfaction due to rewards also positively influenced the motivation to hold meetings and average percentage meetings held. Throughout its adjustment process, the motivation to hold meetings was also growing. Thus, there was a positive trend in indicated number of projects. The rate of increase of this trend was sufficient to dominate the declining pattern in percentage participation. The result was a relatively considerable number of projects. This, in turn, generated greater opportunities for learning. Improvement in ability contributed to better satisfaction. Satisfaction was improving because of the positive changes from two sources: rewards and ability.

When satisfaction finally reached a considerable level, motivation to participate began to approach zero. Percentage participation slowed down its decline as motivation to participate improved. Eventually, the decline stopped and an equilibrium is reached. Figures A3.9 shows the percentage participation and motivation to participate levels. The equilibrium achieved by percentage participation, coupled with the increasing indicated number of projects, resulted in an increasing number of total projects (bottom figure, Figure A3.9). An average of 0.10 project per year was realised in this run.

A3.3.5 TQM Staff only (X5)

This experiment dealt with the setting up of a TQM section. The essence of this test input lies in the amount of available time by the TQM staff. In this experiment there is an input of 3 full time TQM staff, each having 160 working hours per month. The budget ratio is also set to 1.0 to indicate the provision for all

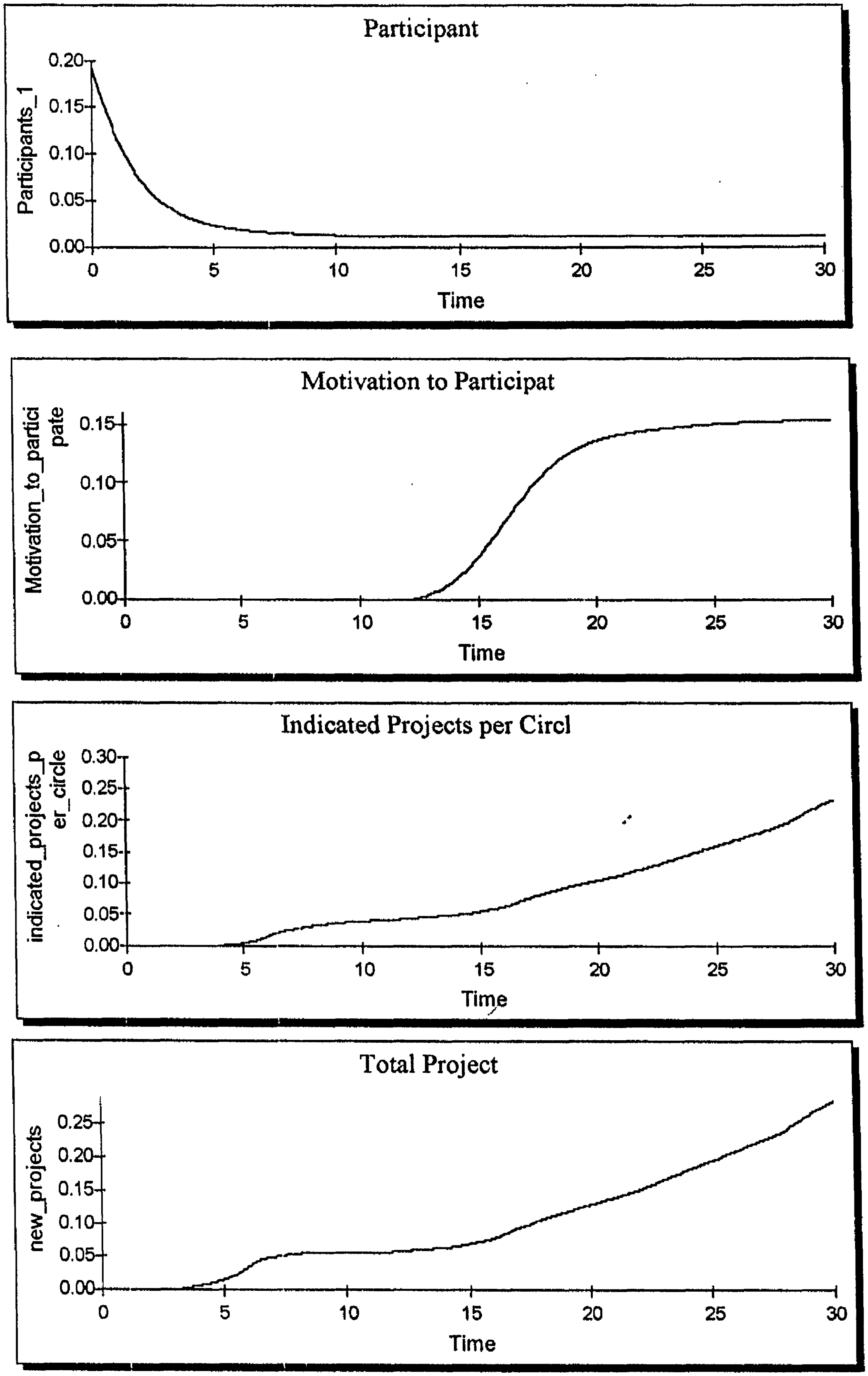

Figure A3.9 Results of the rewards only experiment necessary expenses for the TQM staff and their activities including training, conferences and the like.

The model assumes that 80 percent of the time is allocated for training purposes and the remaining time is spent on facilitating and monitoring. The relevant variables touched by the input of TQM staff are the training ratio and the facilitation ratio. Both these ratios affect the perceived support variable. In addition, they also contribute directly to ability derived from learning from training and facilitation, and ability is one of the sources of satisfaction. The combined effects of an increasing satisfaction level and a considerable level of perceived support is an increasing trend of motivation to participate.

Despite these positive trends, motivation to participate was not lifted from its initial minimum levels (second graph, Figure A3.11). The only active satisfaction factor was ability and it was increasing at a gradual incremental pace. Despite the increase in projects for implementation, the contribution factor was still negligible because of the long implementation delay. Until motivation to participate goes beyond zero, percentage participation continues to fall (top graph, Figure A3.11).

Moreover, the facilitation ratio influences the motivation to hold meetings and average percentage meetings held. Thus, with the input of the TQM staff, and the declining number of participants, there was an increasing amount of time available for facilitation. This supported and encouraged more meetings held and eventually, more project proposals per circle (third graph, Figure A3.11). This rate

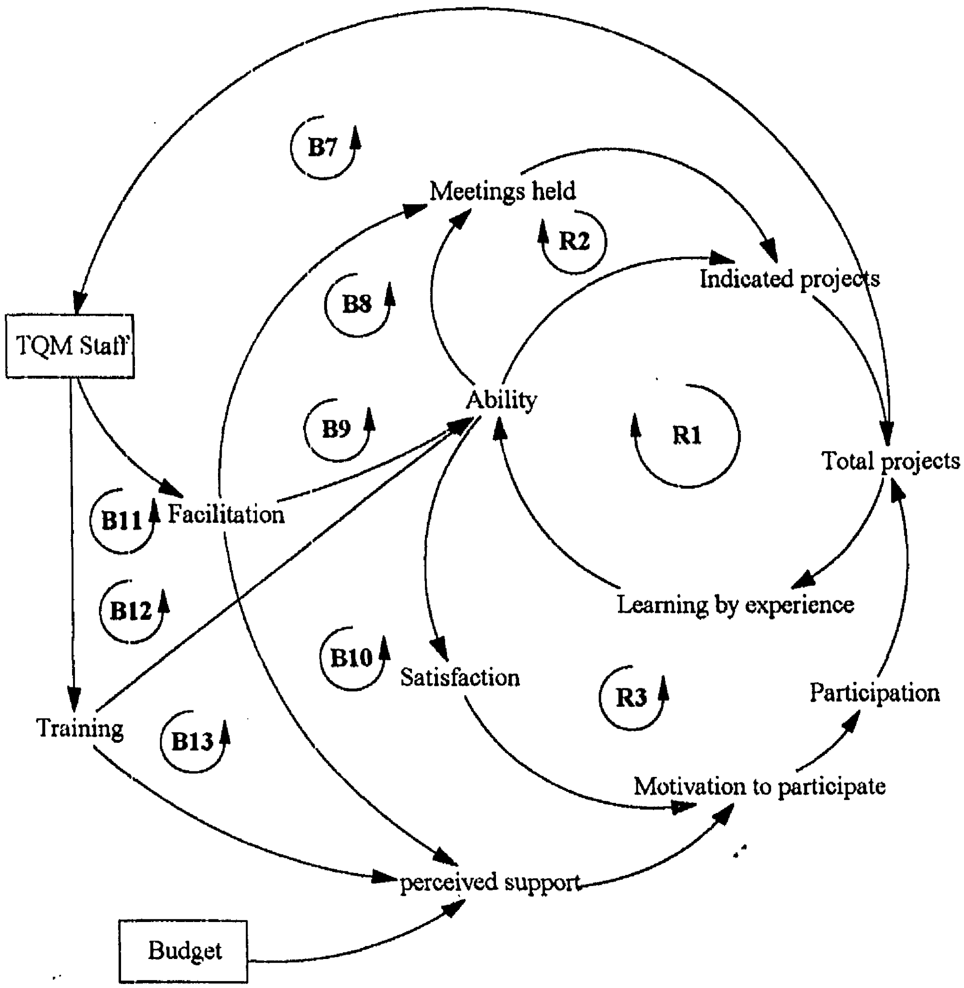

Figure A3.10. Active loops involved in TQM staff only experiment (X5)

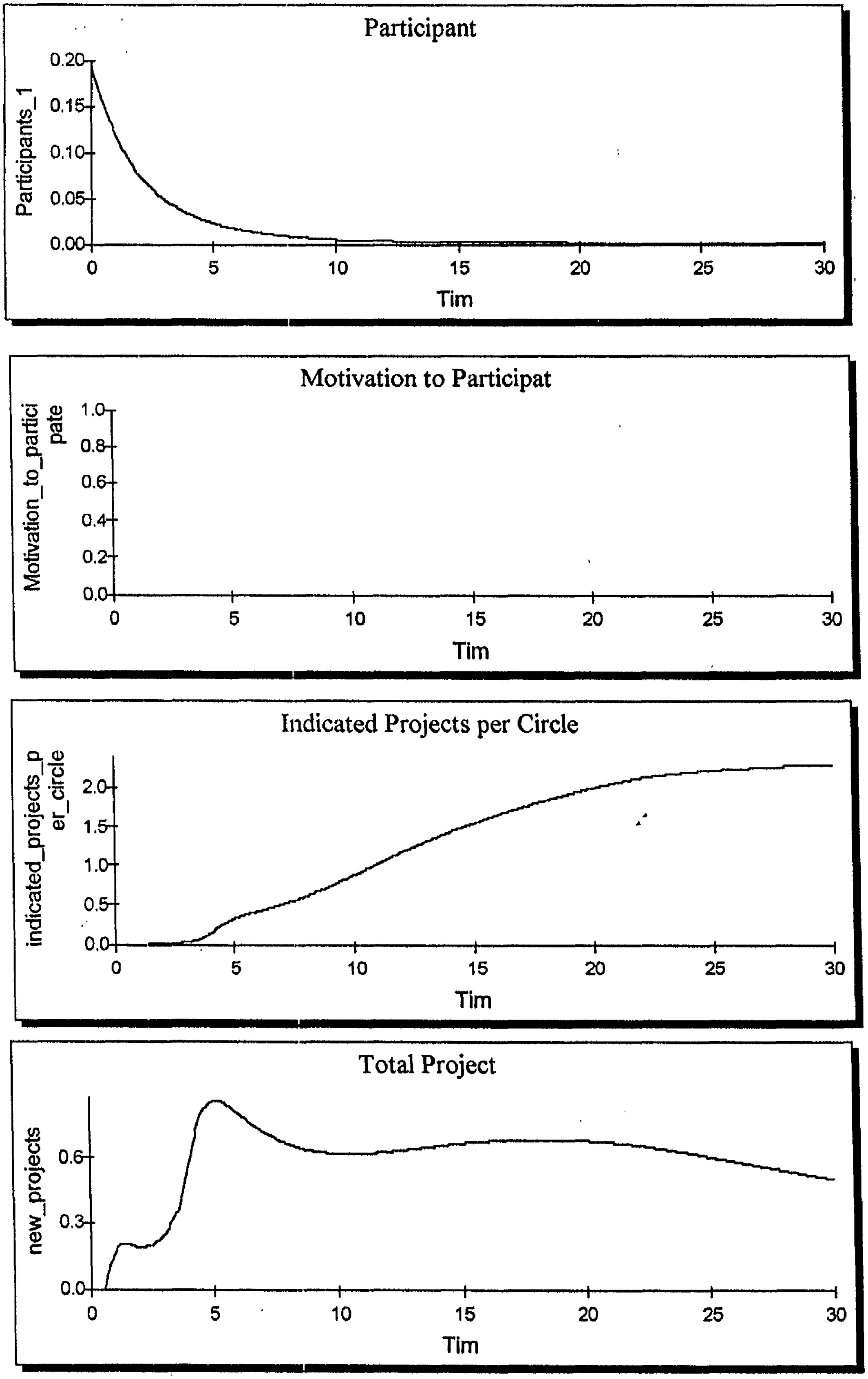

Figure A3.11 Results of the TQM staff only experiment ..;)

of increase dominated the rate of decrease in participation levels. This resulted in an improved trend in the total projects (bottom graph, Figure A3.11).

The relatively greater number of projects offered more opportunities for learning that further improved ability. This led to further satisfaction. However, satisfaction did not sufficiently increase as to push the motivation to participate significantly beyond zero. The satisfaction due to contributions remained at a very low level and had very little impact on the motivation to participate. The overall result did not help the control the decline of percentage participation. Thus, although the indicated number of projects was rising, the declining participation levels pulled down the total number of projects (bottom graph, Figure A3.11). Overall, this simulation yielded the most number of projects with a total of 23.35 projects, or an average of 0.78 projects per year.

In sum, the single factor experiments highlighted the inability of each factor, independent from others, to generate a strong inertia to trigger the TQM engine and yield substantial tangible benefits. Nevertheless, the simulation runs have shown the strengths and weaknesses of each of the factors. It was observed that the first three factors are not capable of generating a considerable number of projects. Not even a single project resulted from the input of each of these resource inputs over the 30-year simulated time. In contrast, the rewards only experiment yielded 3.0 projects over the same period. The TQM staff input had better results with a total of 23.35 projects over the 30 years.

The simulations have highlighted the importance of the multi-causal nature of the main variables of the system. The input of single factor, therefore, is not sufficient to simultaneously address all these other variables.

A final point about the single factor experiments is the dormancy of the balancing loops. The experiments did not yield a significant number of projects that is large enough to put strong pressures on the limited amount of the resource. The available temporal resources (middle management time, top management time, TQM staff time) were more than sufficient in providing for the few projects that were generated. Even the cumulative number of projects that were generated did not trigger the difficulty factor, which affects the expected rewards through increased effort. Moreover, the difficulty factor, although not explicitly shown in the other figures, could also affect the search and resolution of new projects and develop frustration that hampers learning. Thus, the TQM engine's reinforcing loops were by no means constrained by the balancing loops. Therefore, the insignificant number of projects generated and the failure to control the declining trend of participation were solely due to the weak effect of singular factors.

A3.4 Two factor experiments

In the following sets of experiments, two factors are simultaneously inputted in the model. The same values for the inputs in the single factor experiments were used. But the extra input factor will activate additional feedback loops. These loops can combine to produce more dynamics for the entire system.

For ease of comparison, these two factor experiments are presented in sets, according to the resulting pattern of behaviour of the participation level. Two general patterns of behaviour were observed: a continual decline, and a decline with recovery. Each of these will be described briefly.

The inputs of the first experiments that resulted to an uncontrolled decline of the participation levels are specified in Table A3.2 below, and the corresponding graph is shown in Figure A3.12.

Table A3.2. Schedule of two-factor inputs that resulted in a continual decline of participation levels.

Experiment code	Graph legend	Budget	Contri bution	Middle Mgt time	Top mgt time	Rewards	TQM staff
X6	1	√	√	√	×	×	×
X7	2	√	√	×	√	×	×
X8	3	×	×	√	√	×	×
X9	4	√	×	√	×	×	√
X10	5	√	×	×	√	×	√
X11	6	√	√	×	×	√	×

The main reason for the decline of participation lies in the minimum level of motivation to participate. Its value has been kept to zero throughout the simulation. This suggested that one, or both, of its determinants has been kept to a minimum value. In the first two experiments (X6 and X7), the satisfaction due to contribution factor can account for the failure of these experiments to generate sufficient satisfaction, as there was adequate source of perceived support from middle or top management time. As earlier observed, the contribution factor is not effective in

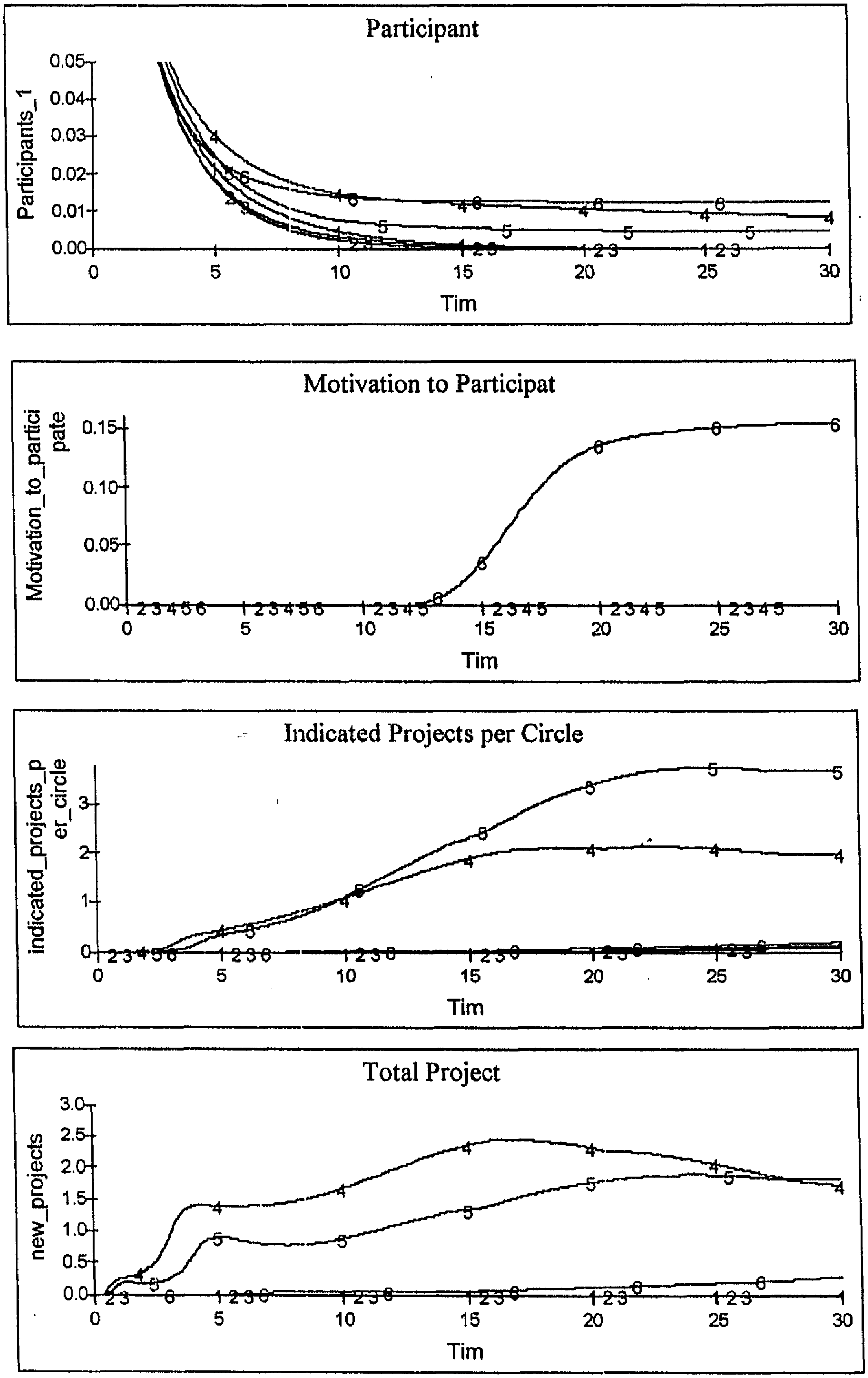

Figure A3.12 Results of the two-factor input that yielded a continual decline of participati levels.

eliciting strong responses that can yield a number of projects. The rather complex nature of satisfaction due to contribution and the inherent delays between the intervening variables prevents it from generating the needed motivation to push the system.

In the third experiment (X8; line 3 in Figure A3.12), where the inputs were constrained only to top and middle management time, the absence of a satisfaction-related input apparently did not generate the necessary motivation to participate to halt the decline of participation.

Experiments X9 and X10 (lines 4 and 5 in Figure A3.12) showed relatively more favourable results. The input of TQM staff, together with either top or middle management time, allowed for significant changes in both the determinant variables of the motivation to participate. The TQM staff is important to the system, not only as an indicator of perceived support, but also as it provides for training and facilitation that will develop ability of the participants. And ability generates satisfaction that supports the motivation to participate. Nevertheless, the second graph of Figure A3.12 shows that motivation to participate for X9 and X10 did not develop beyond zero. It was noted in the TQM staff only experiment that ability alone is not sufficient to improve satisfaction significantly, despite its upward trend.

In contrast to the first three experiments, this combination of factors in X9 and X10 allowed for an initial momentum that activated the ability virtuous circle. The initial support from the TQM staff activated not only the participation side of the system, but also encouraged the holding of meetings and the search for new projects. This led to more actual projects (lines 4 and 5, bottom graph, Figure A3.12), more learning by doing, and further motivation for meetings and projects. However, the combined effects of the learning through training and facilitation, and learning from the total number of proposed projects considerably raised the level of ability that later contributed to the slow down of the decline of participation.

The last experiment (X11; line 6 in Figure A3.12) illustrates a slight variation of the decline dynamics. In this case, participation levels actually ceased to decline, as the motivation to participate had significant improvements (line 6, second graph). In contrast to the preceding experiments' (X9 and X10) dependence on the TQM staff factor, the initial push for new total projects (lower graph, Figure A3.12) in the present test was provided by rewards input. Similarly, despite the declining participation, the total proposed projects provided opportunities for learning by experience, which thereby developed ability. The improvement in ability further improved the motivation to hold meetings and propose projects. Furthermore, ability also supported the satisfaction variable. Thus, with two active satisfaction variables (rewards and ability), the satisfaction increased to a significant level and exceeded zero (second graph, Figure A3.12). This slowed down the decline of participation and later, actually halted the decline. Whilst the motivation to participate kept the participants from rejecting the programme, it was, however, not sufficient to attract and encourage non participants to become members.

In summary, the inability of the inputs to control the decline of participation is mainly due to the inadequacy of the motivation to participate, which, in turn, is closely related to the factor inputs. This suggests that there is a good combination of factor inputs that can generate the necessary motivation to halt the decay of participation. This was actually illustrated by X11 when the contribution and rewards factor combined to generate motivation that is sufficient to halt the decline of participation.

The next set of experiments shows that it is possible to generate a high level of motivation that can, not only halt the slide of participation, but also lead to a recovery. The experiments in this set of experiments are specified in Table A3.3, and the participation levels and total projects shown in Figure A3.13.

Table A3.3. Schedule of two-factor inputs that resulted in a recovery of participation.

Experiment code	Graph legend	Budget	Contri bution	Middle mgt time	Top mgt time	Rewards	TQM staff
X12	1	√	×	√	×	√	×
X13	2	√	×	×	√	√	×
X14	3	√	√	×	×	×	√
X15	4	√	×	×	×	√	√

The behaviour of participation showed a downward trend, whose rate of decline slowed down until the trend was reversed. The changes in the behaviour pattern are directly related to the behaviour of the motivation to participate as shown in the second graph of Figure A3.13. The graph shows that there was an initial equilibrium at zero, which later improved. The zero equilibrium indicates that the initial value of zero for motivation to participate is sustained mainly because there are no significant changes and influences coming from its determinant variables of satisfaction and perceived support. As shown earlier, the perceived support variable adjusts according to the input, and usually is not the source of zero motivation to participate[10]. Thus, as in this case, the zero motivation to participate is due to the low level of satisfaction, which is still adjusting from its initial negative levels. When the satisfaction levels improved beyond zero, the motivation to participate also begin to increase above zero after its adjustment time elapses.

The satisfaction levels in X12 and X13 (lines 1 and 2) were due to the effects of rewards. The success of rewards in improving the motivation to participate can be traced to the initial push it gives to the system as in X4 (Section A3.2.4) and X11. Rewards immediately affects the motivation to hold meetings, which in turn, pushes the number of projects per circle. This later provides some opportunity to learn by experience, leading to more ability and more motivation to hold meetings and propose projects.

What distinguishes this experiment from the previous rewards-related experiments of X4 and X11 is the occurrence of a recovery that was not observed in the earlier experiments. The recovery in participation levels can be traced to the higher level of perceived support. In X4 and X11, the perceived support level was singularly due to the available budget. In the X12, perceived support was due to both budget and middle management time. And it was even higher in X13[11], as top management time later encouraged the involvement of middle management. The

[10] This is so unless there is no perceived support related input factor. But considering the nature of the factors, a perceived support variable will always be part of the input. The satisfaction variables are always accompanied by the budget ratio, which is a perceived support variable

[11] The level of participation for X13 reached to around 57 percent at the end of the simulation run.

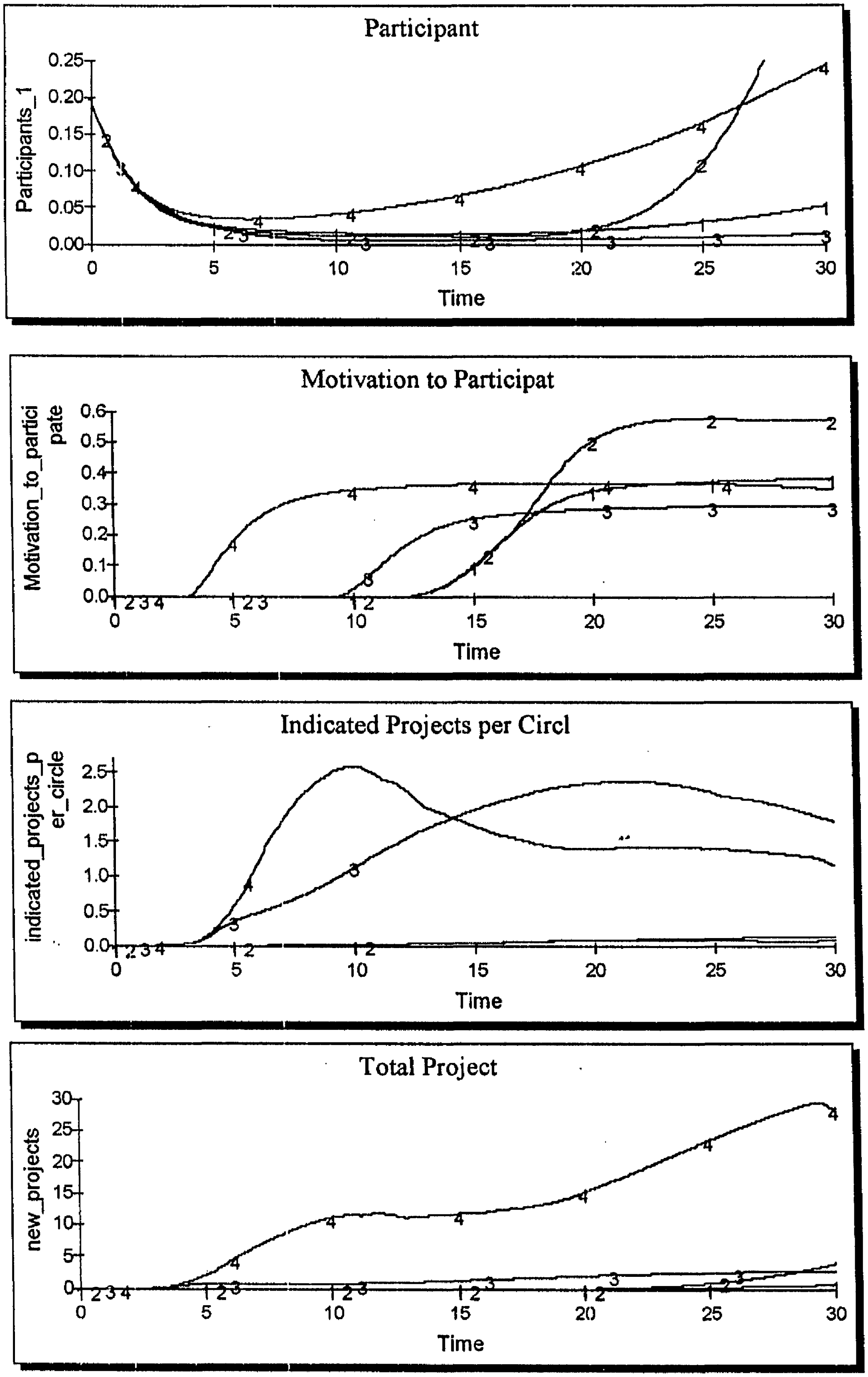

Figure A3.13 Results the two-factor input experiment that yielded a recovery in participation levels higher level of support, given the same level of satisfaction, resulted in a greater motivation to participate. Thus, in X12 and X13, it was possible for the level of participation to recover, whilst the lower level of support in X4 and X11 did not allow the system to improve.

In contrast to X12 and X13, X14 derives its strength from the TQM staff that develops ability at a relatively faster rate than learning by doing. Similarly, this experiment activates the same loops as those in X5, X9 and X10: TQM staff, through the facilitation factor, drives the motivation to hold meetings, and propose projects which led to more learning and ability[12]. However, these previous experiments did not generate enough motivation to participate as to halt the decline of participation levels. On the other hand, the present experiment did improve on such motivation and even reversed the decline.

This difference in observed behaviour is related to the input factors. In X5, X9 and X10, the only active satisfaction factor is ability, with negligible effects from satisfaction due to contribution. The long implementation times did not allow the increased total projects to have a significant effect on contribution ratio. In the present experiment, the other input was improved implementation time. Thus, the initial high total projects (from more meetings and proposed projects) had an impact on contribution ratio, which in turn, led to satisfaction due to contributions, and a higher total satisfaction. This eventually controlled the decline of participation and later yielded an upward trend.

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[12] The indicated projects per circle generated by X14 is as much as 20 times that of X12 and X13.

The combination of the two more successful single factor (rewards and TQM staff) experiments is represented by experiment X15 (line 4). The simultaneous input of rewards and TQM staff provided a very strong momentum for both satisfaction levels and the motivation to hold meetings and propose projects. The effect of such initial force is two-fold. First, it elicited a strong motivation to hold meetings that generated more projects and more learning, and more ability that further increased the motivation to hold meetings. The other effect of the strong initial impetus is a shorter delay in improving the motivation to participate. In other words, motivation to participate increased to a significant level in a relatively shorter time because implementing a rewards scheme does not involve another adjustment process. This led to the earlier recovery of participation. The combined effects of all these interactions is a greater number of proposed projects as seen in line 4 in Figure A3.13.

This accumulated number of projects began to trigger the difficulty variable. As more projects were identified and resolved, the next projects became increasingly harder to identify and solve. The initially dormant difficulty variable steadily increased with total projects. Whilst it had not yet dominated the other loops, it was continuously eroding the indicated projects variable as seen in its decline at year 10. Moreover, the difficulty was creating some frustration. This, in turn, negatively affected learning and ability development slowed down. Eventually, indicated projects was also affected by the slower growth of ability.

Nevertheless, the total projects continued to increase as participation was also positively sloped. This rising number of projects should correspondingly make the next projects more difficult and complex.

In sum, the preceding experiments showed that the combination of two factors can generate different behaviour patterns. More interestingly, a good combination of important resources can yield to an increasing trend in participation, as well to a significant number of projects.

However, a recovery should be accompanied by the motivation to propose projects to create a bigger impact on the organisation. In particular, the recovery of participation in experiments X12 and X13 did not lead to a substantial number of projects because of low indicated projects per circle. These runs generated only 6.07 and 15.7 projects, respectively, over the 30 year simulation period. In contrast, X14 yielded a total of 48.4 projects in the same period. Moreover, the strong factors proved their strength by generating 395.3 projects in 30 years. In these two latter cases, the indicated projects were very high. Thus, there is a good combination of factors that leads not only to recovery but also to greater number of projects.

A3.5 Three factor experiments

The following experiments improved on the previous set of experiments by including a third factor. In addition to the two observed patterns of behaviour for participation levels, a third pattern was observed. It shows the same initial decline and recovery but includes another decline at a later time. Two of the ten three-factor combinations resulted in a continual decline with their graph shown in Figure

A3.14. Six experiments accounted for the decline and recovery behaviour, whilst the rest showed boom-bust behaviour (Figures A3.15 and A3.16, respectively). The details of these experiments are shown in Table A3.4.

Table A3.4. Schedule of three-factor inputs for different behaviour patterns of participation levels.

Experiment code	Graph legend	Budget	Contribution	Middle Mgt time	Top mgt time	Rewards	TQM staff
Decline							
X16	1	√	√	√	√	×	×
X17	2	√	×	√	√	×	√
Decline & recovery							
X18	1	√	√	√	×	√	×
X19	2	√	√	×	√	√	×
X20	3	√	×	√	√	√	×
X21	4	√	√	√	×	×	√
X22	5	√	√	×	√	×	√
X23	6	√	√	×	×	√	√
Boom-bust							
X24	1	√	×	√	×	√	√
X25	2	√	×	×	√	√	√

As in the two-factor input experiments, there is a good combination of factors that can improve the motivation to participate, sufficient enough to control and reverse the decline of participation level. In the first set (X16 and X17), the failure to control the decline was mainly due to the concentration of the inputs on perceived support variables to the neglect of satisfaction factors. In X16, only one satisfaction related variable (implementation time improvement) was introduced. As observed earlier, the contribution-related input was noted for its inability to yield significant improvement in satisfaction, due to its weak coupling with the entire

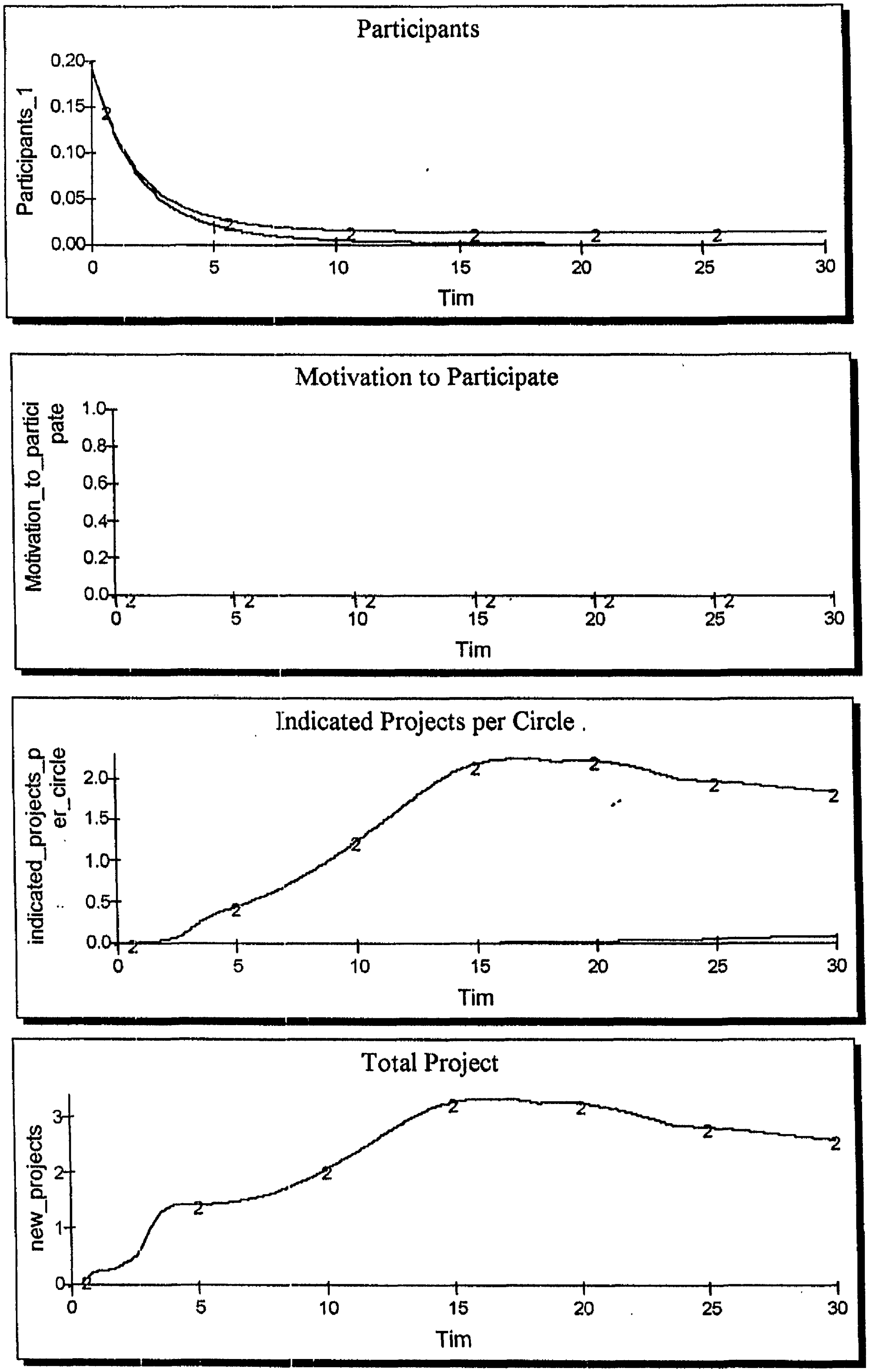


Figure A3.14 Results the three-factor input experiment that yielded a continual decline in participation levels

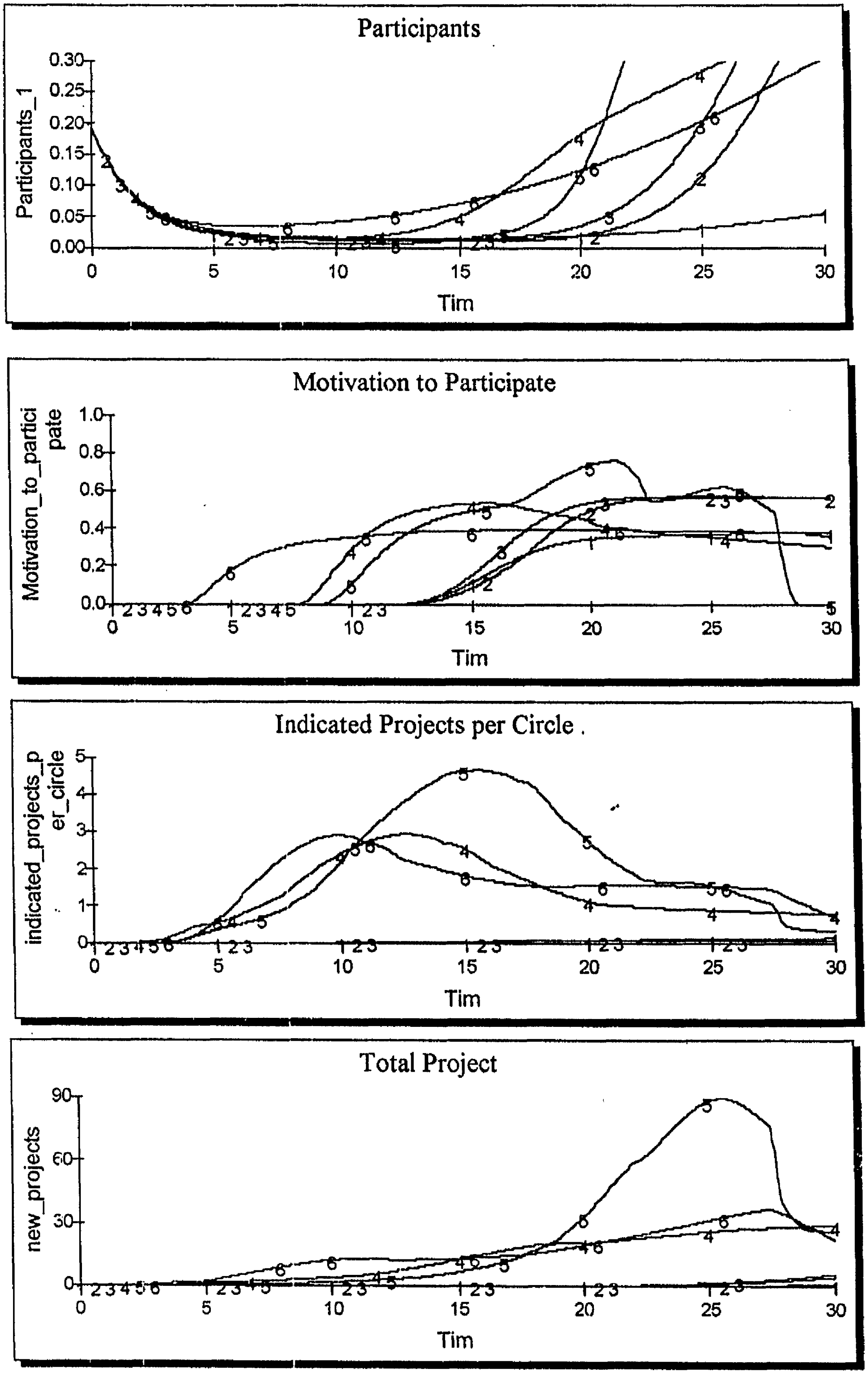


Figure A3.15 Results the three-factor input experiment that yielded a recovery in participation levels system. In X17, only ability developed by the TQM staff contributed to the total satisfaction level. Similarly pointed out in the earlier sections, ability is not able to lead to very significant changes because of inherent delays in learning. This combination of factors, however, successfully slowed the decline of participation level. Thus, despite the substantial and consistent show of support from management, there is no observed recovery in participation in the absence of stronger effects from satisfaction.

The second set of experiments (X18 to X23) was also rather similar to experiments X12 to X14. The slow down in the decline of participation, and the subsequent recovery, was to due to a high level of motivation to participate (second graph, Figure A3.15). For the most part of the simulation, motivation was considerable, thus, encouraging non-participants to become active members. All the runs in this set had rather stable motivation to participate, except for X21 and X22. The first three experiments (X18 to X20) had rather late recoveries and yielded a relatively low number of projects. Thus, for the most part, there were few participants and few projects that cannot deplete the available temporal resources, nor sufficiently large to trigger the difficulty variable.

The last three experiments can be contrasted with each other. All three simulation runs produced a relatively large number of projects. However, motivation to participate dropped at some later stage in experiments X21 and X22, whilst it was sustained and was stable in X23.

The instability of motivation to participate in experiments X21 and X22 (represented by line 4 and line 5 in Figure A3.15), which was not observed in earlier experiments, indicates the fluctuations in the satisfaction due to contributions. The large number of projects being implemented increased satisfaction to a significant level, as to have a huge impact on the shape of motivation to participate. The adjustment process interactions of expected contributions and implemented projects led to some oscillations in the corresponding satisfaction variable. However, the decline of satisfaction due to rewards (as difficulty considerably increased expected rewards) dragged down the motivation to participate in the latter part of the simulation.

The large number of projects generated in X23 (line 6) also provided a strong input into the dynamics of contribution satisfaction, which eventually affected total satisfaction. However, the fluctuations and declines in this latter experiment were not evident because of the gradual adjustment of the total projects (bottom graph, Figure A3.15). Unlike the behaviour of total projects in X21 and X22 that had sharp increases, total projects in X23 smoothly increased. As a result, the dynamics of contributions satisfaction was not sharply reacting and adjusting to these changes. The averaging process itself was smooth. Thus, the rate of decline in X23 is lower than that of X21 and X22.

The third type of behaviour pattern of the levels of participation is observed in experiments X24 and X25. These three-factor experiments showed the participation level following the initial bath-tub shaped behaviour, reached a higher peak at more than 65 per cent, and declined later as shown in Figure A3.16. The corresponding motivation to participate (second graph, Figure A3.16) indeed fell to zero at the point when percent participation began to fall. The total projects generated in these experiments also reflected the rise and fall pattern of percent participation (bottom graph, Figure A3.16). The dwindling participation was initially triggered by decreased perception of support as a consequence of increased participation and more projects. It was reinforced by the increase in difficulty, which led to negative effects on reward satisfaction, and learning rates, which subsequently decreased satisfaction due to ability.

The three factor experiments in this section extended some of the insights from the preceding two factor simulation runs. The present section offers some qualifications to the arguments that top and middle management support are essential to the success of TQM implementations. The simulation runs pointed out that even with high support and involvement of both top and middle management in the programme, participation levels can continually decline and fail when combined with an 'incompatible' third factor. This is mainly due to the inability of the third factor to make up for the weakness of the management factors in raising the motivation to participate. The management factors' effects are limited only to improvements in perceived support so that the third factor must contribute to raising the level of satisfaction to initiate an impetus to drive the reinforcing loops. However, the contribution factor in experiment X16 did not provide the necessary force to raise satisfaction due to its own inherent weakness in generating a considerable push to the system. In X17, the TQM staff, as a third factor, had a low and slow reaction as it involved the inherent delays in learning and development of

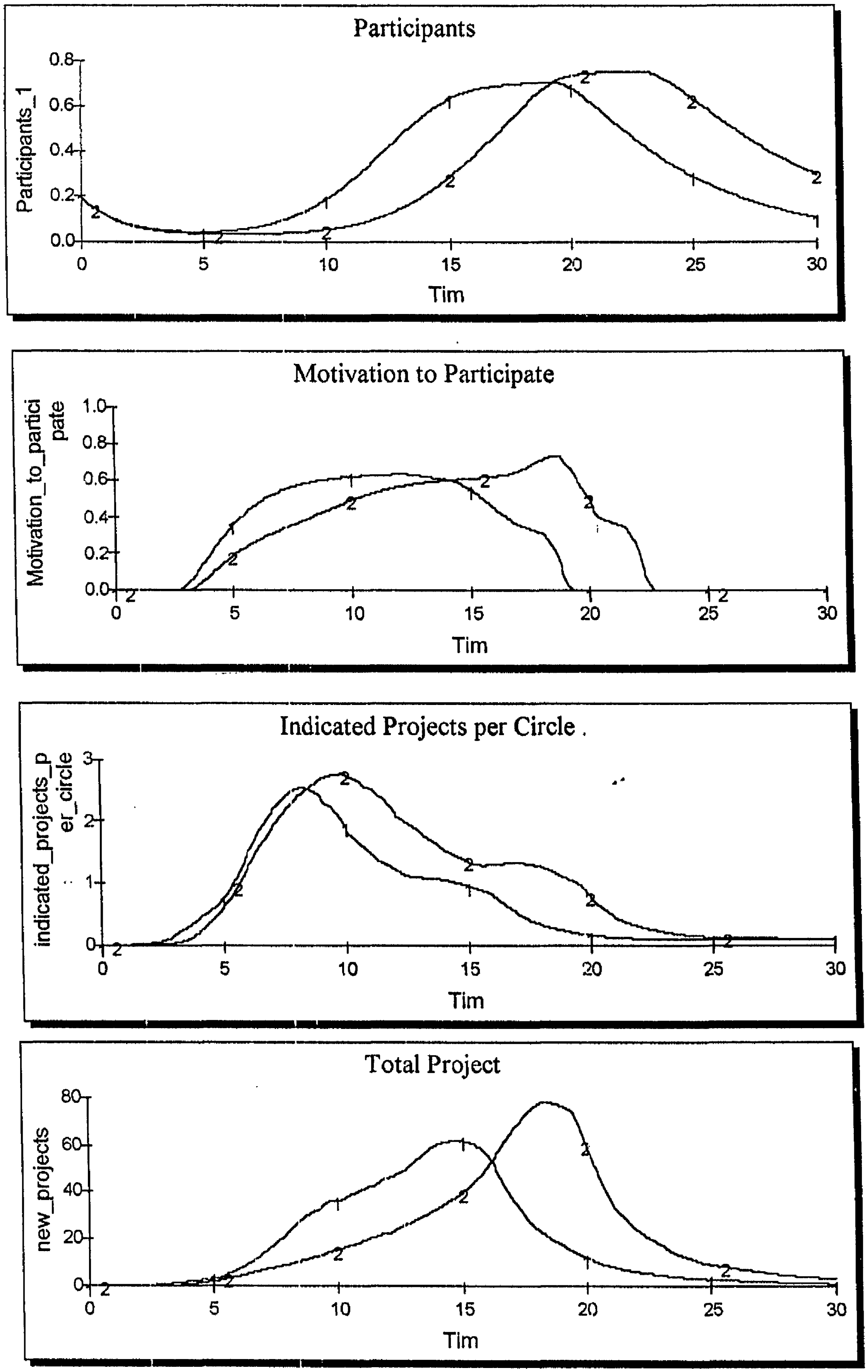


Figure A3.16 Results the three-factor input experiment that yielded a boom-bust behaviour in participation levels ability. Thus, as noted earlier, higher support, in the absence of positive satisfaction, led to more rejection of the programme.

In effect, the intuitive idea that more available resources can lead to better results has been disproved by these experiments. Instead, the simulation runs suggest that in the absence of other factors, there must be a more compatible combination of these available resources. Indeed, experiment X20 indicated that the management factors are more compatible with the rewards factor; whilst the TQM staff factor combined well with the contribution factor (X21 and X22) to reverse the declining trend in participation levels and yield to a larger number of projects. More interestingly, the combination of the strong factors, rewards and TQM staff (in X23 - X25), yielded a huge number of projects.

An analysis of these combinations reveals that a strong factor coupled with a weak factor is a fair combination. However, as Table A3.5 indicates, not all weak and strong factor combinations are good combinations. The compatibility of the factors lies in the capacity of the weak variable to reinforce the strength of the strong factor.

The reward factor's strength is in its capacity to effect considerable improvements in the motivation to participate, mainly because it does not involve an adjustment process to the allocated actual rewards. The management factors support this strength by providing the additional level of perceived support that will further increase the motivation to participate. On the other hand, the strength of the TQM staff factor is in the capacity to elicit more motivation to hold meetings through facilitation. The contribution factor supports this strength as it also supplements the motivation to hold meetings. It may be noted that the exchange of factors does not yield the same complementary relationships.

Table A3.5. Comparison of the factor combinations and their results.

Input Factors	Total projects	Average Motivation to participate	Average Indicated projects per circle
Weak factors			
X3: TM	0.016	0.00	0.07
X2: MM	0.020	0.00	0.04
X1: CONT	0.026	0.00	0.04
X7: CONT + TM	0.031	0.00	0.04
X8: MM + TM	0.036	0.00	0.03
X6: CONT + MM	0.060	0.00	0.04
X16: CONT + MM + TM	0.115	0.00	0.03
Rewards and weak factors			
X4: REW	3.03	0.07	0.08
X11: REW + CONT	3.20	0.07	0.08
X12: REW + MM	6.07	0.17	0.07
X18: REW + MM + CONT	6.97	0.17	0.08
X13: REW + TM	15.71	0.24	0.06
X19: REW + TM + CONT	17.73	0.24	0.06
X20: REW + MM + TM	23.90	0.26	0.06
Staff and weak factors			
X5: STAFF	17.91	0.00	1.36
X10: STAFF + TM	38.32	0.00	2.14
X14: STAFF + CONT	48.40	0.17	1.50
X9: STAFF + MM	54.04	0.00	1.46
X17: STAFF + MM + TM	71.33	0.00	1.50
X21: STAFF + CONT + MM	413.47	0.29	1.35
X22: STAFF + CONT + TM	730.59	0.33	1.97
Rewards and Staff			
X15: REW + STAFF	395.31	0.30	1.40
X23: REW + STAFF + CONT	485.16	0.32	1.53
X24: REW + STAFF +MM	567.39	0.26	0.71
X25: REW + STAFF + TM	654.84	0.30	0.98

The presence of both rewards and TQM staff resulted in the most favourable outcomes, because of their complementarity. Rewards provide a strong impetus for the motivation to participate and supplemented by the gradual effects from ability developed by the TQM staff. On the other hand, a strong push comes from TQM staff as it encourages the holding of more meetings and supplemented by incentives from rewards. Thus, strong inertia on both determinants of total projects lead to a very high level of activity as shown in the boom-bust experiments (X24 and X25). These experiments had an average total of 611.1 projects for 30 years, or an annual average of 20.4 projects. Unfortunately, these runs led to a later decline.

However, the best three factor combinations that yielded the most number of projects are those that combined TQM staff, contributions and management time factors (X22). The management time factors compensated for the weakness of the TQM staff-contributions combination in improving the motivation to participate. The results show that the top management time factor provided more support to motivation to participate, and thus yielded more projects.

The effects of a compatible combination of factors is not only limited to reversing the declining trend of participation and generating a large number of projects. A second effect of a good combination of factors involves temporal improvements. The latter three simulation runs resulted in the earlier recovery of participation in comparison to those of X18 to X22. There is at least a five year difference in the recovery. The time difference is clearer in the comparison of the motivation to participate graphs (second graph, Figures A3.15 and A3.16). The corresponding lower graphs of these figures similarly highlight the effects of the better factor combination.

As noted earlier, the strong initial combined impetus from rewards and TQM staff pushed the system to an earlier recovery in participation levels, whilst the strong motivation to hold meetings resulted in a huge number of projects. With the continued allocation of these resources, the high level of activity results was further improved on as the core reinforcing loops were activated. However, the negative loops were also triggered sooner. This level of activity was not attained by any of the previous experiments and thus, these negative effects were not observed earlier.

The balancing feedback loops that act in opposite directions to keep the system in within limits are an inherent part of the system. The introduction of a factor includes not only the allocation of the resource but also some connections or relationships amongst the variables and the resource. The first section on the single factor experiments showed the additional loops that were introduced with the resource. However, the balancing loops remained inactive during the previous simulation runs as the level of activity was near its minimum. The present experiments that led to a boom bust behaviour and some of the recovery tests yielded very high levels of activity that activated these formerly dormant loops. And their action towards the opposite direction was further reinforced by the positive feedback loops, resulting in rapid decay of motivation to participate, the level of participation and eventually the total proposed projects.

Moreover, as the balancing loops are influenced not based on temporal factors but on the number of projects, the resulting negative effects occur as the projects reach the critical level. Thus, the experiments using a good combination of factors led to earlier declines as the generation of projects was rather rapid.

In sum, the three factor experiments focused on the ideal relationships among the factors that led to improvements in both magnitudes as well as timing of improvements, albeit early decline. These tests highlighted the strength of rewards and TQM staff in providing the inertia to drive the system that the three other factors did not have. Nevertheless, these simulation runs were not able to gage the critical nature of each factor. The next set of experiments attempts to deal with this issue.

A3.6 Four factor experiments

This last set of experiments explores the effect of each input factor and determines their importance from a different perspective. In the previous experiments, the importance of each factor is indicated by the effects of their presence in conjunction with others. In the following set of experiments, importance is reflected in the factor's absence. The details of the experiments are set in the table below.

These 'except one factor' experiments exhibited the familiar patterns of decline and recovery, and boom bust behaviours that were observed in the earlier runs. The recovery experiments are plotted in Figure A3.17, whilst the boom-bust experiments are shown in Figure A3.18.

Table A3.6. Schedule of four-factor input experiments

Experiment code	Graph legend	Budget	Contribution	Middle Mgt time	Top mgt time	Rewards	TQM staff
Decline & recovery							
X26	1	√	√	√	√	×	√
X27	2	√	√	√	√	√	×
Boom bust							
X28	1	√	×	√	√	√	√
X29	2	√	√	×	√	√	√
X30	3	√	√	√	×	√	√

A3.6.1 Except rewards experiment (X26)

The first experiment which omitted the rewards factor input showed the decline and recovery behaviour (line 1 in Figure A3.17). The second graph shows that motivation to participate reached a peak and had some small fluctuations before the uncontrolled decline toward zero. The fluctuations, like in experiment X22, were due to the inherent transient instability of the satisfaction due to contributions. The later decline was due to the high number of projects that reached a critical level as to trigger the difficulty variable. Difficulty affected learning, and eventually the ability level began to decline. At the same time, the average number of projects identified began to fall. Moreover, the waning motivation to participate was also caused by the diminished perception of adequate support as less time was becoming available to all participants and projects.

What distinguishes this experiment from previous experiments is the staggering number of projects it was able to generate despite the absence of the seemingly important rewards variable. This experiment generated a total of 823

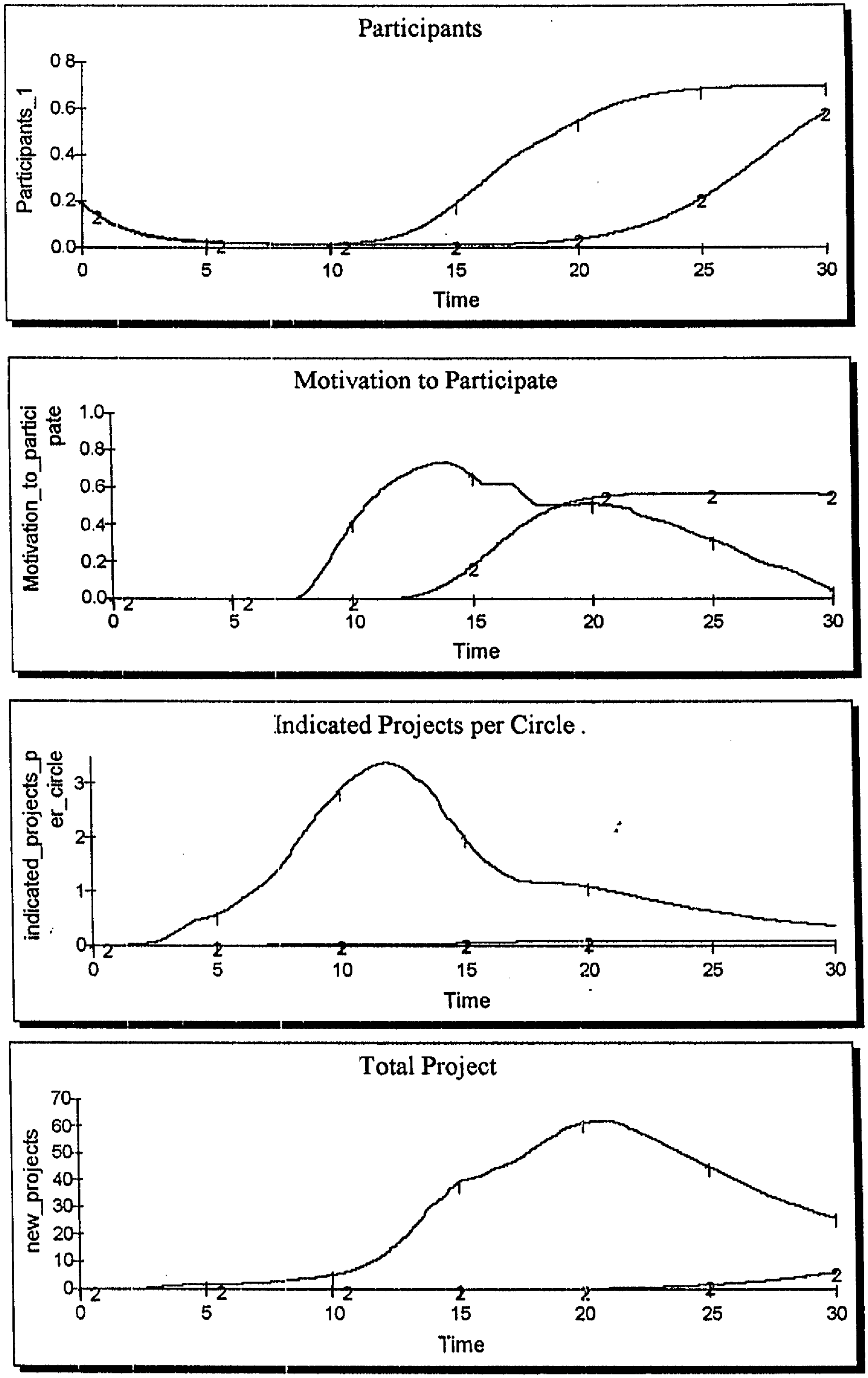


Figure A3.17 Results the four-factor input experiment that yielded a recovery in participation levels projects over the 30 years, or an average of 27.4 projects per year! However, it might be noted from Figure A3.17 that it took a longer time for this experiment to recover in comparison to experiments X23 and X24. The substantial number of projects were proposed only in the second half of the simulation, and the number was considerably less in the early half.

This delay in the peak of total projects is mainly due to the later recovery and peaking of participation level. There is a time displacement between the peaking of indicated projects and participation. From Figure A3.17, the average number of projects (and the percentage meetings held) peaked earlier at year 12, but the lower level of participation at this time produced only a few projects.

A3.6.2 Except TQM staff experiment (X27)

The absence of TQM staff in this experiment resulted in a long delayed recovery of participation that began only at around year 17 (line 2, Figure A3.17). The motivation to participate showed a slow late improvement but seemed to stabilise at it peak. The experiment generated a very small number of projects totalling to only 27.78 projects over the 30 years.

The total number of projects was very low because indicated projects (third graph, Figure A3.17) had not considerably improved and pales in comparison with the 'except rewards' experiment. This was due to the low motivation to hold meetings. The absence of TQM staff had kept the access to learning limited to experience and trial and error. Low motivation to hold meetings led to only a few proposed projects which offered only as much opportunities to learn and increase ability. The few projects generated also diminished the implemented projects so that satisfaction due to contributions was also at a lower level. Overall, the system was generating an increasing number of projects but at a very low and slow rate in the absence of a TQM staff . The low level of ability prevented the identification of a greater number of projects. It also prevented the improvement of total satisfaction that can support the motivation to participate. Thus, the combination of two low determinant variables yielded a low number of total projects.

A3.6.3 Except contributions experiment (X28)

This experiment conceives of a situation where projects are generated but are barely implemented (line 1, Figure A3.18). The long implementation delay reflects this situation. The result shows that despite the long implementation delay, percent participation managed to recover from its initial decline. The rewards input and the ability derived from training and facilitation by TQM staff, and the support from management all provided the necessary motivation to participate, even as the projects took so long to be implemented.

The effects of the long implementation time were not apparent in the recovery of the participation level but more reflected on the timing of the decline of participation, and from its determinant, the motivation to participate. The motivation to participate began to fall at around year 12, and participation levels started to fall at around year 19, earlier than the two other experiments. In contrast to the two other runs, the present experiment had a steeper fall in motivation to participate. This was due to the great number of participants that began to deplete the available

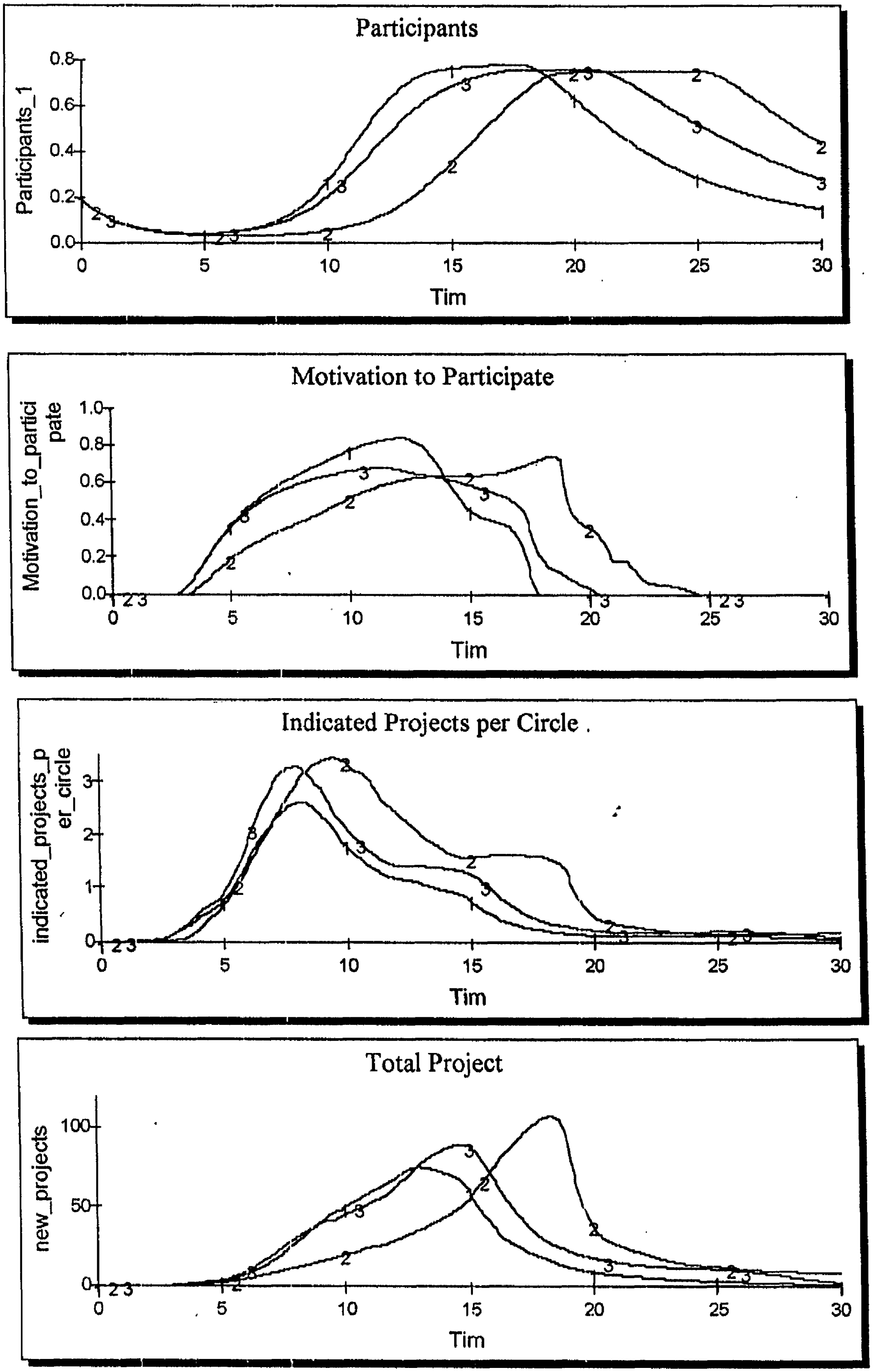


Figure A3.18 Results the four-factor input experiment that yielded a boom-bust behaviour pattern in participation levels temporal resources allocated by top and middle management and the TQM staff time.

Moreover, the non-implementation of the projects contributed greatly to the increase of frustration. This, in turn, affected learning which dampened the development of ability and its level began to decline. However, this decline was not sufficient to pull down motivation to participate. It was only when rewards satisfaction fell that motivation to participate also decreased.

As in the previous cases, rewards satisfaction declined when expected rewards increased as an effect of more difficulty. However, the decline of rewards satisfaction occurred earlier than in other experiments. This earlier decline was caused by an initial level of frustration from long delays in implementation and secondly, from a high number of projects.

The absence of the contribution factor did not dampen the motivation to hold meetings in the early part of the simulation. Thus there was a high average number of projects per circle initially, that was further reinforced by learning from experience. A high indicated projects coupled with an early recovery in participation levels resulted in a big number of projects This may contrasted to the 'except rewards' and 'except TQM staff' experiments, where percent participation improved too late for the higher motivation to hold meetings to yield more projects. This experiment generated 625.25 projects, or an average of 20.8 projects per year.

A3.6.4 Except middle management time experiment (X29)

The fourth test in these four factor experiments explores the possibility of the non-involvement of middle management in spite of the presence of other factors. Line 2 in the top graph of Figure A3.18 represents the level of participation that results from this simulation. It shows the same boom-bust behaviour that was observed in other experiments. This suggests that the combined effects of the other factors enabled the system to offset the absence of middle management and successfully controlled the decline of participation level, and even effected a recovery.

Nevertheless, the more apparent differences, in contrast to the 'except contribution' experiment, are the change in phase and a slightly lower peak in participation levels. Indeed, this experiment had a lower peak and a slower rate of increase in its motivation to participation in comparison to the 'except contribution' experiment. Both these factors caused the slow and late recovery of the participation levels. The motivation to participate had a lower slope mainly because there was relatively less perceived support, as middle management support was absent.

Because participation was at a lower magnitude for some time, the total number of projects that were proposed (line 2, bottom graph, Figure A3.18) remained depressed despite the higher indicated number of projects (third graph, Figure A3.18), and high motivation to hold meetings. This, in turn, delayed the increase in difficulty level. As a consequence, reward satisfaction, and therefore, motivation to participate, stayed high for a longer period. This caused the percent participation to stay longer at its peak and decline later than the 'except contribution' experiment.

A3.6.5 Except top management time experiment (X30)

This experiment attempts to confirm the often suggested point that top management visibility and involvement is the most important factor that determines the success of the TQM programme. The experiment conceives of a situation where all other variables are present except the top management's visibility and involvement with the programme's activities. As in the previous cases, the other factors still managed to support the satisfaction and support needs of the participants. In fact, the first part of the participation levels was almost identical to the 'except contributions' experiment as they actually traced a close path, breaking away from it only at around year 7. From this point, the present experiment had a slower rate of increase, had a lower peak but stayed longer at this level, and declined later than the 'except contributions' experiment. The slower rate of increase and the lower peak are similarly explained by lower motivation to participate, caused by the absence of top management attention.

An interesting difference of this experiment from the 'except contributions' and 'except middle management time' experiments lies in the reason for the slower and later decline of participation. In the earlier experiments, the cause of the decline was the rapid fall of satisfaction due to rewards, as total projects went up. A comparison of rewards ratio generated by the three experiments (Figure A3.19), showed that the present test had caused the ratio to fall faster than the two previous tests![13] This suggests that even in the absence of top management attention the total number of projects increased. Moreover, the projects grew at an earlier and faster rate. As shown by line 3 in Figure A3.18 (lower graph), the total number of projects had a higher peak than the 'except contributions' experiment. Although motivation to participate fell earlier, its decline was not rapid, unlike that of X28. The sharp fall of rewards ratio was compensated by the stability of the contribution ratio. This led to shallower fluctuations in satisfaction due to contributions.

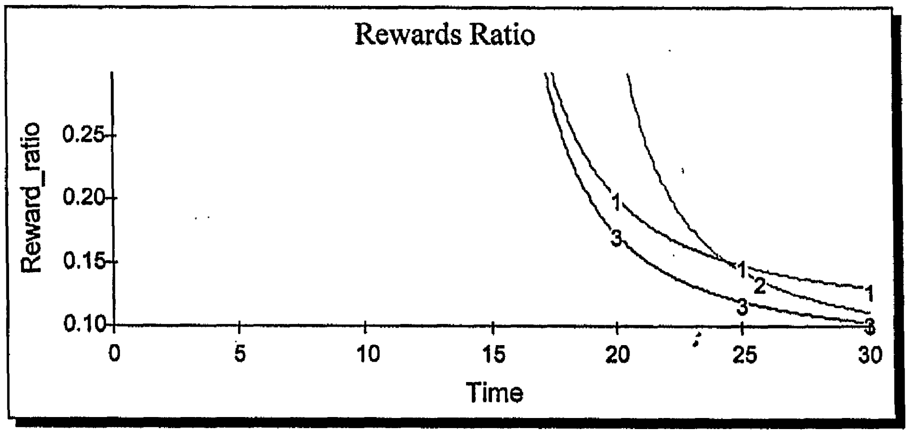


Figure A3.19. Comparison of rewards ratio from X28, X29, and X30.

Both these situations, the slower and later decline of participation and the higher number of total projects, are explained by the large indicated projects per circle (third graph, Figure A3.18) which peaked at around 3.25 projects per circle, earlier than the other two experiments. As the average number of projects (caused by

[13] The comparison can still be seen from the peaks and the timing of the start of the decline in the motivation to participate of Figure A3.18 (second graph). 'Except contributions' (line 1) fell at around year 13, 'except middle management time' (line 2) fell at around year 18, while 'except top management time' fell at around year 11.

high motivation to hold meetings) remained significant, the total number of projects continued to be considerable.

In contrast to 'except contributions' test, there were more meetings held (and therefore more indicated projects proposed) mainly because of the motivation to contribute. In the former, contribution motivation was insignificant, as there was a long implementation delay and few implemented projects. In the latter, the presence of contributions factor and the high number of total project resulted in greater motivation due to contribution. In other words, the present experiment excepting top management time was able to trigger the TQM engine that amplified satisfaction and encouraged the holding of meetings and average project generation.

With more total projects proposed, the implementation rate remained high for a whilst. The resulting contribution ratio caused a corresponding significant level of satisfaction. So that when rewards satisfaction sharply declined, satisfaction due to contributions propped up the minimum level achieved by the 'except contributions' experiment. The higher satisfaction, which however, did not prevent the decline, raised it sufficiently as to lower the rate of participation rejection, and thus a slower decline in participation.

In contrast to 'except middle management time' experiment, the present experiment had less indicated number of projects per circle. But because of the slow and late recovery of participation in the previous experiment, the total number of projects was not as many. The present experiment generated an average of 26.7

projects per year whilst 'except middle management time' yielded a slightly lower average of 26.5 projects per year.

The present set of experiments was intended to examine the effects of additional input factors. The introduction of a fourth factor increases the possibility of a better combination as this additional factor is expected to compensate for the weakness or supplement the strength of the three-factor strategy. Indeed, the complementary or supplementary role of the additional factor improved on the motivation to participate and the indicated number of projects per circle (Table A3.7). Excepting the trial that omitted TQM staff, the average total number of output was 760.6 projects. Moreover, the fourth factor removed the possibility that participation levels will continue to decline without recovery and improvement. In other words, the addition of an extra factor assures the recovery of the participation levels. Thus, the present experiments support the intuitive idea that more input factors can result to better outcomes, albeit, with one exception.

These simulation runs have also indicated the relative importance of the factors. It is apparent from Table A3.7 that the absence of TQM staff had strong adverse effects on the programme as it yielded the fewest projects. Whilst the presence of the four other factors combined to establish a high level of motivation to participate, the average indicated projects per circle was at a minimum level. This highlights the role of the TQM staff in providing the training and facilitation that develops the ability of the employees. The table shows that the motivation to participate is not a sufficient condition for the achievement of the desired outcomes.

Table A3.7. Comparison of summary results from the four factor experiments.

Inputs	Total projects	Average motivation to participate	Average indicated projects per circle
Except STAFF	27.8	0.27	0.06
Except CONT	625.2	0.27	0.67
Except MM	794.3	0.30	1.12
Except TM	799.7	0.27	0.88
Except REW	823.0	0.32	1.26

The difference between the least and best outcomes lies in the average projects per circle. In the absence of TQM staff, development of ability has been limited to in-process learning, which is a relatively slower process with its dependence on its experience and trial and error. This dependence on total projects complicates the situation as this involves a reinforcing loop - more projects lead to more learning and more ability, which in turn encourages meetings and more projects. The reinforcing loops' operation is dependent on the push it gets from the system. As discussed earlier, the strong push originates from a high level of ability, which can rapidly be developed from training and facilitation. In the absence of training and facilitation, there is a very weak force that activates the feedback loops.

The effects of the strong momentum, particularly in the indicated number of projects, provided by the TQM staff is also reflected in the other experiments as the rest of the runs had modest to high values. Among these tests, the lowest indicated projects resulted from the experiment without the contribution factor. This is not surprising as the TQM staff factor combines best with contributions. As earlier pointed out, the contributions factor reinforces the strength of the TQM staff factor. Thus, in the absence of the contributions variable, the strength of the staff resource, which is the indicated projects per circle, is considerably reduced. The importance of the contribution factor to TQM staff is also apparent in the three other experiments that had very high averages.

At the other extreme, the absence of rewards did not seem to have an effect on the system as the simulation run produced the most number of projects. The reason for this good performance can be traced to the compatibility of the management time factors to the TQM staff-contribution combination. As earlier pointed out, the management time factors effectively support this combination by improving on the motivation to participate. Thus, the management time factors compensate for the absence of rewards, and effectively cancelled out its importance.

This good combination of factors facilitated the development of ability that proved to reach levels that are higher than in any previous experiment. This ability level kept the difficulty factor ineffective for some time. Thus, more projects were proposed before the imminent negative effects of difficulty and frustration.

The presence of rewards in the other runs showed a considerable level of motivation to participate. Whilst the absence of any of the weak factors did not effect any significant changes on this level of motivation, its basis lies with the rewards and staff combination as similarly reflected in Table A3.6. The absence of the rewards factor in the first part of Table A3.6 is reflected in the zero motivation to participate. Similarly, the first section of the third set of the same table shows zero or low motivation in the absence of the incentives. However, this table also shows the effect of management time factors on the staff and contribution combination experiments.

Another observation from these four factor experiments is the notable absence of a declining trend in participation levels in the simulation runs that did not involve rewards and TQM staff (Figure A3.17). The absence of rewards as a factor in the first experiment (line 1) effectively removed the effects of the rapid decline in satisfaction due to rewards that was the common cause of the collapse of participation of earlier experiments. However, since the organisation still had the expectation for rewards, the level of satisfaction due to rewards was kept to its minimum. As mentioned earlier, the satisfaction due to ability and contributions offset this absence. This led to the gradual increase in projects.

The absence of rewards, nevertheless, does not discount the occurrence of a decline in participation. In fact, a longer simulation showed that participation indeed decayed after year 30. The reason similarly lies with the increased difficulty of projects. The effect of difficulty was solely focused on ability since increased difficulty cannot further pull down satisfaction due to rewards (which is already at its minimum). The level of frustration followed the rising trend of difficulty. This slowed down learning, as well as the development of ability, and the reinforcing loops of the TQM engine reversed their direction of changes and subsequently effected the decline. Since ability is now the main variable that determines the satisfaction variable, any changes affecting ability impacts on the satisfaction variable. Thus, participation fell with the decrease in satisfaction.

It must be pointed out that in the earlier experiments, ability also fell but it was gradual. The sharper decline in rewards obscured its impact on the motivation to participate and participation levels. Moreover, the gradual decline of ability and participation allowed the accumulation of more projects before the final collapse.

In the second case where the TQM staff was not inputted, the main reason for the absence of a decline is the low level of activity. In the absence of training and facilitation, and few opportunities for learning, fewer projects were proposed. As a result, the level of difficulty only gradually increased. Nevertheless, a longer simulation run showed that difficulty overtook the level of ability, which soon led to increased efforts, and higher expectations of rewards. Subsequently, satisfaction due to rewards started to wane, and brought down with it the motivation to participate and the participation levels.

These simulation runs highlight the fundamental nature of ability in the TQM implementation process. The engine that can sustain the TQM programme is made up of the reinforcing loops centred on ability. Thus, improvement in ability can activate the reinforcing loops that will drive the programme. This centrality of ability then shifts the focus to its own driver: training and facilitation. The learning from the TQM staff builds ability faster and more efficiently than from in-process learning. Thus, in the absence of the staff, learning by experience, which is basically trial and error, is a gradual process and by no means, replaces the more formal learning and expert-guided methods. Therefore, unlike rewards, other factors cannot offset or make up for the absence of the TQM staff. This irreplaceability makes this factor the most important resource that determines the success of the implementation programme.

In comparison, rewards have a curious and ironic impact. The four factor experiments seemed to contradict the earlier observations on the importance of the rewards. Whilst these four factor experiments have indicated its dispensability, the earlier runs have suggested otherwise. In the single factor experiments, only the 'rewards only' experiment (X4) had controlled the decline of participants, and had a positive motivation to participate. It also yielded the second most number of projects, after the TQM staff only test (X5). The other tests, as shown in Table A3.6, also proved the importance of both TQM staff and rewards. Secondly, whilst rewards supported the motivation to participate in the earlier part of the simulation, the later decline of participation in most of these experiments was also precipitated by the diminishing satisfaction due to rewards.

These features of the rewards factor suggest its short-term effects. It can elicit the intended positive response in a shorter time, as it does not have an adjustment process to perceive the availability of the response. In contrast, the TQM staff factor affects the system through the gradual development of ability and thus cannot have an immediate strong positive impact.

On the other hand, satisfaction due to rewards also wanes very rapidly, as more projects become increasingly more complex and difficult. The paradoxical effect lies in the earlier successes that begin to decline and fail earlier. Although not apparent, similar effects were also observed in the absence of the rewards factors above. The TQM staff factor, however, took longer time to yield more projects because of its inherent gradual development of ability. Similarly, it took longer for it to decline as ability takes time to become obsolete, unlike rewards satisfaction that is based on the exponentially increasing rewards expectations.

Such contradictory results are typical of the limits to growth model behaviour (Senge, 1990; Wolstenholme, 1990). The positive feedback loops amplify and reinforce success but some secondary and underlying effects also result. These hidden results later become stronger as to undermine success. In TQM, rewards and TQM staff provide the push and momentum to activate the reinforcing loops of ability and satisfaction to generate more and more projects. These projects become more difficult and complex, which thereby slows down success until it leads to decline and failure.

TQM literature (both prescriptive and empirical) argues that failures of TQM programme have been due to the inadequate attention to other important critical factors. The previous experiments have all tested the contention of missing factors and showed that it is possible to reach the goals of maximum participation and improvement projects in the absence of some factors. However, it will be necessary to compare the performance of these relatively successful implementations with a 'full' TQM implementation. In the next section, the input of all critical factors shall provide a comparison with the other 'incomplete' implementations.

A3.7 Total factor experiment

This section involves the input of all these important factors. As has been discussed in the earlier chapters, the presence of all these factors is seen as necessary and sufficient condition for the success of the programme. This experiment tests these claims.

The top graph of Figure A3.20 shows the simulated level of participation. The behaviour is similar to the earlier boom bust behaviours. In contrast to the four factor experiments, it generated an earlier and faster rate of increase and a corresponding higher peak, and a decline that was very similar to the 'except top management time' experiment. In fact, most of the generated behaviour followed the pattern of the experiment X30.

The inclusion of top management time factor improved on the behaviour of experiment X30. Although the indicated projects were almost identical, the total projects showed a greater number of projects. The average number of projects generated was expected higher at 30.2 projects per year.

The simulation run generally shows the importance of the presence of all input factors as total number of projects produced were more than in any of the other previous experiments. The input of all factors ascertains that the presence of the factors that form the proper combination. Thus, the strong and weak combinations are present as well as the strong-strong combinations of rewards and TQM staff. The combined effects provides the strong push to the system and encourages the identification of projects. Furthermore, the difference between results of this

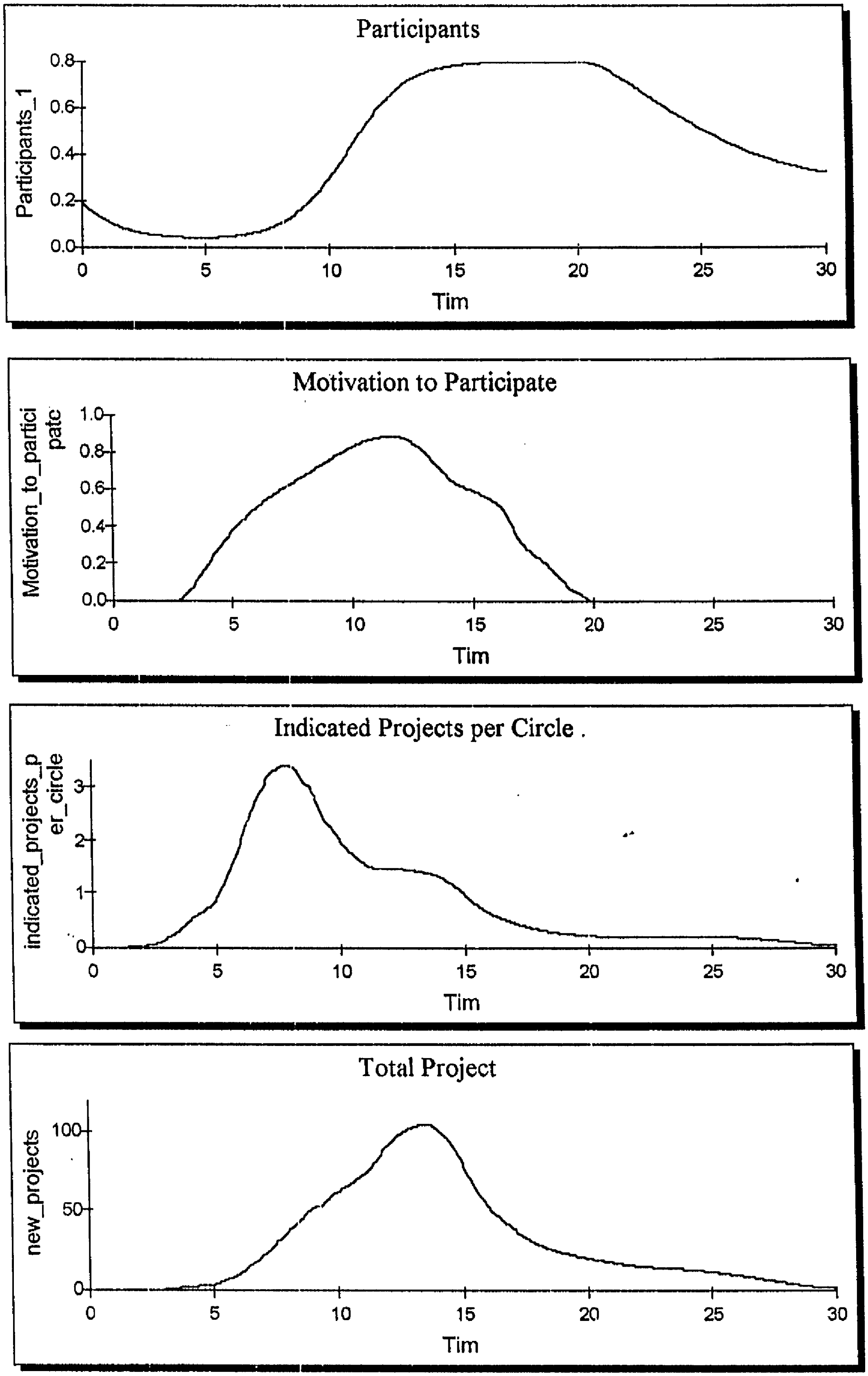


Figure A3.20. Results the all factor input experiment.

simulation run and the four factor runs can indicate the relative importance of the missing factor. Thus, the importance of TQM staff is confirmed by this test since the introduction the staff yielded the highest additional projects.

However, even as the full factor combination increased the output, it did not prevent the decline of participation.

A3.8 Conclusion

In system dynamics, the first simulation runs are conducted to study the interaction of the variables and the result of the various feedback loops. These initial simulation runs, referred to as base runs, test the ability of the model to reproduce the identified problem behaviour. Moreover, the experiments provide the further learning and understanding that cannot be provided by the causal diagrams. Whilst diagrams provide insights into the relationships of variables; they do not show the possible actions and reactions, and therefore the resulting behaviour patterns from such interactions. Indeed, Senge and Sterman (1994) observe that "experienced managers frequently have accurate perceptions of causal structure and decision-making process but draw erroneous conclusions about what happens when different parts of the system interact" (p.200).

Thus, this chapter covered all 31 possible combinations of the factor inputs to draw observations on the effects of varying implementation strategies. The analysis in this chapter assumed that the goal of the TQM programme is continuous improvement, and forming groups that discuss and identify projects is a way to promote and achieve this goal. In the model, continuous improvement is represented by the total number of projects proposed and implemented by the participants[14]. In effect, the goal of the TQM programme is to encourage and sustain the identification and proposal of projects. Consequently, the focus of the analysis is on the determinants of total projects: indicated projects and levels of participation.

As multiplicative factors of total projects, both variables need to take significant values to yield a considerable number of project proposals. The simulation runs indicated that the consistent show of support through resources had positive effect on the indicated projects. Thus, in all the runs, indicated projects took some substantial value until it was affected by the uncontrolled increase of difficulty. The increasing complexity of new projects slowed down the indicated number of projects because the level of ability was not able to offset difficulty. Eventually, the indicated number of projects declined.

However, even in the period when indicated projects were not affected by difficulty and assumed significant values, the level of participation tended to dominate the relationship. Thus, even as the indicated projects per circle was high at the beginning of the simulation, total projects were down because of the declining level of participation. The same dominating effect was observed towards the end of the simulation when the participation level also fell,[15] when motivation to participate went down to zero. In the final analysis, the level of participation determined much

[14] The model does not represent the amount of improvement that resulted from the projects. However, there is some implicit improvement as the model incorporates a sector where proposals are evaluated. It is assumed that implemented projects are those that contribute some benefit to the organisation.

[15] At this time, indicated projects per circle also declined when difficulty began to rise significantly so that it was greater than the level of ability.

of the behaviour and magnitude of total projects, and ultimately affected the goal of continuous and sustained improvement.

The base runs showed three general shapes of the behaviour patterns for the participation levels resulting from the interactions: decline, the recovery and the boom-bust patterns. Further testing, however, indicated that these behaviours could be collapsed into only two types, as the recovery patterns are only a transitory phase of the boom-bust behaviour. Longer simulations showed that the recovery patterns were bound to decline after some time. Thus, the base runs confirmed that the model could reproduce the problem of TQM failures.

These experiments showed two possible ways by which the TQM programme can lead to a decline in participation. In the first case, the initial decline was shown to be related to the inability to trigger the reinforcing loops of the programme. The factor inputs are unable to generate the strong impetus to yield sufficient motivation to become involved and thus, could not control the rejection rate. The initial relevant organisational conditions characterised by satisfaction and perceived organisational support, are a result of past experiences with the allocation of resources (or factors). In the implementation of a quality programme, the consistent show of support through the allocation of resources needs to reverse these negative perceptions by disproving their validity. However, the change of these perceptions takes time. In the meantime, the negative perceptions continue to undermine the participation level as motivation to participate is zero. The inability to control the rejection of the programme further leads to fewer projects that cannot trigger the reinforcing loops of the programme. The involvement of the reinforcing loops further worsens the inability to generate the motivation to participate.

This condition where the reinforcing loops only bring the system to its collapse may be referred to as "programme failure". The stated goals of the TQM programme of generating quality improvement as well as sustaining these efforts were not achieved as participation was not successfully encouraged. The limited resources expended by the organisation for the programme did not match the expected benefits. Whilst the organisation might not recognise that the limited benefits and inability to motivate its members was due to limited resources inputs or to a non-complementary set of inputs, the organisation may be expected to see the failure of the programme to deliver the promised benefits of quality improvement. Thus, the organisation may be tempted, even forced to abandon the programme and call it a failed attempt.

In the second case of declining indicators, although there was the initial decline, similarly due to initial negative perceptions, certain combination of factors were able to improve on the initial negative perceptions that led to increased motivation and a positive trend to participate. However, the resulting negative feedback loops from the implementation of the resources gradually began to undermine the success. The rising number of projects started to deplete the limited available resources, as to indicate lower organisational support. Secondly, difficulty and frustration began to affect satisfaction due to rewards and the ability development process.

This second condition where the complementary factor resources were able to reverse the initial downward trends yielded some benefits before the indicators began to fall. Thus, in contrast to the first "programme failure", this situation arguably achieved its objectives. However, as the programme matured other problems and difficulties set in as to discourage participants into sustaining their efforts leading to the withdrawal and abandonment of their quality efforts. This situation can be termed as "programme fatigue" denoting the programme outliving its purpose.

Both situations can be explained by the limits to growth model. In the first case, the input factors were not able to activate the reinforcing loops because of the initial conditions. In the second case, the reinforcing loops were active for a time until the effects of the balancing loops started to slow down success and eventually reversed the reactions of the reinforcing loops.

In some limits to growth models (Senge, 1990), the behaviour oscillates, as there is an alternating shift in the strength of the loops[16]. However, in this case, the processes are largely irreversible. Although, the oscillations appear in the perceived support variables, the motivation to participate does not show these behaviour patterns. This is mainly due to difficulty. As an inherent characteristic of projects, it cannot be controlled. Thus, when difficulty has reached a certain level, and rewards

[16] When the reinforcing loops dominate, there is an increasing positive, or negative, trend. That is the rate of change is always increasing. When the balancing loops begin to dominate, the rate of change decreases gradually until it is zero. Then, the reinforcing loops begin to take over and amplify the effects of the balancing loops by pushing the behaviour in the opposite direction until a certain level is reached where the balancing loops again slows down the effects of the reinforcing loops. The results of these interactions are oscillations.

satisfaction and ability begin to decline, later recovery is not possible, as the later projects are far more complex that the decreasing ability cannot handle.

These runs emphasise the point that whilst all the factors are indeed important, the resulting interactions among the variables also contribute much to the observable behaviour patterns. Although the most favourable results were generated by the run in the presence of all factors, it is, however, possible to have a positive trend in both participation level and total projects in the absence of other factors. Thus, it is not necessarily true that the implementation programme will fail if other factors are not present. The absence of a factor can be compensated for by some other factor or factors so that a recovery can still be effected. These runs show that improvements in participation and total projects are mainly due to the ability to activate the reinforcing loops. These loops are the engine of the system.

These reinforcing loops have generally been the main focus of attention of the management consulting-based TQM literature. These become the selling point in many arguments to the inherent ability of TQM to continuously encourage and motivate employees once the system has been set. Sneddon (1995), for example, argued that workers want to contribute to the management of the organisation and by providing them with the opportunity and the supporting system to contribute, then they will continue helping the organisation. Similarly, training provides some satisfaction that encourages workers to learn more and become more motivated. In an earlier paper, this author (Mutuc, 1994) argued that there has been unqualified attention to these reinforcing loops. These propositions suggest that failure of programmes occur because there is not enough effort or resources to trigger their positive effects. Although the absence or inadequacy of resources or inputs can actually lead to decline as these tests showed, and further tests in the next chapter demonstrate, the availability of all resources do not discount the possibility of a failure in the longer term. The balancing loops have been the key to the decline in the long run.

Nevertheless, these initial experiments have explored the formal model's behaviour and have shown several possible ways by which the level of participation can wane in the longer run. Furthermore, the graphs of indicated projects per circle also showed a peak and decline that soon undermined the total projects. This behaviour pattern is similar in all the experiments. As an indicator of the programme, both indicated projects and total projects demonstrate that all TQM efforts are bound to fail. Such observations are consistent with many accounts of the failure of TQM programmes.

The experiments in this chapter have been based on certain assumptions.

1. It was assumed that the value of the input is realistic and sufficient to elicit the desired effects.
2. The conditions of the organisation represent the worst possible conditions.
3. Top management is interested in sustaining the programme to as long as possible so that a 30-year time span is used to study the interactions.
4. Top management is unwavering in its allocation of resources so that these values are fixed and constant.

The next chapter investigates the effects of relaxing these assumptions.

CHAPTER A4
CONFIRMING THE RESULTS: SOME SCENARIO ANALYSIS

This chapter deals with the testing of the results of the preceding chapter. Chapter A3 presented 31 base runs representing the various possible approaches to implementing TQM. In system dynamics terms, 'base runs' represent the first tests of the model that utilises the original assumptions and analysis of the conceptual model. The first trials hope to replicate the observed behaviour pattern that results from the problem concern. Indeed, the runs showed the expected declining pattern of behaviour that has been described and discussed in the earlier chapters.

However, these base runs may be seen as restricted by the assumptions of the parameter values. This chapter recognises the limits of these assumptions. Thus, the present chapter is devoted to relaxing these constraints. The assumptions, which are implicit in the values of input parameters, are adjusted to reflect other organisational conditions and strategies. The resulting behaviour patterns are studied and compared.

In this chapter, the initial runs of Chapter A3 are explored to establish the model's logical consistency and mathematical robustness. The tests in this chapter first establish whether plausible changes in parameters result to reasonable and consistent behaviour patterns. Secondly, the model must also pass the extreme conditions tests for parameters to ascertain that no unrealistic results, such as negative values for strictly positive variables or division by zeroes, are generated from the computations[17]. All these contribute to building confidence to the model's validity (Barlas, 1996; Forrester, 1961; Forrester and Senge, 1980; Peterson and Eberlein (1994)).

Moreover, these experiments aim to further the understanding the model's structure and behaviour dynamics. Analysing and comparing the runs led to deeper appreciation of the interactions of the variables. In system dynamics, causes of behaviour patterns are attributed not to isolated variables but to feedback structures (Richardson and Pugh, 1981). They point that "whilst a single factor can change the strength of a feedback loop and affect its dominance in the rest of the model, it is more useful to see the loop, not the factor, as the causal agent in the system" (p. 268). Indeed, in many situations persons in the system find themselves as victims of the system because of these feedback loops, as they feel helpless to change or improve their situation (Senge, 1990). Further understanding of the causal interactions of variables and their resulting behaviour patterns can facilitate the development of solutions to unwanted behavioural trends. Thus, to further analyse the relationships between structure and behaviour, this chapter considers variations in parameter values and loop dominance.

The chapter involves simulation runs that explores and examines the behaviour resulting from changes in strategy, organisational conditions and structure.

[17] Some of the extreme condition tests were implicit in the parameter modification tests as these bore out the weaknesses of certain equation formulations. These faults usually dealt with division with zeroes and abrupt jumps in the graphs. Tracing these faults was not easy as Powersim, unlike the old version of DYNAMO, did not flag up the errors and continued the simulation. The other extreme condition tests were separately done but are not presented in this chapter.

The implementation strategy is represented by the changes in the values of initial participation. Relaxing the organisational conditions is undertaken by varying the initial values of the level variables that represent satisfaction and perceived support. The magnitudes of the input resources are also adjusted to determine their corresponding effects on total system behaviour. Lastly, the structure is modified to represent the policy of outcome evaluation.

The chapter ends with a summary of the observations and theoretical implications.

A4.1 Participation Levels

The first set of initial condition tests explores the reactions of the organisation to different levels of initial participation. The rate of conversion from non-participants to participants is directly proportional to both these groups at any time. The contact between participants and non-participants influences the latter group to join the programme. This influence, however, is dependent on the motivation to participate. Thus, the interaction between these three variables determines the rate at which the programme spreads through the organisation. These tests explore these interactions and their resulting behaviour patterns as different initial participation levels are assumed.

This set of experiments was consecutively set to 5 percent, 20 percent, 50 percent and 100 percent of the organisation's workforce as initial participation levels.

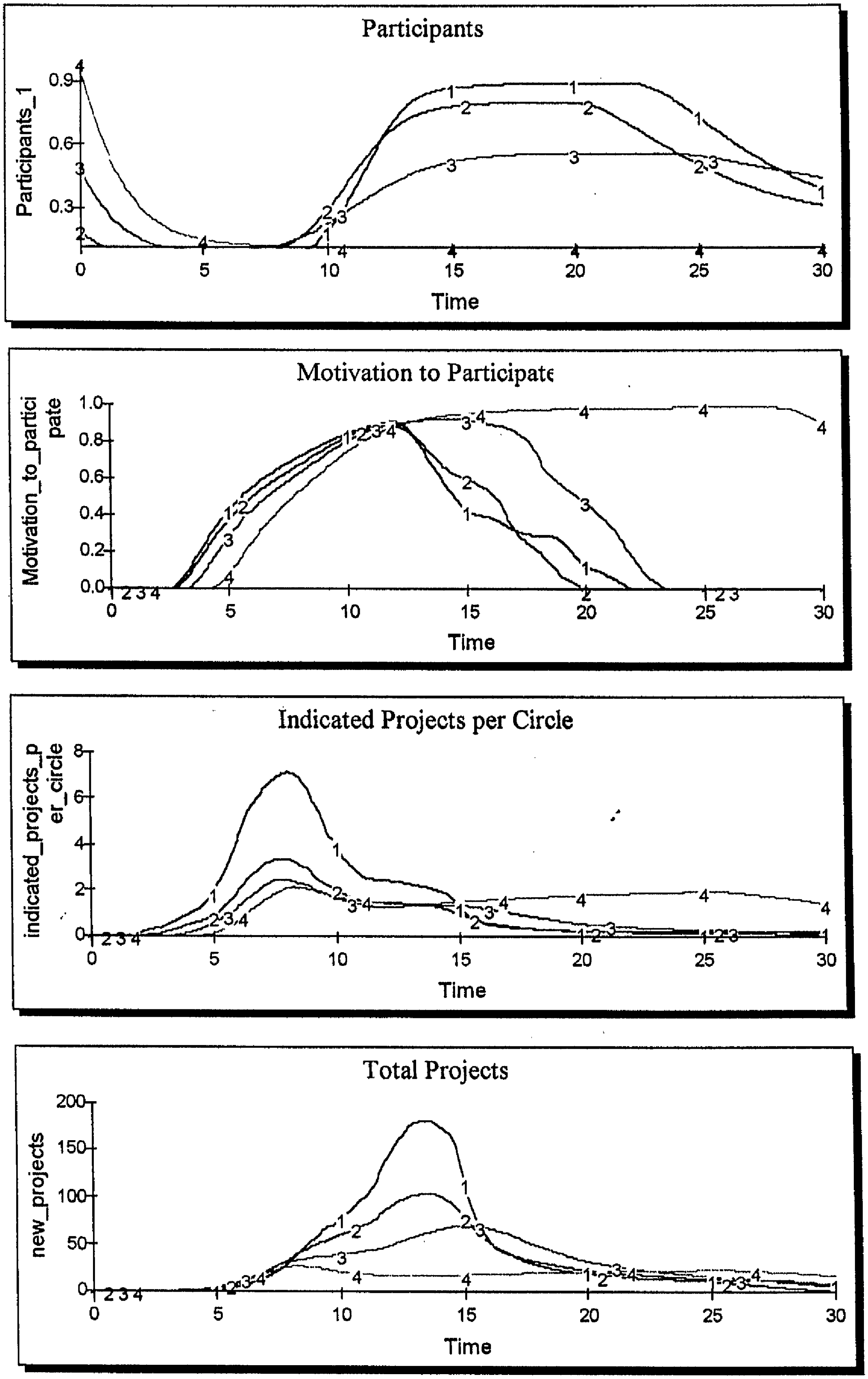


Figure A4.1. Results of varying the initial level of participation

The experiments used the ideal values for all factor inputs. Figure A4.1 shows the results of the major variables. The topmost graph shows the familiar decline and boom-bust behaviour of participation. In general, as initial participation increased, a slower rate of recovery and a lower peak were observed. In contrast, the fourth line, representing an initial participation level of 100 percent shows only a decay pattern without recovery.

Despite the marked difference of the fourth test, these behaviour patterns are all explained by the same dynamics of motivation to participate (second graph, Figure A4.1). As pointed out in earlier experiments, the rate at which the decline of participation slows down, stops, and reverses to a positive slope are all due to the rise and fall in the motivation to participate. As motivation increases (as the availability of resources is recognised), present members become satisfied, and the number of quitters begin to diminish, until nobody quits. At this time, the participation graph stops declining. It is also at this time that the programme becomes increasingly attractive to non-members, and they are encouraged to join. This reverses the downward trend.

Moreover, the slope of the increase in participation depends, not only on the present members, but also on the number of non-participants. As the initial number of participants increases, the pool of non-participants decreases. Thus, at higher levels of initial participation (lines 2 and 3 in contrast to line 1), the non-members are fewer. Consequently, the number of those who become members, as they are a fraction of non-members, is limited. The result is a slower rate of recovery, and a lower peak. Furthermore, it may be recalled that rejection of the programme was assumed to be an irreversible process. Those who had left the programme are not willing to return to become active participants. In other words, the only potential members are non-members. A smaller pool of non-members, a result of greater participation at the outset, therefore, limits and slows down the conversion rate.

The fourth simulation run provides an extreme case for the interaction of non-participants, participants and rejecters. This test involved the entire organisation at the launch of the programme. As motivation to participate has not yet improved beyond zero, participants continued to reject the programme. When motivation to participate had significantly improved (just before time 5), the decline rate slowed down and later, halted. However, even as motivation to participate continued to improve, indicating higher satisfaction and sufficient perception of support, there is no reversal of the declining trend. This is due to the absence of the pool of non-participants. As all members of the organisation had been involved at the outset, the only other people who are not participating are rejecters. But these cannot be enticed to return to the programme. Thus, there are no additional members. On the other hand, there are no new rejecters because of the higher motivation to participate at this time[18].

The timing of the halt of the decline of levels of participation is also related to the improvement in the motivation to participate. More specifically, the point in

[18] Participation levels appears to have reached an equilibrium point at this stage. However, further simulation showed that motivation to participate also began to decline and fall to zero. As a result, participation levels also declined, albeit, slightly at around time 49.

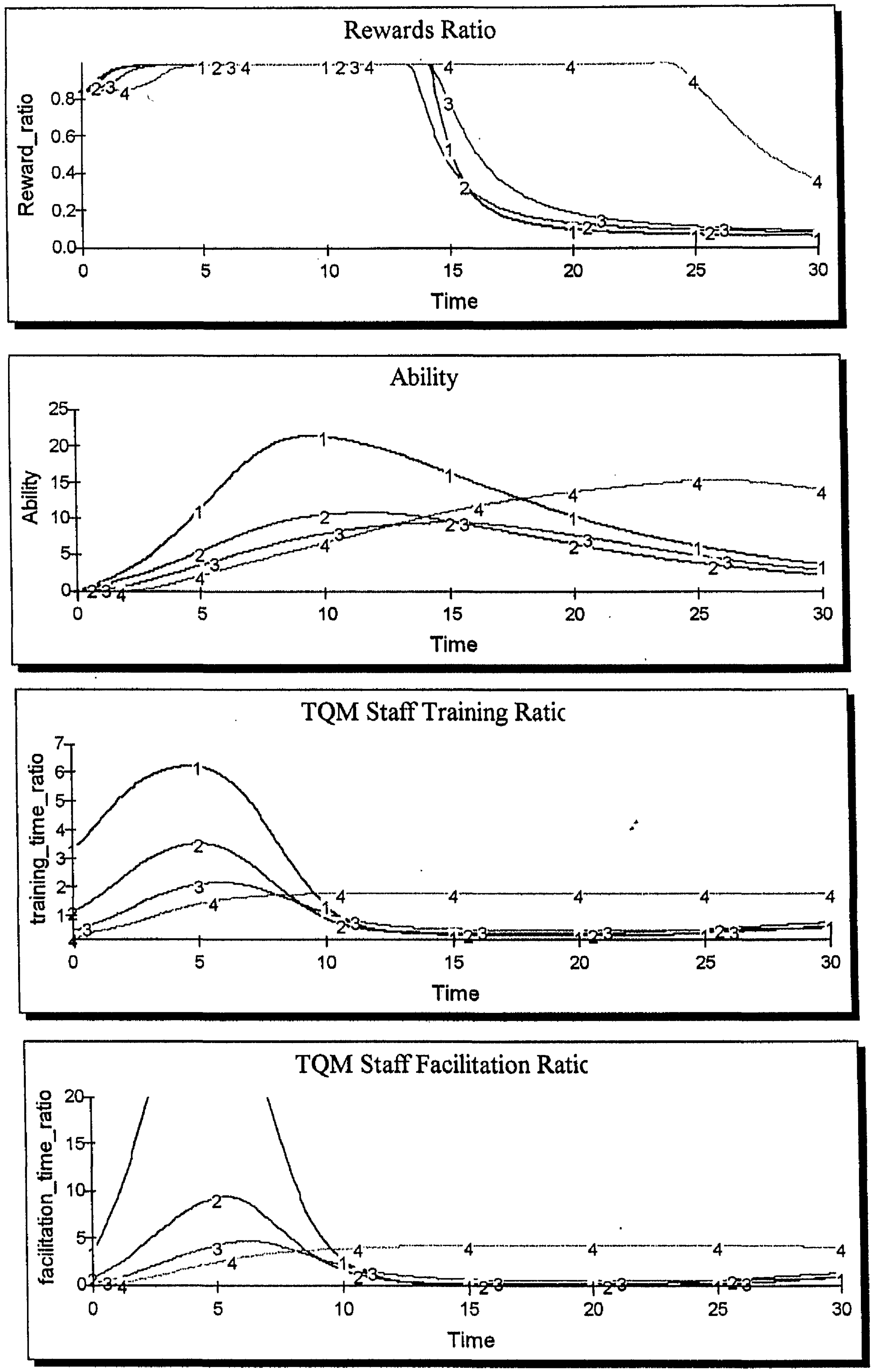


Figure A4.2 Results of varying the initial level of participation time raised. This is explained by the higher impact of more initial participants on the when motivation exceeded zero determines when participation levels will recover. This improvement from zero occurred later, as the initial participation level was constant level of available resources. More participants required more attention and support from the TQM staff, so that their workload and pressure were amplified even at the outset of the programme (third and fourth graph, Figure A4.2). As a result, there was a delay in the development of ability (second graph, Figure A4.2). The later development of ability postponed the improvement in total satisfaction, and subsequently the motivation to participate. Thus, the greater the number of participants involved at the outset of the programme, the longer the delay in recovery of the participation level.

The delays in improvement were also observed in the indicated projects per circle as shown in Figure A4.1. These delays were similarly due to ability and facilitation effects.

Later in the simulation, the decreasing perception of support and the decline of satisfaction caused the collapse of participation. As explained earlier, fewer initial members led to a later and higher maximum participation. The lower participation at the outset provided for a larger pool of non-participants, which can be enticed into participating. The result of maximum participation is more pressure on the available temporal resources from top and middle management as well as TQM staff. And this limited available time is perceived to be an indication of low management support.

Moreover, a greater number of total projects led to an earlier identification of more complex and difficult projects. The inherent complexity of the projects coupled with the delayed development of ability triggered the difficulty factor to influence both satisfactions due to rewards and ability. This led to diminishing total satisfaction. The combined effect of perceived low support and decreasing satisfaction pulled down participation earlier as initial participation decreased.

The fourth test again indicated the extreme case. The total number of projects proposed were not as many as those of the three other runs because of the limited participation. This effectively delayed the negative effects of difficulty and extended the satisfaction due to rewards. The satisfaction due to contributions was also extended with the almost uniform number of projects that are implemented. Both these factors delayed the decline of the motivation to participate, as shown by line 4 in the second graph of Figure A4.1. Extended simulation, however, showed that the participation levels eventually declined.

The overall results of all these interactions are shown in the total projects graph in Figure A4.1 and the outcomes are summarised in Table A4.1.

Table A4.1. Comparison of outcomes from initial participation experiments.

Initial participation	Total projects	Average motivation to participate	Indicated number of projects per circle
0.05	1248.69	0.31	1.55
0.20	906.39	0.30	0.86
0.50	867.92	0.41	0.83
1.00	518.85	0.72	1.40

The table indicates clearly that increasing the initial number of participants leads to fewer projects over the 30-year period. There are fewer projects mainly because the level of ability was not effectively high at the outset (Figure A4.2). This low level of ability affected the indicated number of projects per circle. Thus, there appears to be an inverse relationship between the initial level of participation and the indicated projects per circle. However, the fourth run is an exception. Since there was no recovery when 100 percent of the organisation were initially involved, the pressure on the TQM staff is tremendously reduced with lower participation. This enabled them to develop ability only at the later part of simulation and compensate for the earlier low contributions.

The average motivation to participate, on the other hand, does not seem to have a clear relationship with the initial level of participation. It is more closely related to the current level of participation at any time. Thus, as the transitory equilibrium level of participants goes down (Figure A4.1), the average motivation to participate improves. This is explained by the amount of workload that higher participation places on organisational resources. Furthermore, lower levels of participation generate less total projects, which in turn delay the effects of difficulty on the system.

In general, these experiments support the notion of 'pilot testing' the programme, in contrast to soliciting broader participation at the outset. The tests showed that starting with a small group of pioneers could yield more projects in the long run. This strategy has several advantages as revealed by the simulation runs. First, fewer initial participants put less strain on the organisational resources. In particular, training and facilitation can be concentrated on these few people so that ability is developed more efficiently and effectively. This leads to a second point that less strain on resources will improve the perception of support as well as satisfaction with the organisation. This, in turn, proves to be attractive to potential participants. Thirdly, fewer initial participants also mean fewer rejecters, which do not deplete the pool of potential participants. But when the programme begin to succeed, there is a greater number of non-participants who can be encouraged to join. In sum, starting the programme with fewer people, lead to small successes but also limited failures. Later, the small successes can lead to other small successes, and trigger the reinforcing loops of the TQM engine.

As for parameter sensitivity, the varying levels of starting participation generated similar decline-boom-bust behaviour patterns. There were differences in the timing and magnitudes of the recovery, peaks and collapse but as Richardson and Pugh (1981) point out numerical sensitivity is a characteristic of all mathematical models. The main concern in system dynamics models is behavioural insensitivity. The only exception is the extreme 100-percent initial participation test as it involved only a decline and a levelling off. Thus, it can be asserted that the model is not sensitive to changes in initial participation.

A4.2 Initial organisational conditions

In system dynamics, the initial conditions are represented by the parameter values taken by the level variables at the start of the simulation. These values provide the starting inertia of the model and can determine the direction of the reaction of the system. This reaction depends on the magnitudes of the input as well as their combined pressures.

In Chapter A3, the base runs assumed that all the level variables had low conditions, that is, the minimum values. This reflects the negative perception of the members of the organisation to management's quality initiatives. This section explores the effects of relaxing this assumption. The following experiments use some low, medium and high conditions for the level variables as specified in Table A4.2.

Table A4.2. Specifications of low, medium and high initial conditions for the level variables.

Variable	Low	Medium	High
Motivation to participate variables			
Satisfaction by participants	-1.0	0.0	1.0
Satisfaction due to rewards	-1.0	0.0	1.0
Satisfaction due to contributions	-1.0	0.0	1.0
Perceived support by participants	0.0	0.5	1.0
Middle management support ratio	0.0	0.5	1.0
Memory of top management visibility	0.0	0.5	1.0
Memory of budget inadequacy	1.0	0.5	0.0
Meetings Variables			
Motivation to hold meetings	-1.0	0.0	1.0
Valence for rewards	-1.0	0.0	1.0
Valence for contributions	-1.0	0.0	1.0
Job security	0.0	0.5	1.0

The effects of varying the parameters' values and their combinations are studied in this section. First, only one factor is varied whilst the system is kept constant. The second set of experiments assumes an all low, all medium and all high conditions. Varying the conditions for the meetings variables whilst keeping the motivation to participate variables constant forms the last part of the section.

A4.2.1 Single variable experiments

The single variable experiments are intended to determine the strength of each variable in influencing the behaviour of the system, as well as the direction of the change. These runs test the sensitivity of the system to singular changes in initial conditions of these variables. The assumed conditions for the rest of the variables are low, similar to the conditions of the base runs in the preceding chapter. The base run from Chapter A3 with its all low conditions is presented here as the base comparison and is represented by line 1.

Figure A4.3 shows the resulting behaviour of major variables when the initial level of satisfaction by participants is varied. Improving this variable yielded a shallower trough in the level of participation. In addition, the recovery is earlier and the peak is higher, although it did not stay as long at that level as the base run. Total projects (last graph, Figure A4.3) also showed similar changes in its behaviour. The improved conditions effectively shifted the phase to the left but had a lower peak.

The improved initial conditions provided a strong impetus in motivation to participate so that the percent participation did not decline as rapidly as in the first

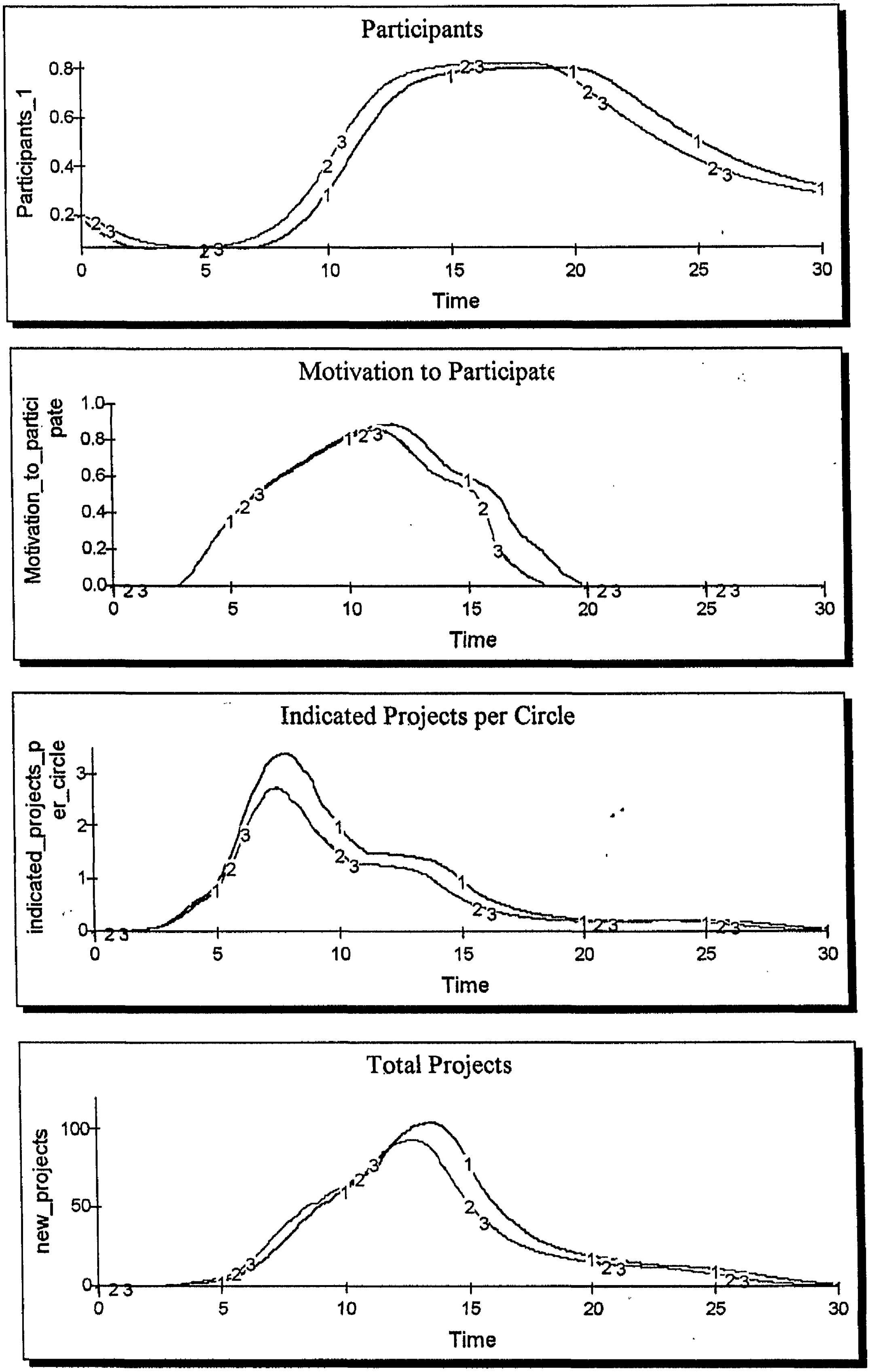


Figure A4.3. Results of varying the initial total satisfaction variable run. Taken from another perspective, the negative initial conditions for satisfaction actually had a strong impact on the rejection variable so that there was a greater number of participants who were quitting the programme at the beginning than when the initial satisfaction was raised. However, this strong push was short lived as satisfaction by participation adjusted to its determinant factors, which showed a constant level of resources. But it was sufficient to effect an early recovery. This also led to an early peaking of participation, and consequently total projects followed the trend. This led to early effects from difficulty and followed shortly by the decline.

The second row in Table A4.3 compares the total projects from the three runs. It indicates that as initial conditions of satisfaction by participants increased, the total number of projects over the 30-year period diminished. This counter-intuitive result can be traced to the earlier decline in more favourable conditions (Figure A4.3).

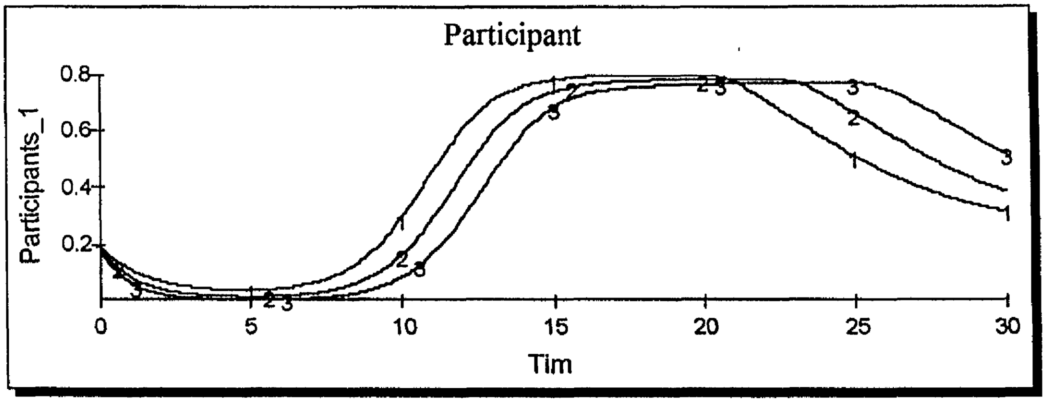
Table A4.3. Comparison of the total projects generated by single variable experiments

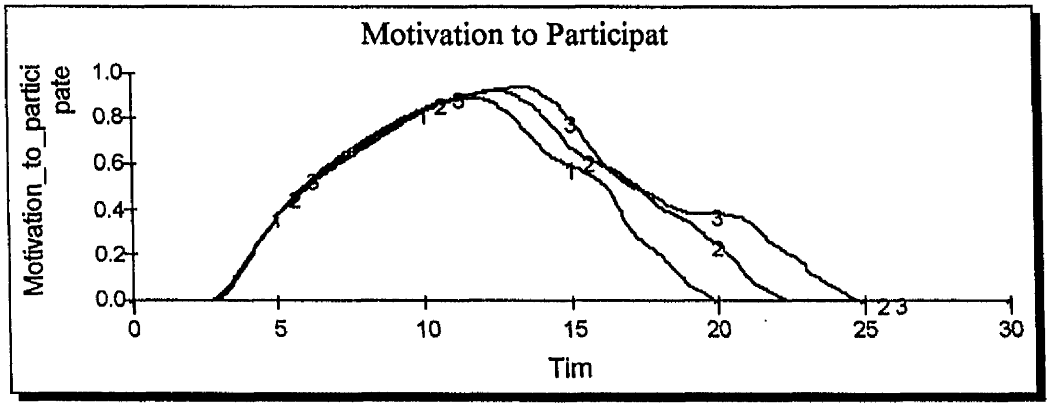
Variable	Low	Medium	High
Satisfaction by participants	906.39	807.09	806.63
Satisfaction due to rewards	906.39	874.87	851.21
Satisfaction due to contributions	906.39	905.74	866.61
Perceived support by participants	906.39	834.09	800.75
Middle management support ratio	906.39	872.71	859.08
Memory of top management visibility	906.39	872.22	847.48
Memory of budget inadequacy	906.39	890.83	890.60
Motivation to hold meetings	906.39	907.32	918.63
Valence for rewards	906.39	903.42	898.43
Valence for contributions	906.39	906.26	906.28
Job insecurity	906.39	1088.21	1318.46

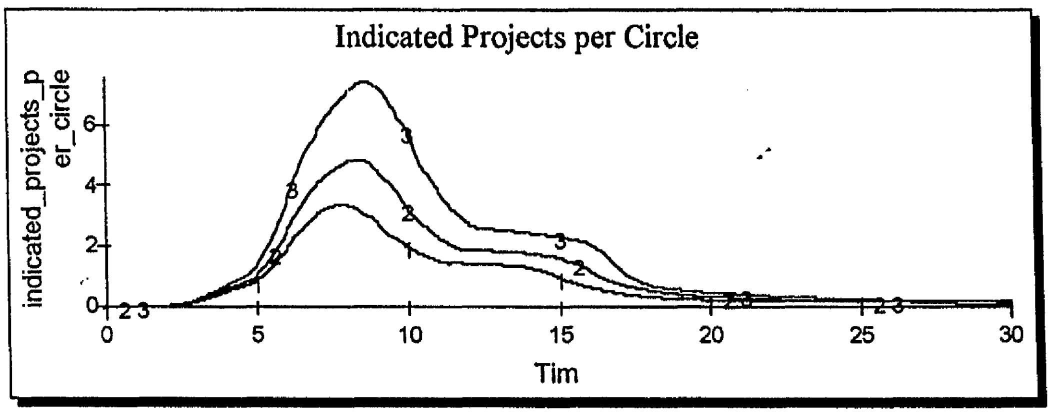
The other single factor runs showed similar behaviour patterns that are shifted to the left, indicating those improved conditions, indeed, lead to earlier recovery. But early decline cancels off the early improvements. In the end, there were fewer projects as conditions improved. Table A4.3 summarises the results of the simulations.

There are two exceptions to this general pattern of decreasing total projects as a result of better initial conditions. One of them is based on the motivation to hold meetings variable (fourth from the last row in Table A4.3). Closer investigation showed that the early additional projects, in contrast to the other experiments, were marginal as to significantly trigger the difficulty variable. In other words, the level of ability in this experiment rendered the difficulty variable less effective. In contrast, the other experiments also showed a higher number of projects early in the simulation period, but their number were sufficiently higher to trigger more difficulty. Thus, in the later part of the simulation these other experiments declined earlier.

The second exception is the last run involving the initial perception of adverse effects of the programme on job security (last row, table A4.3). As the initial job insecurity increased, the total number of projects actually increased. Figure A4.4 shows that this was mainly due to a later recovery in participation levels and total projects. Adverse effects from difficulty and available resources were delayed so that ability stayed above difficulty for a longer time. The delay is comparatively significant as the peaks now occur closer to year 20 instead of year 15.







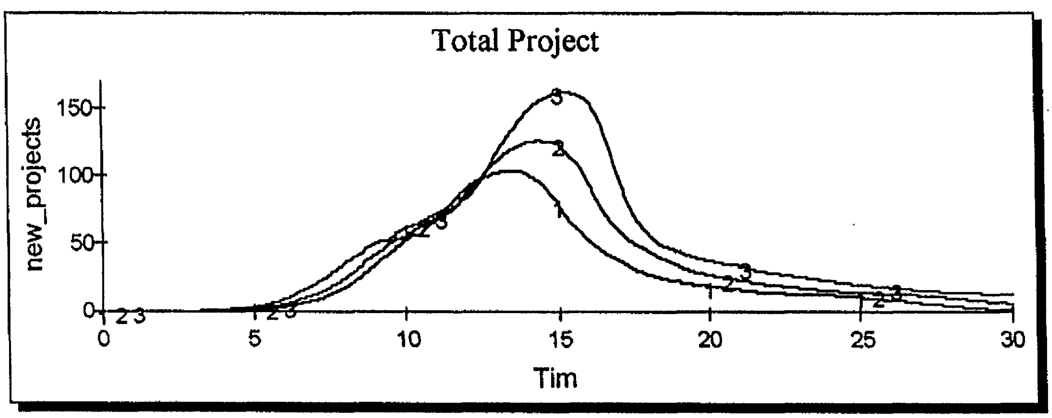


Figure A4.4 Results of varying the initial job security variable

It may be noted that the counterintuitive behaviour of total projects generated in this experiment is also due to the favourable situation of the organisation. Experience did not confirm the earlier fears of redundancy and dislocation. Thus, these fears began to dissipate over the years, which diminished their negative effects on the main TQM variables.

The experiments in this section highlighted the strength of some variables, as the observed shift was relatively larger than other runs. Both the determinants of satisfaction - due to rewards and due to contributions - had strong initial impetus that effected earlier recovery in the condition of consistent and unwavering availability of resources. Improving the initial conditions in these two variables directly impact on satisfaction and motivation to participate. As pointed out earlier, even as the initial conditions are transitory in nature, the inertia is retained in the motivation to participate so that the trough of the initial decline is shallower and is reversed earlier.

Among the perceived support variables, improving the initial top management visibility proved to have a strongest effect. The higher conditions immediately pushed total perceived support at the outset of the programme so that motivation to participate improved rapidly. This rapid improvement effected an early recovery, as well as a steeper slope, in participation.

Finally, job insecurity has very strong effects on the entire system. It had altered the shape of participation behaviour by extending the plateau before it eventually declined. Although it increased the total number of projects, it also significantly delayed the recovery of participation and total projects. Thus, the early recovery derived from the input of all factors as shown in the final base run in the preceding chapter has been effectively cancelled off by the increasing job insecurity.

The simulation runs also showed that changes in the initial conditions in the meetings variables did not effect any significant changes in either total projects or participation. Changes in meetings variables can affect participation variables through total projects and learning by experience. However, the changes in meetings variables should result in very significant changes in total projects in order to have a greater impact on participation. In the case of the experiments in this section, there was very little improvement so that total projects did not improve considerably as to trigger the learning cycle.

In general, the percentage changes in the outcomes proved to be negligible. This suggests that each variable on its own cannot significantly influence the system's behaviour. However, taken together, these initial conditions can effect larger changes as seen in the next section.

A4.2.2 All-low, All-medium and All-high conditions

This section compares the results from the all-low conditions of the base runs in Chapter A3 with better condition experiments. The results of the major variables are shown in Figure A4.5. Lines 1, 2 and 3 represent low, medium and high conditions, respectively. The earlier observed decline-boom-bust behaviour is similarly generated in the medium conditions test. The apparent effect of more

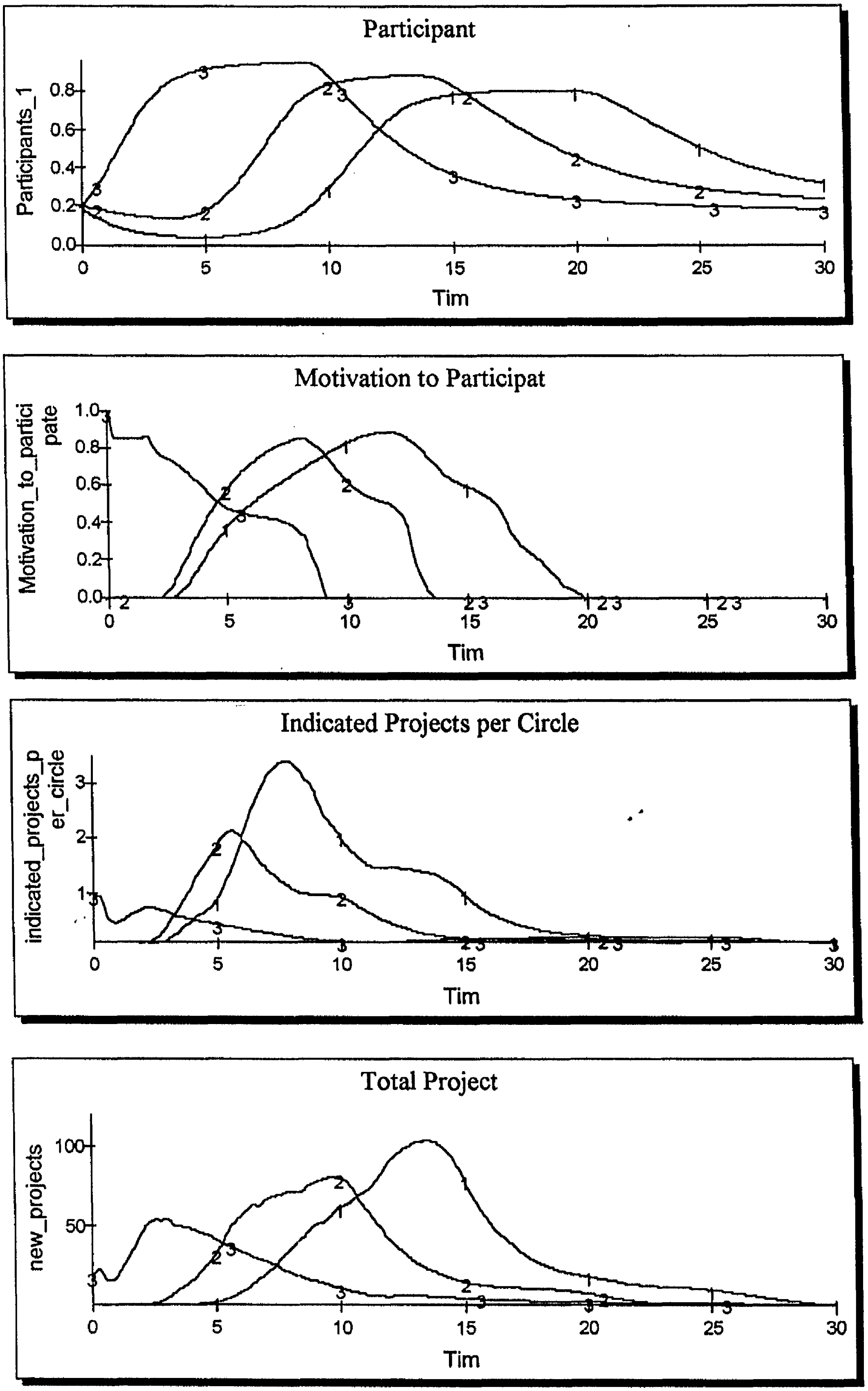


Figure A4.5 . Results of all-low, all-medium, and all-high conditions experime favourable organisational conditions is the shift in phase: as conditions become better, the recovery occur earlier, and so does the subsequent peak and decline.

The graphs highlight the combined effect of initial conditions on the level of participation. As the initial conditions improved from low to medium conditions, the initial trough was shallower and recovery was earlier. When the high conditions were inputted, the decline disappeared, and replaced by an immediate positive trend.

These changes in the behaviour patterns of participation indicate that the first reactions of the organisation to the implementation of the programme are mainly due to the delayed effects of the initial conditions, regardless of the availability of resources. The reactions of participants, which include the motivation to participate, total satisfaction with resources and perceived organisational support are conceived as level variables that store past information and perceptions. The present experience only fractionally modifies these information and perceptions. In practice, this means that participants act based on previous experiences, and the current experiences have little impact, unless they are negative, on their current actions. The constancy of the availability of resources will gradually convince them to change their old perceptions.

In the present set of simulation runs, the all-low and all-medium conditions begun with declines that reflect the poor conditions of the past. The unchanging level of resources slowly changed these perceptions until a recovery was effected. In contrast, the immediate positive ramp was initiated by past satisfactory experiences and perceptions that encouraged further participation.

The early peak and decline are explained by the same dynamics of the previous experiments. As conditions improved, more participation and total projects resulted so that the difficulty variable sufficiently increased as to affect the entire system. The higher participation also impacts on the available temporal resources as to indicate lower support.

The changes in the participation are similarly reflected in the indicated projects per circle and total projects (Figure A4.5).

A comparison of the total projects generated by each of the runs revealed that the all-high conditions test yielded the least projects. As in the single variable tests in Section A4.2.1, improvements in conditions led to fewer total projects over the entire simulation run. Earlier success leads to a faster accumulation of projects that trigger the difficulty level. Later, ability development slows down; effort increases and triggers dissatisfaction; and identification of projects becomes more and more difficult.

A4.2.3 Varying the meetings variable under all-high motivation to participate conditions

This set of experiments explores the situation where the organisational conditions are favourable but its members do not necessarily have an interest in holding meetings. These conditions reflect the workers aversion or reluctance to hold meetings perhaps as an indication of fear, failure, or lack of skills. The latter conditions on meetings are represented as low and medium conditions. The positive view to meetings is also presented for comparison.

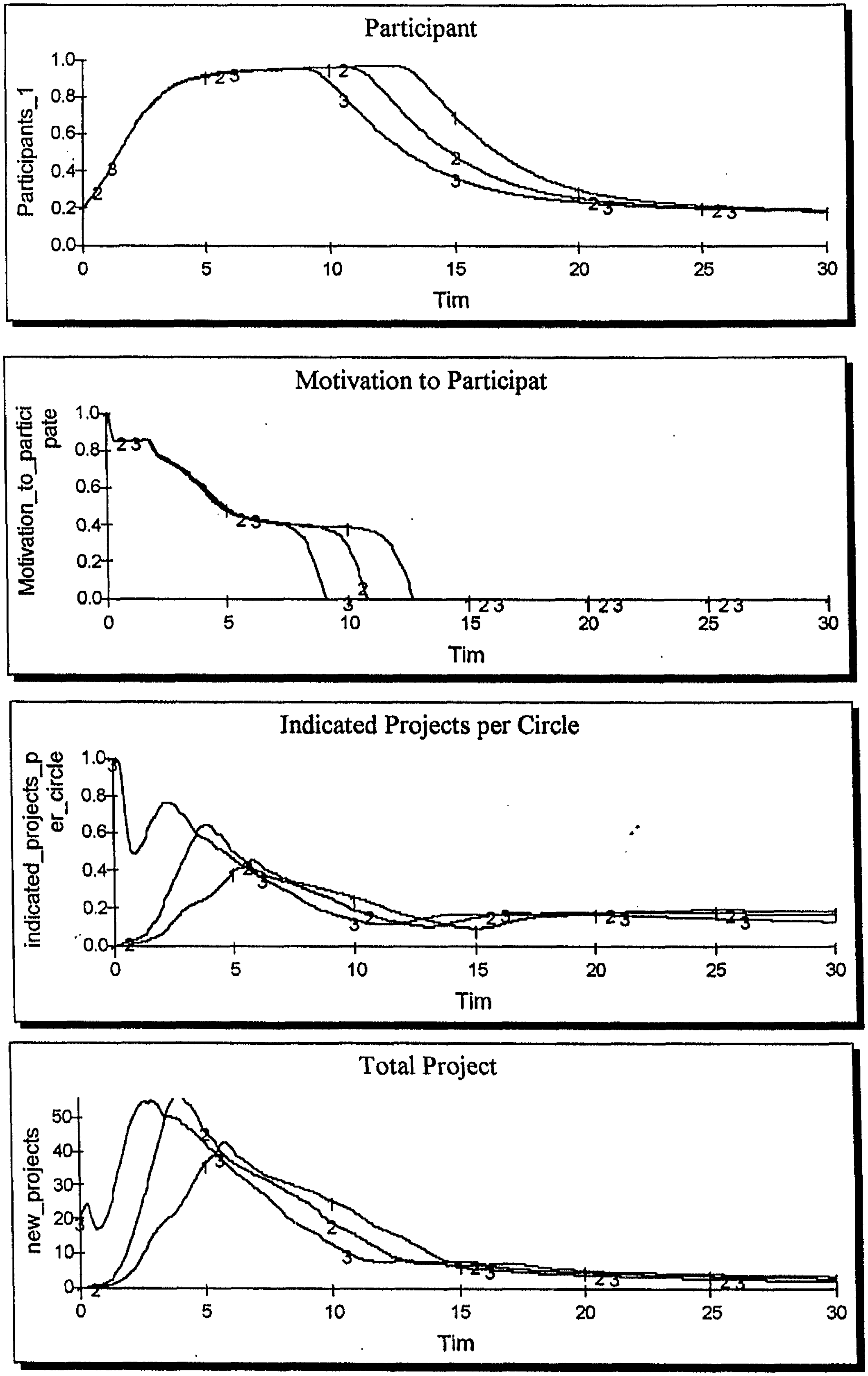


Figure A4.6 Results of varying the meetings variables under an all hi participation conditions

The high conditions of the organisation dictated the initial reactions that were immediately improving (Figure A4.6). As organisational conditions were identical in all three runs, the initial reactions followed the same path. This suggests that the initial conditions in the meetings variables have negligible effects on participation.

The differences, however, are in the timing of the decline. The decline came earlier as the meetings variables improved their initial conditions. This can be traced to the total projects graph (bottom graph, Figure A4.6). With lower meetings initial conditions, both indicated projects and total projects increased and peaked later. As such, the effects of difficulty were delayed so that participation continued to stay at its high level before it declined.

This set of experiments again stresses the point that earlier improvements cause earlier declines. A comparison of the total number of projects indicates that fewer projects were generated by the high conditions run.

A4.2.4 Varying meetings variables under all-low motivation to participate conditions

The contrary conditions from the preceding set are assumed in the present simulation runs. The scenario in this case involves an organisation that had not provided a fulfilling and satisfying work environment in the past but whose members are motivated to participate and hold meetings. A low condition for the meetings variables test is also presented for comparison.

Figure A4.7 shows the results for participation and total projects. Varying the meetings variables did not drastically shift the behaviour patterns. The first reason for such little effect is that the impact of improved meetings conditions were on the initial part of indicated projects. The improvement, however, was not very significant and was easily offset by the low level of participation at the beginning of the programme. Thus, these little changes in total projects did little to reinforce ability (through learning by experience) and trigger the corresponding positive feedback loops. Consequently, satisfaction and participation were not affected by the changes in the meetings variables.

The results from these tests supported the observation in the preceding single factor runs, that meetings variables have little effect on participation rates, unless it leads to very significant changes in total projects.

Overall, the experiments in varying the initial conditions of the organisation proved that the system is rather sensitive to initial conditions, particularly those affecting participation. In particular, the behaviour of participation is determined by these initial organisational conditions. The changes made on the initial conditions of the participation variables remain influential on the first years because, as level variables and even in reality, these variables change gradually even as events and outside conditions (resource allocation) are improving. Thus, until the initial conditions have been totally replaced by the current impressions, the behaviour of participation will be mainly a reaction based on these initial conditions.

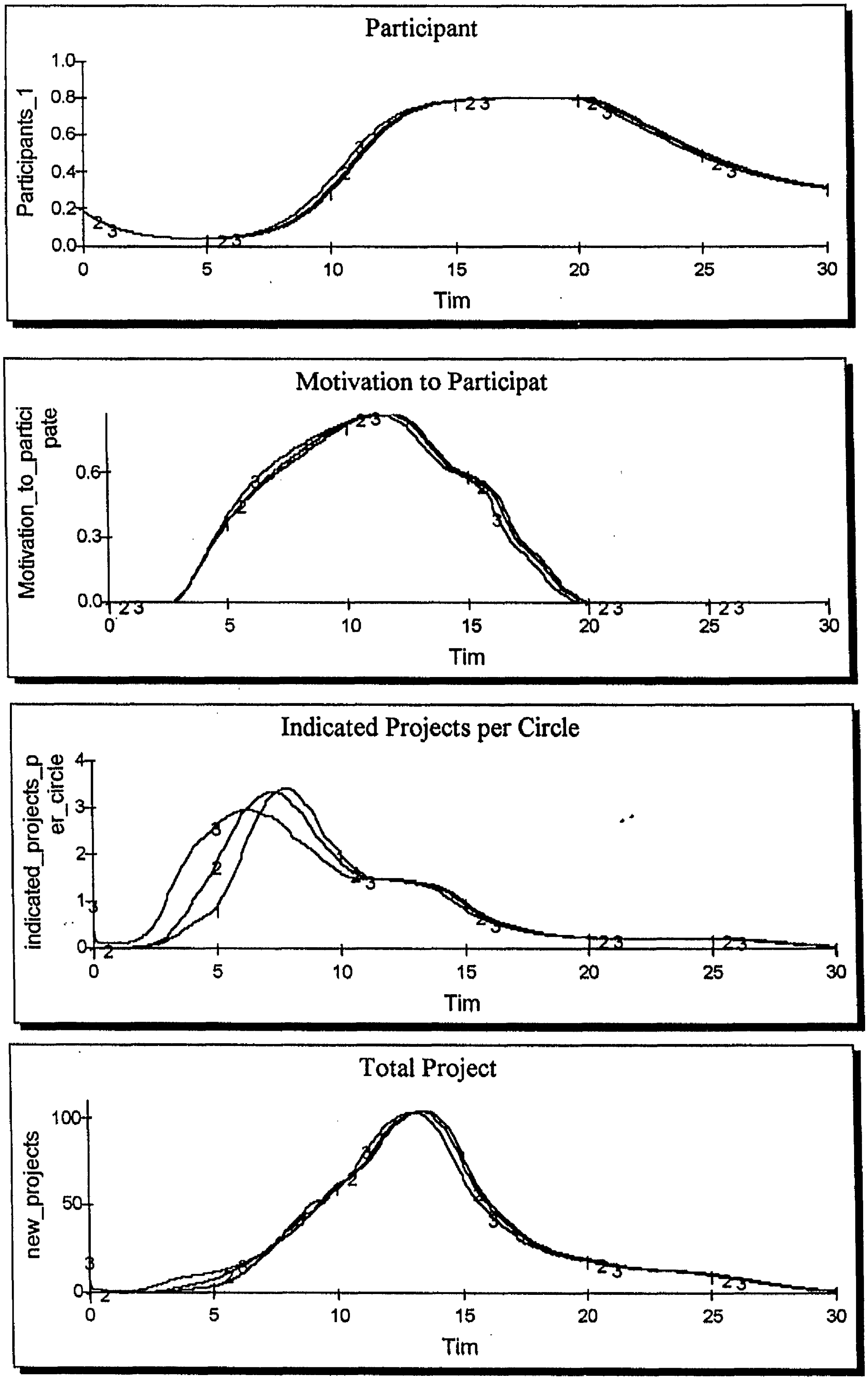


Figure A4.7 Results of varying the meetings variables under an all lo participation conditions

In contrast, the projects generating variables are not very sensitive to changes in conditions because some of its determinant variables are not based on level variables and therefore, not influenced by initial conditions. Two of five variables are more dependent on current conditions than on initial conditions. The motivation to hold meetings that is due to facilitation is based on the current support activities of the TQM staff. The motivating factor, on the other hand, although based on the level of ability, is relatively difficult to manipulate and depends only on long term development based on learning. However, because of these inherent slow processes of developing ability, low conditions for the other level based variables (preference for rewards and contributions) can lead to longer delays in improvement in meetings held, and consequently, the indicated number of projects. Nevertheless, the shape generated by these variables are expected to be generally the same: a slow growth, a peak and then a collapse.

A second point, which is rather specific to the high conditions test, is the correspondence of this behaviour pattern with qualitatively derived or proposed behaviour of TQM variables such as those of the Pasternak and Berry (1993) graph or the analysis by Lawler and Mohrman (1985; 1987) that indicated the interaction of variables and problems. These relationships between variables suggest the structure of TQM implementation. It is postulated that the TQM variables will follow a typical life cycle behaviour pattern: a slow increase, a peak and maturity, then a decline.

The simulation runs in this section supports the Lawler and Mohrman (1985; 1987) model and the experience of French quality circles (Chevalier; 1991). They postulate that the first phase of a quality circles programme is typically positive with highly motivated and productive groups that encourage more interest and support. The experiments reflected this with a growing percentage of participants as motivation improved. The graphs showed a positive slope that led to a peak.

However, after the expansion phase, Lawler and Mohrman (1985; 1987) observed that a number of problems and difficulties might disrupt and hinder activities. The circles begin to compete for management attention and resources and become less productive. During this period, the groups meet less and "the main reason the groups continue at all is because of the social satisfaction and pleasure the members experience rather than the groups' problem solving effectiveness" (p. 69). Indeed, the graphs reveal that whilst there are still a number of participants, the motivation to participate has fallen to zero. Moreover, the indicated number of projects per circle has also declined to a minimum level. Consequently, the total number of projects had been reduced, which in turn, can affect management expectations and may cut back on available resources. This, however, is explored further in the next sections.

The behaviour generated in this section also replicates the experience of French quality circles (Chevalier, 1991), as well as the experiences of two interviewees in this study (Macmillan, 1995; RFK manager, 1995).

The simulations in this section, however, offer some qualifications to this life-cycle model. The runs have shown that an immediate positive ramp is possible only under some high organisational conditions. At other conditions, there was an immediate decline.

A4.3 Varying the resources

The base runs assumed particular values of the factor inputs with the assertion that these values are relatively sufficient but still realistic. It is recognised that there is an infinite set of possible values for these factors. Thus, this section varies the values of these factors and tests the sensitivity of the system to these new values.

Similar to earlier experiments, low, medium and high values are assumed for the trials. The medium values represent the values taken in the base run. Low and high are, thus, relative to the medium values. The low value is one half, or less than half, of the medium values, whilst the high values are double the medium values. In addition, absolute minimum values are also tested for comparison. The tests involving the minimum values are actually the same as the four-factor base runs. Table A4.4 shows the specification of the experiments.

Table A4.4. Experimental values of the factor inputs.

Factor	Minimum	Low	Medium (Base run)	High
Contribution	1000.0	12.0	5.0	2.0
Middle Management time	0.0	1.0	4.0	-
Top Management time	0.0	1.0	2.0	4.0
Rewards	0.0	5.0	10.0	20.0
Staff	0.0	1.0	3.0	5.0

The results of simulation show that all sets of experiments showed the same decline followed by a boom-bust behaviour in participation level. The total projects also had the same exponential increase that ends with a peak and an exponential decay. Nevertheless, each factor showed some details that were not shown in other factor changes.

A4.3.1 Varying implementation time (contribution factor)

Decreasing the implementation time closes the gap between the effects of implemented projects on contribution satisfaction. In other words, changes in projects are reflected on satisfaction due to contribution in a shorter time. However, the behaviour patterns in the first part of the simulation are still dominated by the delayed effects of initial conditions. This is shown in the slight changes in the first part of the simulation, as shown in Figure A4.8.

The more perceptible effect is on the down side of participation where decreased implementation time reduced the rate at which participants rejected the programme. This is due to the higher satisfaction due to contribution. This variable supported total satisfaction even as satisfaction due to rewards and ability were falling at this time. However, as difficulty has affected the indicated projects per circle variable resulting in its decline, total projects also fell. Eventually, the contribution ratio and its corresponding satisfaction were not sustained.

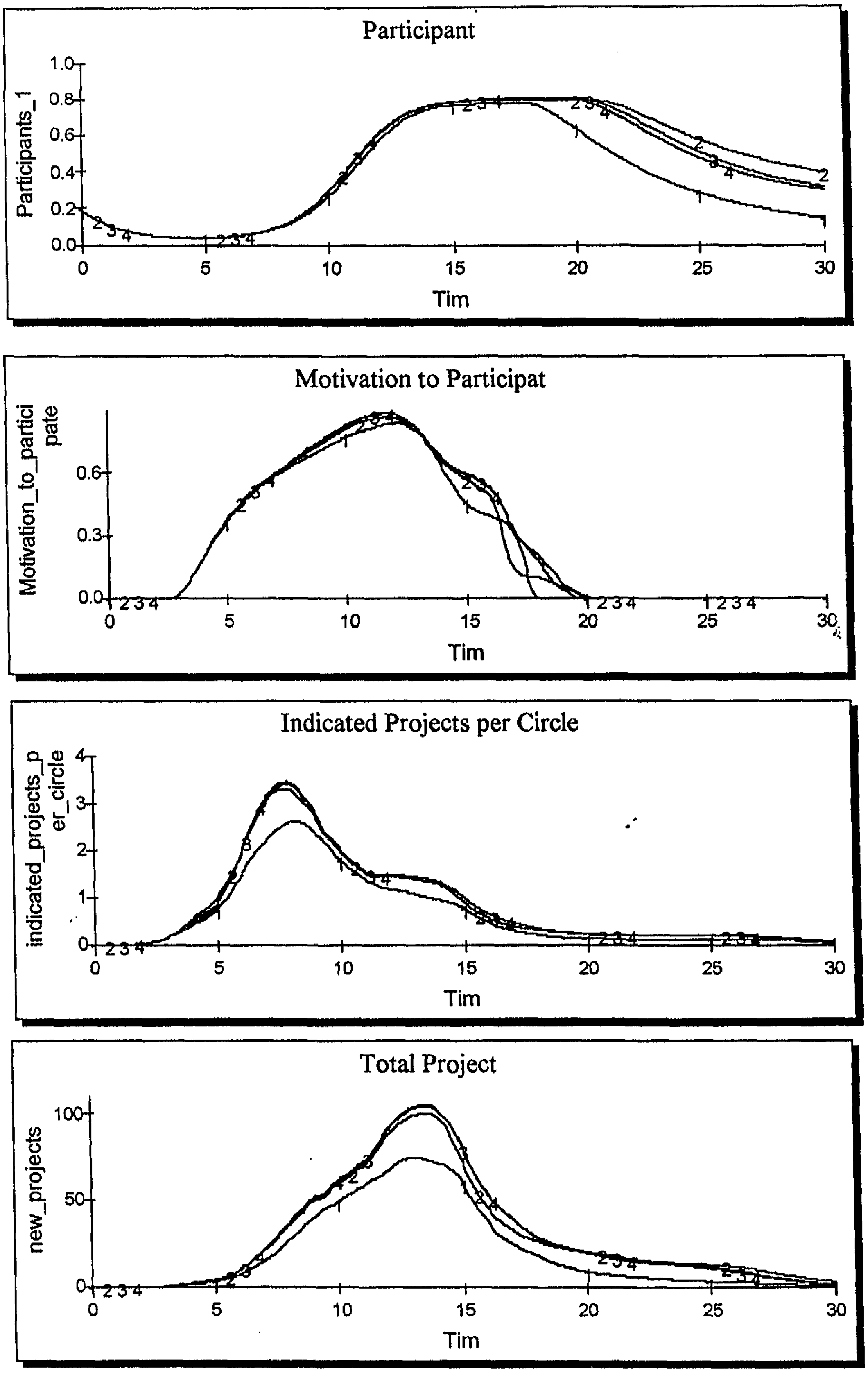


Figure A4.8 Results of varying the implementation tim

A4.3.2 Varying middle management time

TQM literature has suggested the importance of middle management involvement in the programme. Middle management involvement affects the study and implementation of projects. This implies that middle managers must devote some sufficient time for these activities. Otherwise, the proposed projects will face longer implementation delays, or may not even be implemented at all. This has an impact on the participants' motivation to become involved in the programme. This section tests different scenarios by adjusting the time involvement of the middle managers. The results are shown in Figure A4.9.

The topmost graph shows how participants perceive middle managers' support through time. Line 1 represents the scenario where middle managers do not devote time for the programme. Thus, it is not surprising that employees' perception of support is mostly at the zero level. The sudden improvement in perceived support is mainly due to a change in middle managers' time involvement. The middle managers become convinced by top management visibility and involvement during the programme implementation. They may either be forced to follow top management's lead, or are investing time only to win their superiors' favour. In any case, when they perceive top management visibility waning, then their involvement dwindles too.

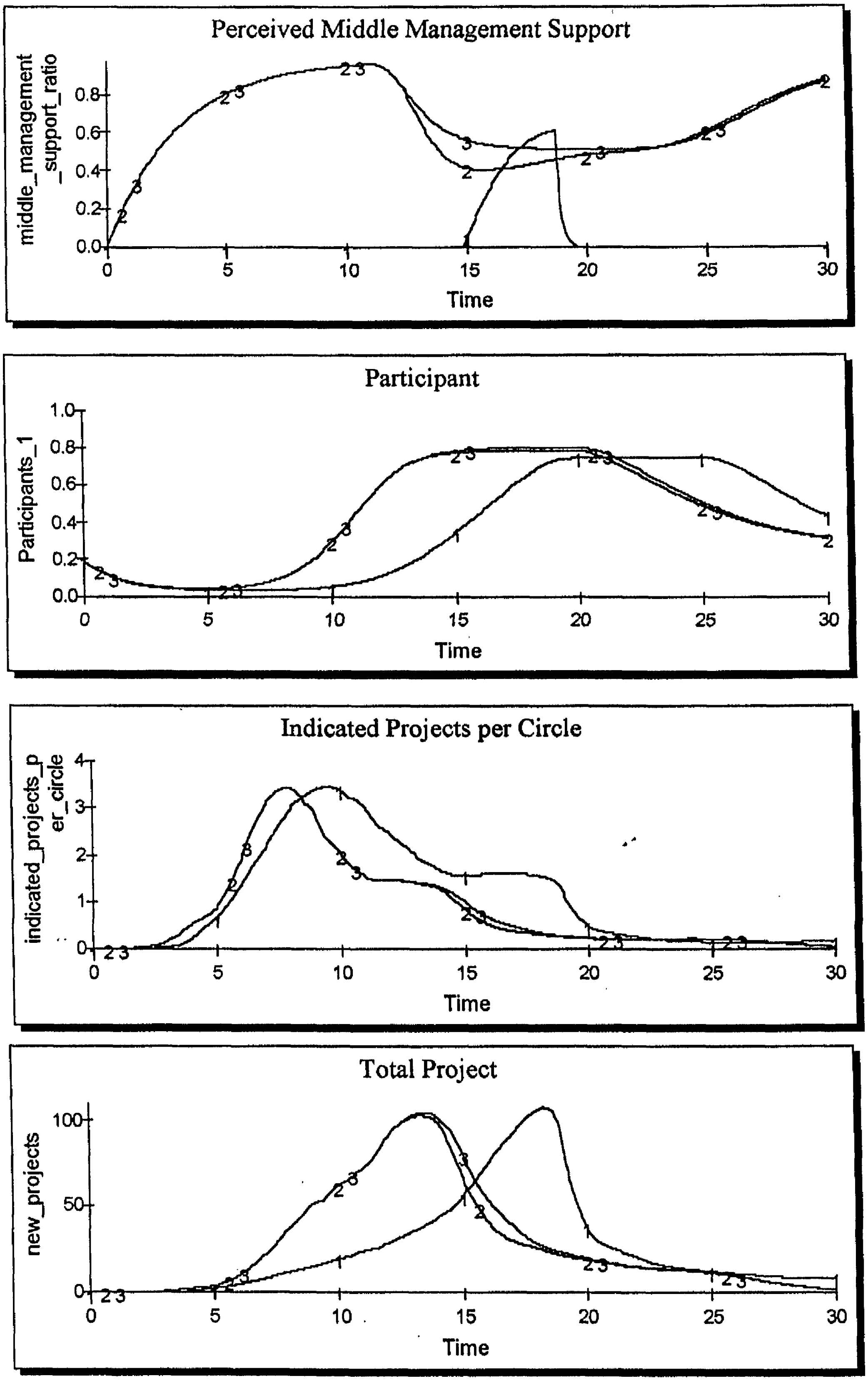


Figure A4.9 Results of varying the middle management time involveme

Additional time devoted to TQM showed an immediate positive ramp, which soon slowed down, then fell sharply. It recovered shortly. The sudden decline was due to increased demands on limited middle management time as participation and total projects peaked. Moreover, the same demands on the attention of top managers indicated a similar decrease in perceived top management visibility. This discouraged middle management and withdrew some of their time. Furthermore, the impressive participation levels threatened the middle managers' position due to the possibility of subordinates getting more attention and getting some promotions, and the visibility of their own weaknesses and inadequacies. Thus, as participation and total projects increased, middle management attention diminished. Middle management support recovered with the fall of these two variables.

Increasing middle management time from zero to one hour per week per manager indicated a substantial improvement on the other variables. The effect of middle management time is mainly on the perceived support. This encouraged further participation as evidenced by the phase shift in participation, indicated projects and total projects. The involvement of middle management made possible an earlier recovery in participation, and led to a slightly higher peak for total projects.

A4.3.3 Varying top management time

The third set of runs involves varying the top management time. The scenarios explore the effects of differing levels of top management time involvement and visibility.

The topmost graph in Figure A4.10 shows that top management is slowly perceived to be involved and supportive over the time. The more time it spends on the programme, the higher is the peak of perceived involvement variable (top graph). In fact, more available time offsets the effects of a downward pull, so that the trough disappears altogether when the available time is doubled. This trough is actually due to increasing demands and requirements from participants. As participants increase, the available time is reduced. Thus, the recovery occurs because there is a decline in total projects that need top management attention. At the extreme scenario where there is no trough, top management is able to provide sufficient time to accommodate all the requirements, even at maximum participation. Indeed, in this scenario, visibility is increasing because the constant time allocation is more than sufficient for the few projects and declining participation.

The effect of top management involvement, as seen in the succeeding graphs of Figure A4.10, is not very large. Although there was a phase shift in the variables, indicating improvement, the magnitude of this improvement is relatively not significant. In effect, the simulation results downplays the importance of top management involvement, which is in contrast to TQM literature that highlights its centrality.

Moreover, it may also be noted that even as top management is increasingly perceived to be involved (line 4), the participation rates begin to fall after time 20. Indicated projects had fallen earlier. This also suggests that top management is not solely responsible for the waning behaviour of the major variables.

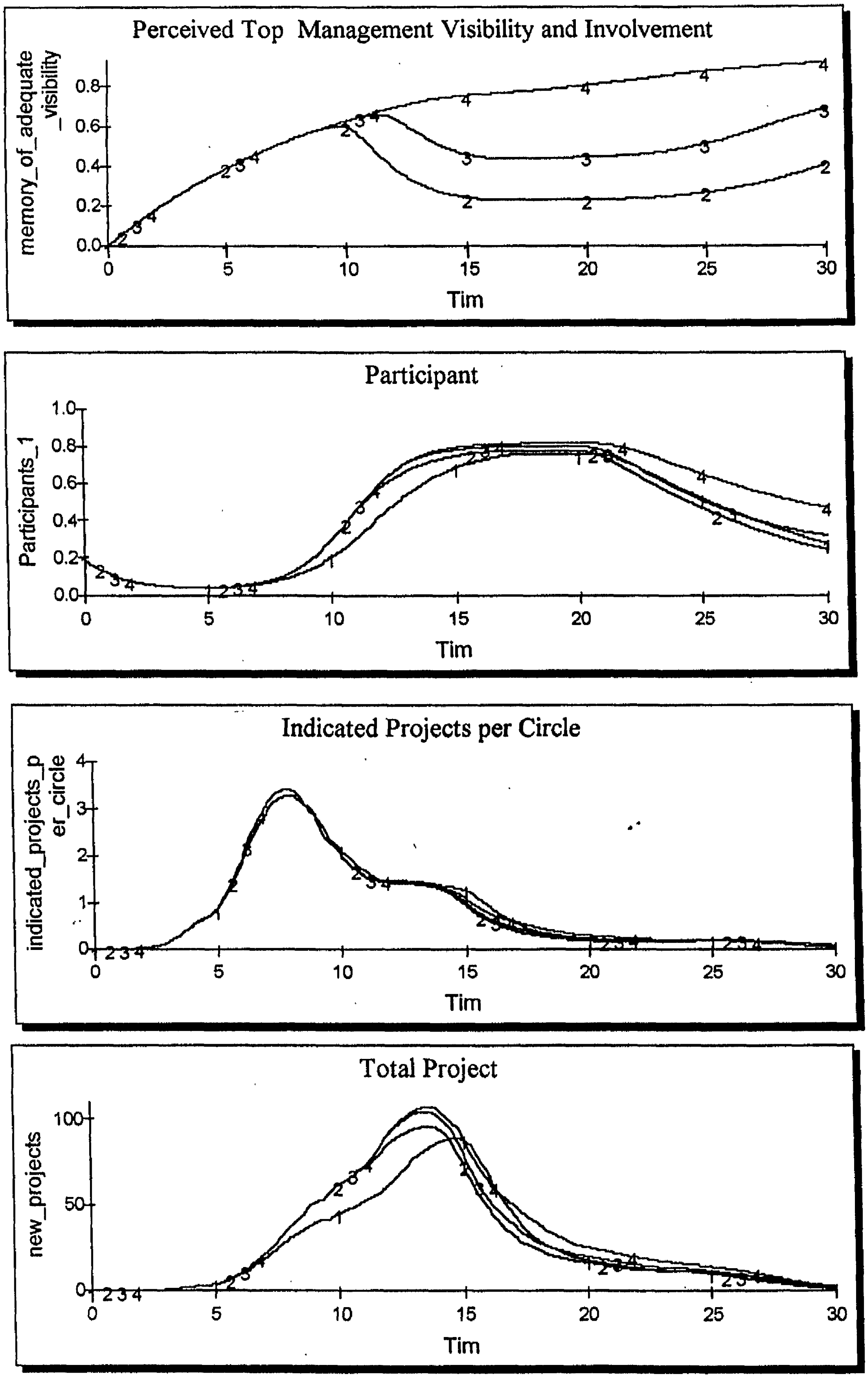


Figure A4.10. Results of varying the top management time involvemen

A4.3.4 Varying rewards

The rewards factor was varied in the fourth set of experiments and the results are shown in Figure A4.11. The second graph showed that the first run, in the absence of rewards, took long before participation can recover. Increasing the rewards hastened the rate of recovery. However, participation also collapsed earlier. Doubling the rewards proved to be an exception, as line 4, which represented the doubled rewards, actually traced the path of line 3. But the plateau of participation was extended and effectively delayed the decline.

The effect of increasing rewards is seen from the rewards satisfaction (top most graph of Figure A4.11). As rewards improved from zero to the initial expected rewards of A4.0, the plateau moved up to indicate a higher rewards ratio[19]. However, line 4 (doubled rewards) shows that the satisfaction effect of a reward ratio that is greater than 1.0 is the same as that of a ratio of 1.0. However, the plateau is extended. This is a logical consequence of the ratio. It takes longer for the denominator, which is a function of effort, to match a higher valued numerator (actual rewards).

As observed in the base runs of Chapter A3, rewards provides a strong push to the system. Adjusting the rewards to match the initial expectations increased the

[19] The rewards ratio indicates a comparison between the actual rewards with expected rewards. As the ratio increases, the rewards are perceived to be more favourable. The declining ratio indicates that the expected rewards are increasing.

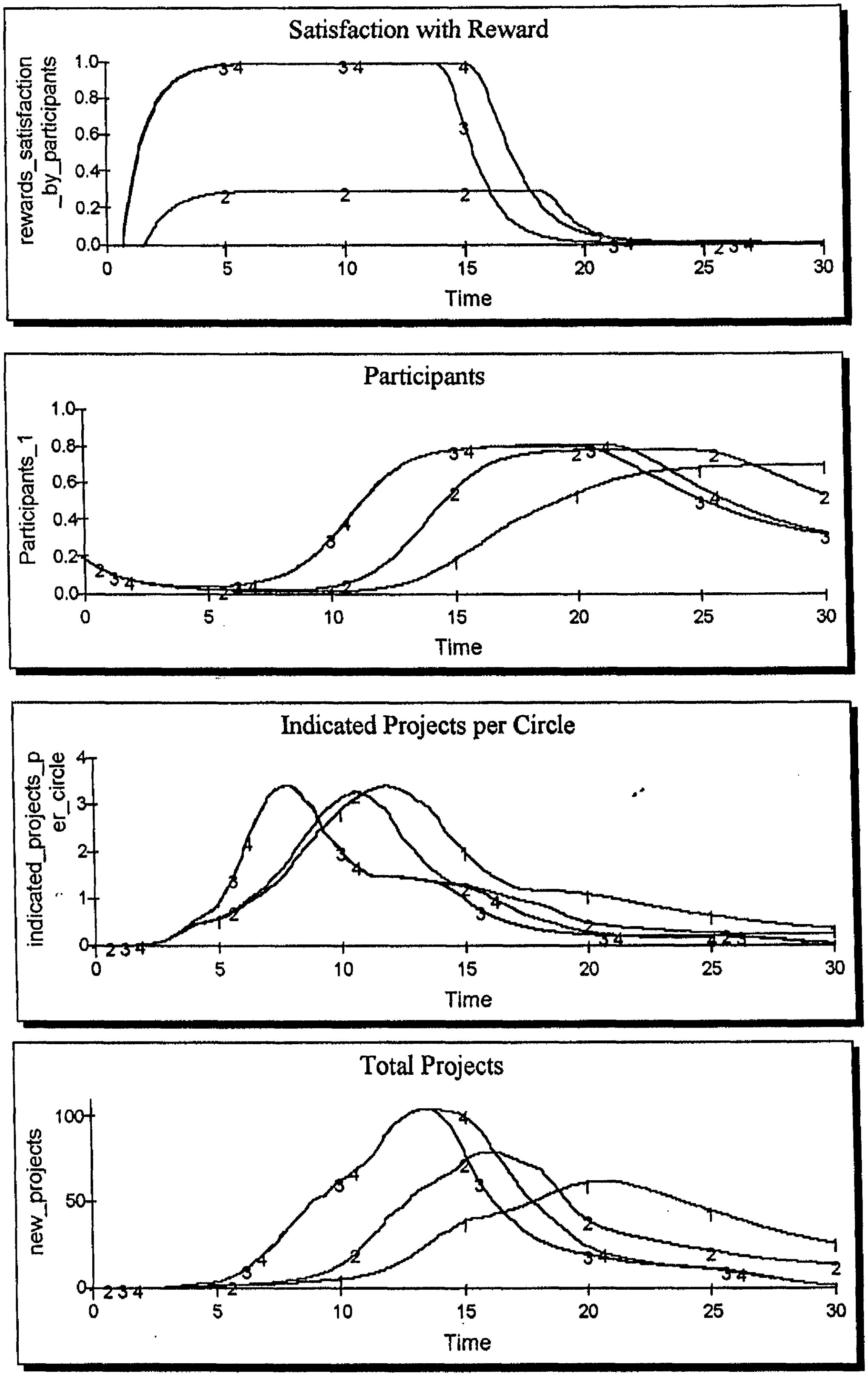


Figure A4.11. Results of varying the rewards momentum the factor provides, as well as delaying the effects of increasing expectations. But bigger rewards that are above the expectations only serve to postpone the decline.

Nevertheless, increasing rewards does not eliminate the possibility of a decline in satisfaction, and eventually reflected in the participation.

A4.3.5 Varying the number of TQM staff

The last run in this set of experiments deals with changes in the available time of the staff. This is a function of the number of personnel assigned to TQM. Line 1 in the graphs of Figure A4.12 represents zero staff. Although the participation level stopped decreasing, it managed to recover only at around year 18. The bottom graph shows that the total projects are negligible compared to the results of other runs. The introduction of a single staff position produced a huge improvement in participation as well as total projects. Further addition of staff continued to improve total projects.

The centrality of the TQM staff in ability development is demonstrated by the graphs of Figure A4.12. The first run showed that the absence of training and facilitation duly delayed the recovery of participation levels. At the same time, the low level ability prevented the active circles from proposing a greater number of projects. Thus, the total number of projects generated is a measly 27.78 projects for the entire 30-year simulation. The introduction of a single TQM staff yielded a total number of projects which is almost twenty times the first run!

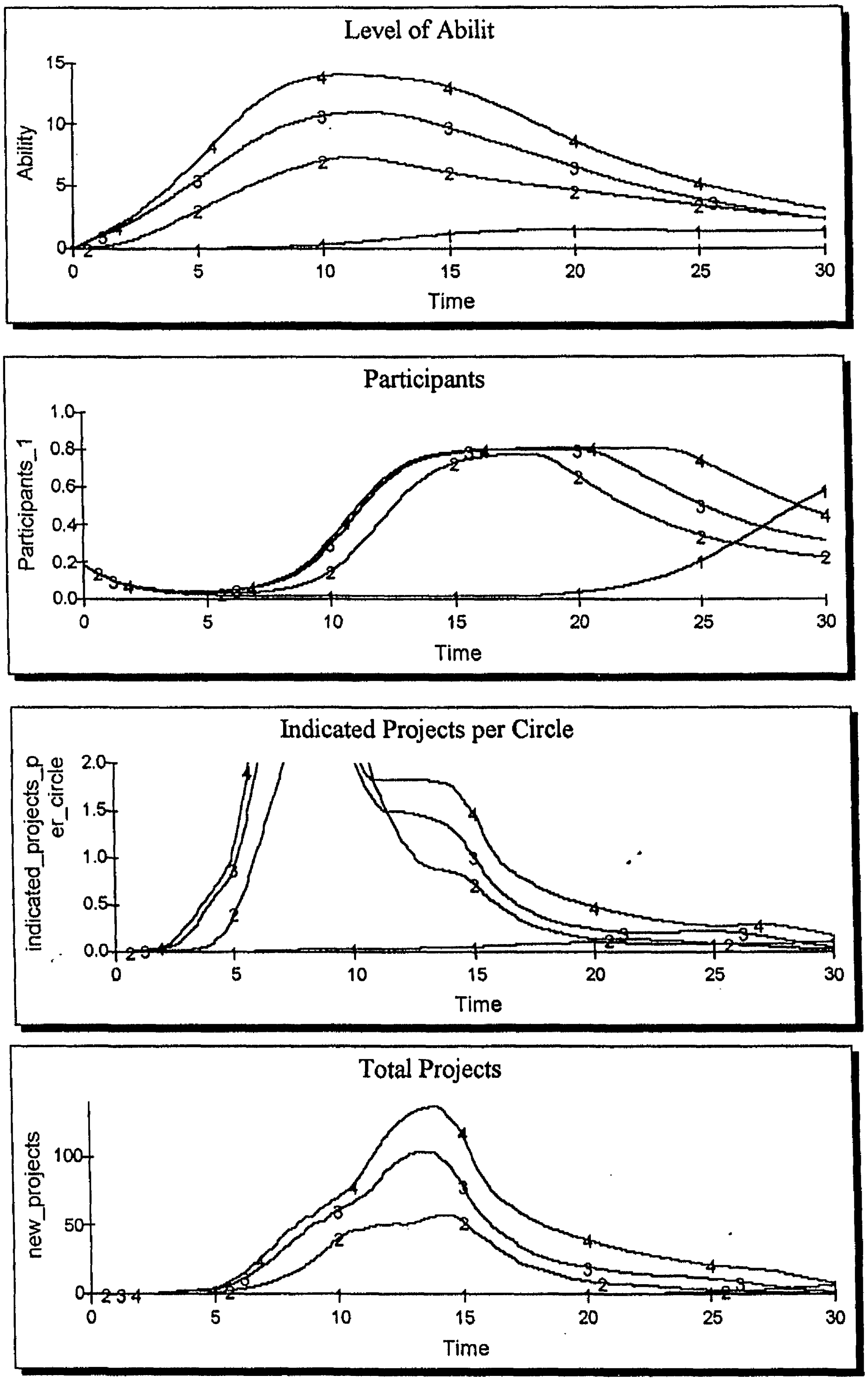


Figure A4.12 . Results of varying the number of TQM staff

In contrast to earlier resources runs, the TQM staff experiments yielded the least number of projects as well as the highest output. Table A4.5 highlights these contrasting results.

Table A4.5. Comparative total projects generated by the varying the factor magnitudes

Factor	Zero	Low	Medium (Base run)	High
Contribution	625.25	879.91	906.39	905.07
Middle Management time	794.27	862.56	906.39	-
Top Management time	799.74	838.29	906.39	993.13
Rewards	822.98	836.48	906.39	1028.10
Staff	27.78	508.15	906.39	1324.43

The table suggests a direct relationship between the level of resources and the total number of projects. This supports the view in literature of the importance of these resources in the implementation efforts. The absence of these resources affect the outcomes derived from the programme. Of these resources, the absence of the TQM staff appears to be most critical. This resource also showed the highest per percentage unit improvement.

In sum, the behaviour of the system is not sensitive to changes in the level of resources. The shape remained essentially the same, following the decline, recovery and collapse pattern for participation. The indicated and total projects followed a boom-bust behaviour pattern. This was also similar to the behaviour of motivation. The system, however, is numerically sensitive as the different levels of resources elicited the corresponding magnitude of responses. This sensitivity gave rise to shifts in phases. Higher availability of these inputs gave rise to better perceptions of satisfaction and support, which in turn, led to earlier growth and success. Nevertheless, the shapes were basically unchanged even with shifts in phases.

These observations highlight the effects of resources allocation on the system. As it is numerically sensitive, additional resource can effect some immediate improvements. On the other hand, the system, as it is behaviourally insensitive, the system will act in still the same way: to grow and then decline, regardless of the available support.

A4.4 Including a feedback structure

All the experiments of the preceding sections have been conducted on the assumption that the input factors are consistently and constantly allocated by the organisation. This implied that the management is not affected by the performance and outcomes of the programme. In the present section, this narrow assumption is broadened by introducing an additional feedback loop from the outcomes of the programme.

The additional feedback loop is based on the commitment of top management to the TQM programme. It is conceived that top management commitment is a function of a particular outcome of the programme and a standard. These outcomes are the total proposed projects, the percent participation, the average number of projects per circle, and the percentage meetings held. The standard represents a desired level of performance. The comparison between the outcome and the standard, represented as a fraction, dictates the appropriate reaction.

Two possible table functions are tested to reflect the differing reactions to the results. The first case is based on the Whalen and Rahim's (1994) observation that preoccupation with short term outcomes negatively affect top management commitment. In this case, commitment[20] drops as the performance falls. The second reaction, as espoused by the TQM philosophy of continuous improvement, adopts the opposite reaction. In this situation, commitment is constant until the outcome declines. The continuous improvement philosophy dictates that a solution must be identified to resolve the problem[21]. Thus, there is an increase in commitment to allocate more resources.

It is assumed that the level of motivation is based on an asymmetric first order averaging process. Similar to the other intangible variables, the level of commitment falls more rapidly and adjusts to a higher value more slowly, to reflect the difficulty in convincing top management of an improvement in the indicator.

Furthermore, the level of commitment affects the resources that are made available for the programme (Whalen and Rahim, 1994). These resources include budget, rewards, top and middle management time. The relationship between top management commitment and these resources is assumed to be an increasing non-linear function. Thus, as top management commitment increases so do the allocated resources.

[20] Here, commitment is conceived from a narrow perspective of committing resources.
[21] This is best exemplified by the plan-do-check and act (PDCA) cycle.

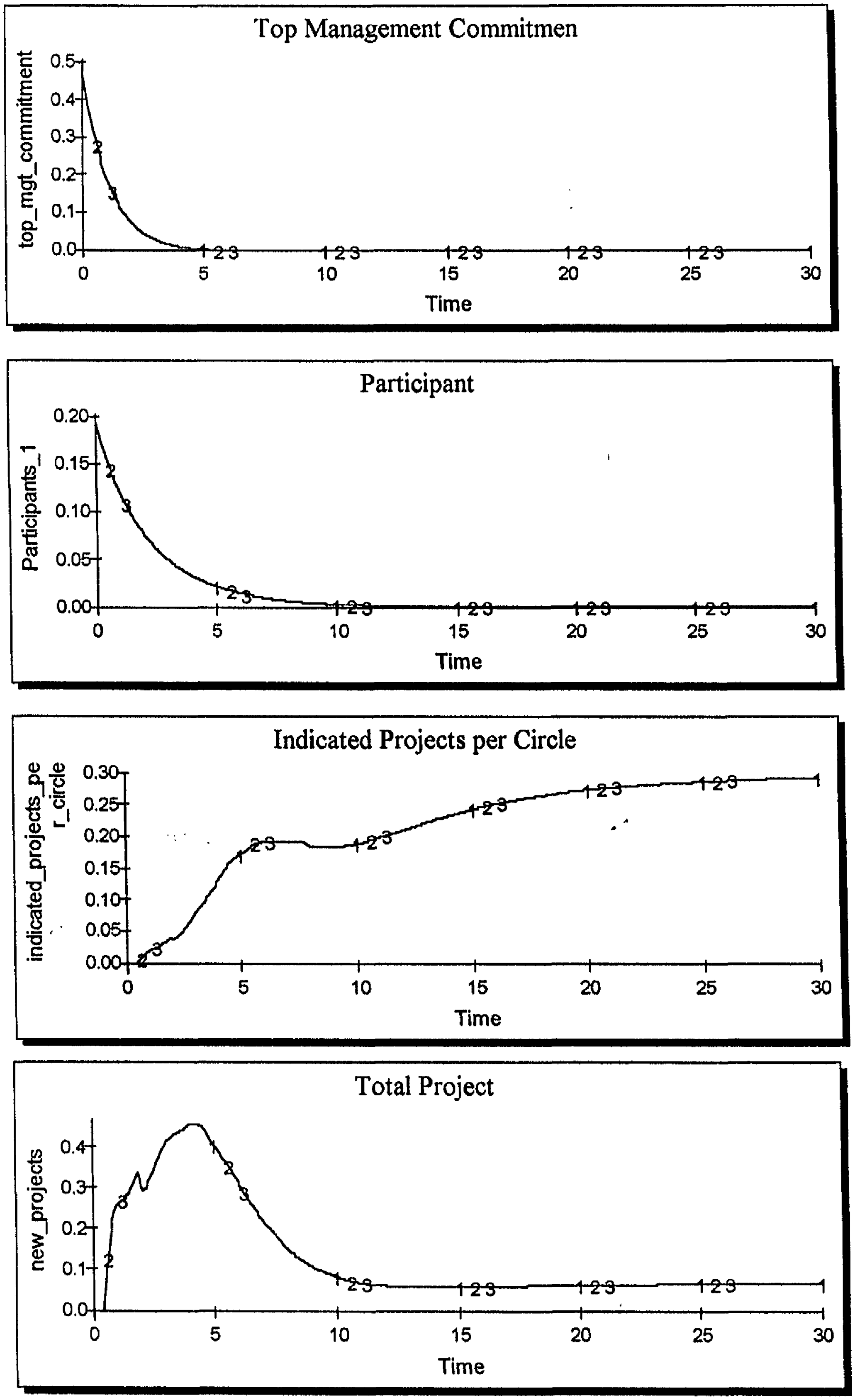


Figure A4.13. Results of varying the total projects target under lo conditions and unsupportive policy .

Each of the four performance measures will be tested based on the high and low organisational conditions, and the possible reactions to falling performance.

A4.4.1 Total projects as the performance measure

The number of proposed projects is a typical performance measure in TQM programmes as it indicates the output of the improvement teams. It represents the level of activity of the groups, and can be used as an indicator of the level of improvement, that is, the more the projects generated, the higher is the expected improvement.

The results of the simulation for low conditions with a short-termist view are shown in Fig A4.13. Lines 1, 2 and 3 represent tests using targets of 80, 40 and 20 projects, respectively. In this scenario, percent participation continued to decline. The resulting behaviour of any of the outcomes were not affected by any changes in targets. It appears that these targets are very high for the initial outcomes of the programme.

In all these different target scenarios, the total number of projects failed to reach the target at the outset. As it continued to miss the goal, it elicited a negative reaction from management. Resources were slowly withdrawn from the programme. This negatively affected perception of support and satisfaction with the programme, and prevented the participation levels from recovering. This, in turn, caused the further reduction of resources.

The programme did not attain its goals at the start because total projects is at a minimum level and has a slow rate of improvement, even with the availability of resources. The few generated projects are due to the combined effect of low initial indicated projects and the declining level of participation. Indicated projects are few because ability develops at a gradual pace. On the other hand, participation continues to fall at the outset because of low initial conditions.

However, participation levels do not recover nor do indicated projects increase significantly as in the earlier tests. The non-supportive policy has introduced complications to the natural gradual growth of the number of projects. By withdrawing the necessary resources, the motivation to participate and motivation to hold meetings were kept to a minimum, and did not improve sufficiently to reverse the declining trends of participation and to encourage the holding of more meetings. The combination of minimum levels of participation and indicated projects is a marginal number of total projects.

Figure A4.14 contrasts the results of an undemanding target of one project with those of the preceding tests. This very low target represents a very tolerant management. The probability of missing this very low target is rather small. In effect, there was no interference from management (as a result of usually hitting the target) and thus, resources were kept at the same level throughout the 30-year period. Total projects increased rather slowly in the first five years, but continued with the positive trend until participation recovered at around year 15. There was a decline when difficulty increased. The test yielded a total of 1626.65 projects or an average of 54.20 projects per year.

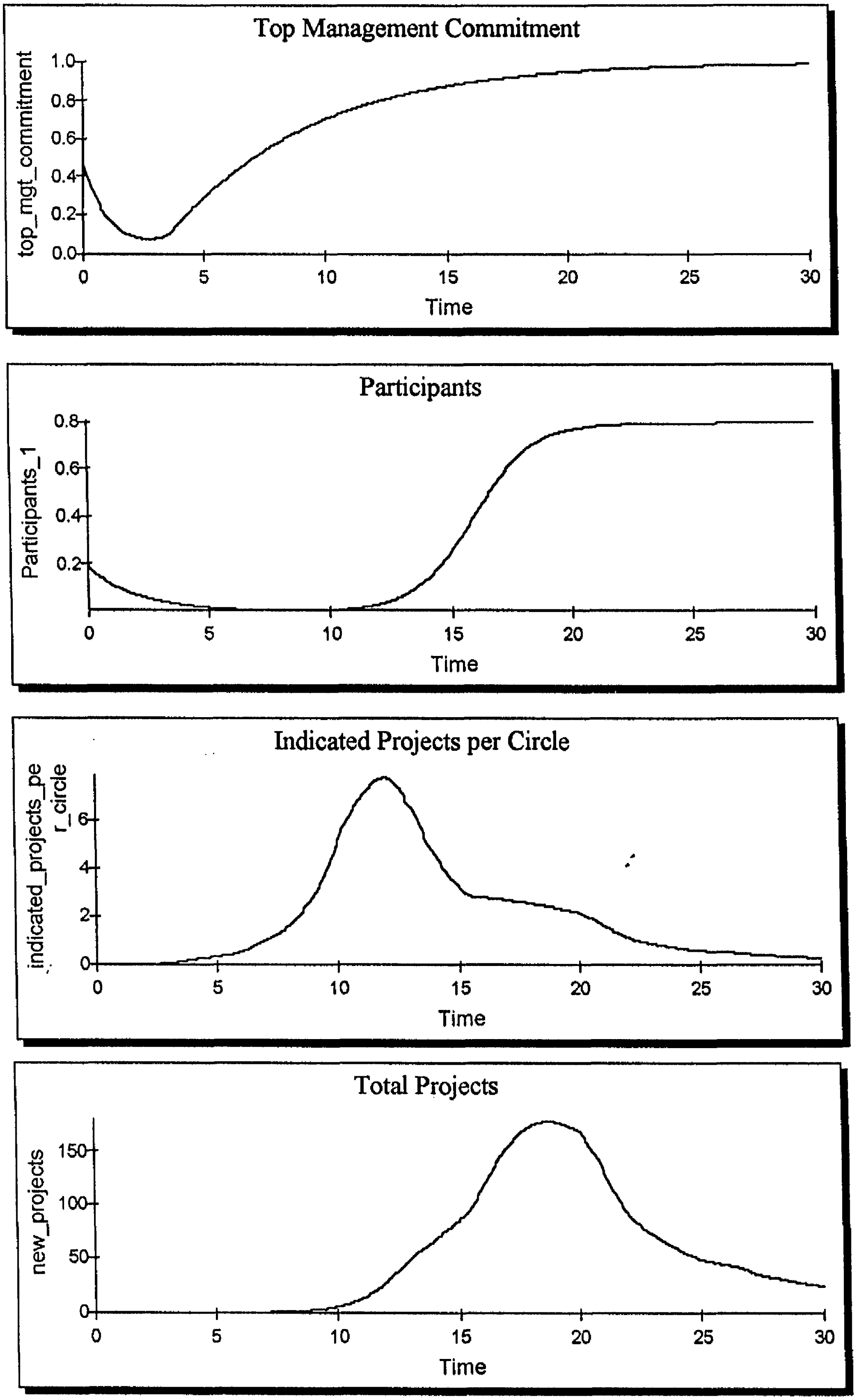


Figure A4.14. Results of setting the total projects target to 1.0 projects under low conditions and unsupportive policy.

In the high condition scenario, percent participation was propelled by the initial favourable conditions, and led to a similar positive trend in total projects (Figure A4.15). Total commitment was also increasing at the outset, and further pushed the trends to higher levels. The total projects ultimately reached the critical level that triggered difficulty, and led to decline of participation and total projects. The falling total projects pulled down with it commitment and the available resources. This hastened the downward trend of total projects and participation.

A comparison of the runs shows that as the target increased, total projects fell[22]. The same performance is relatively understated when the target is increased. Thus, when the targets were raised, top management commitment diminished and withdrew some of the available resources. This led to further lower performance, lower commitment and lower resources, until total projects reached zero. The graph in Figure A4.15 shows that line 1 was kept at this low output. In contrast, the lower target of 40 and 20 projects (lines 2 and 3, respectively), allowed some commitment to maintain the available resources and controlled the trends. At the lowest target, total projects fully recovered from the initial fall, until the effects of difficulty slowed down outcomes, and further complicated by lower commitment. The medium target, on the other hand, did not sustain its increasing trend due to its failure to meet its target.

The trends in total projects were similarly reflected on the participation graphs. At the higher target, the peak was reached even before year 5, in contrast to

[22]The targets set are the same as in the previous experiment. 80, 40 and 20 projects per year were used, and represented by Lines 1, 2 and 3, respectively.

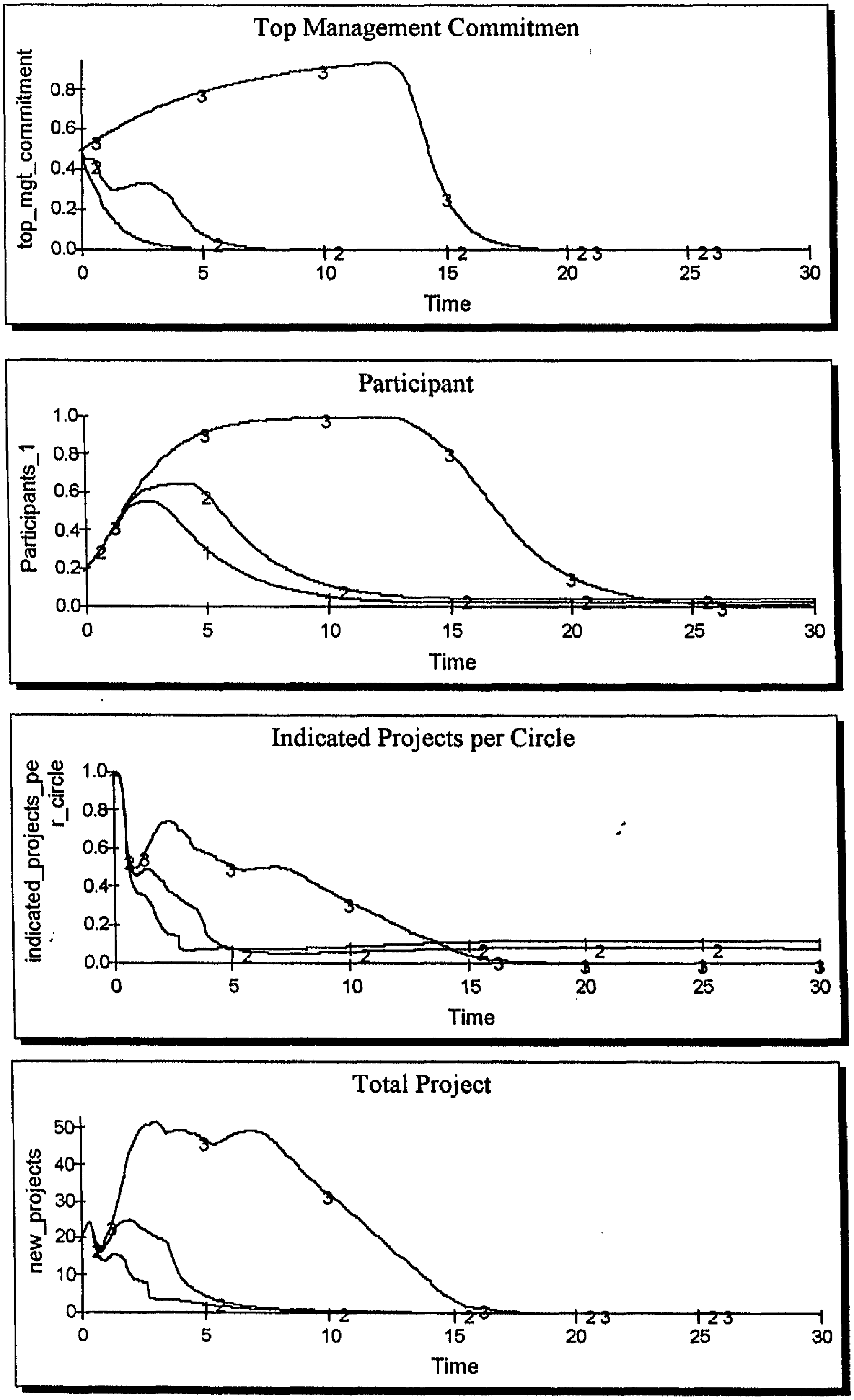


Figure A4.15 Results of varying the total projects target under hi conditions and unsupportive policy.

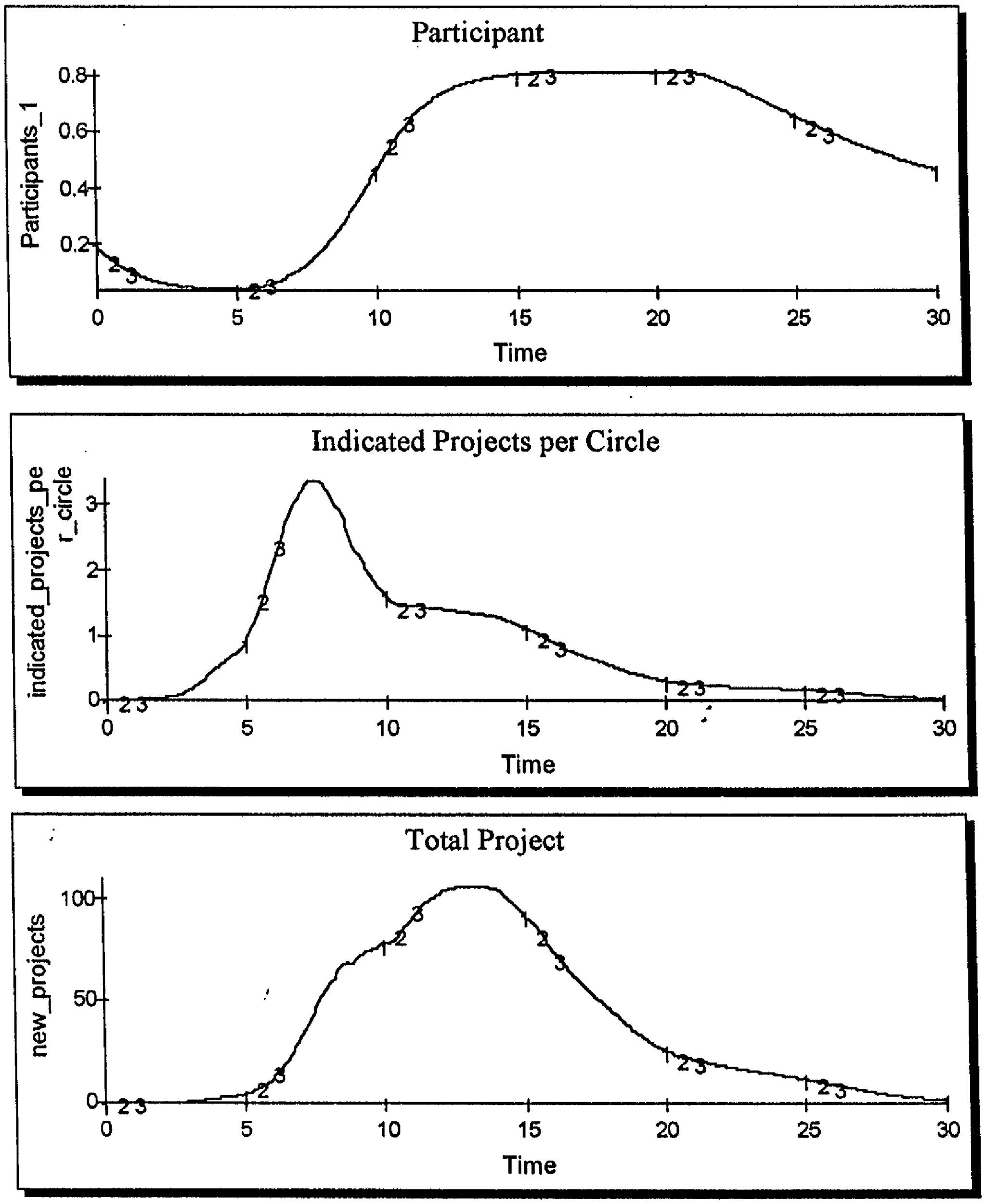


Figure A4.16 Results of varying the total projects target under lo conditions and supportive policy .

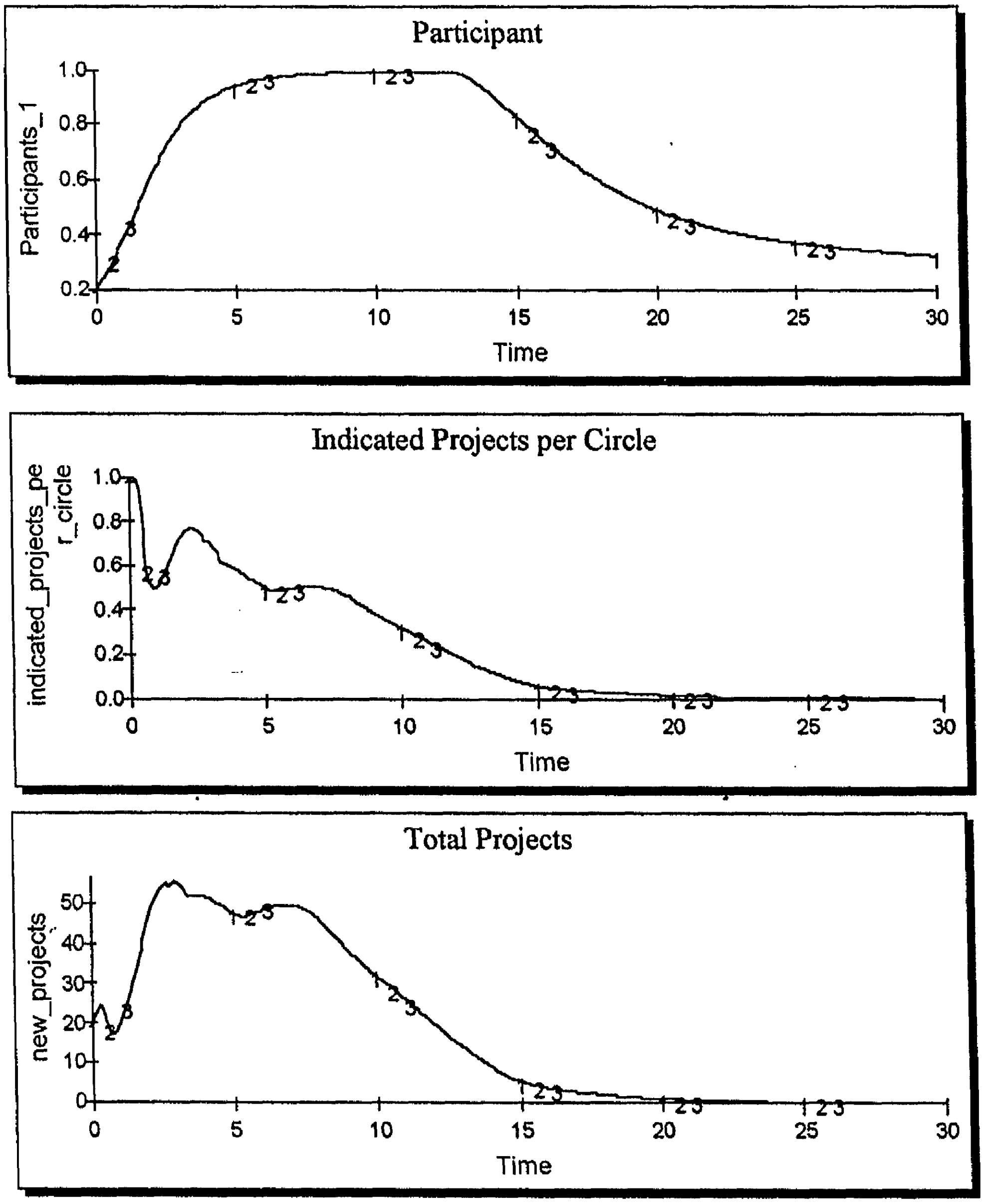


Figure A4.17 Results of varying the total projects target under hig conditions and supportive policy .

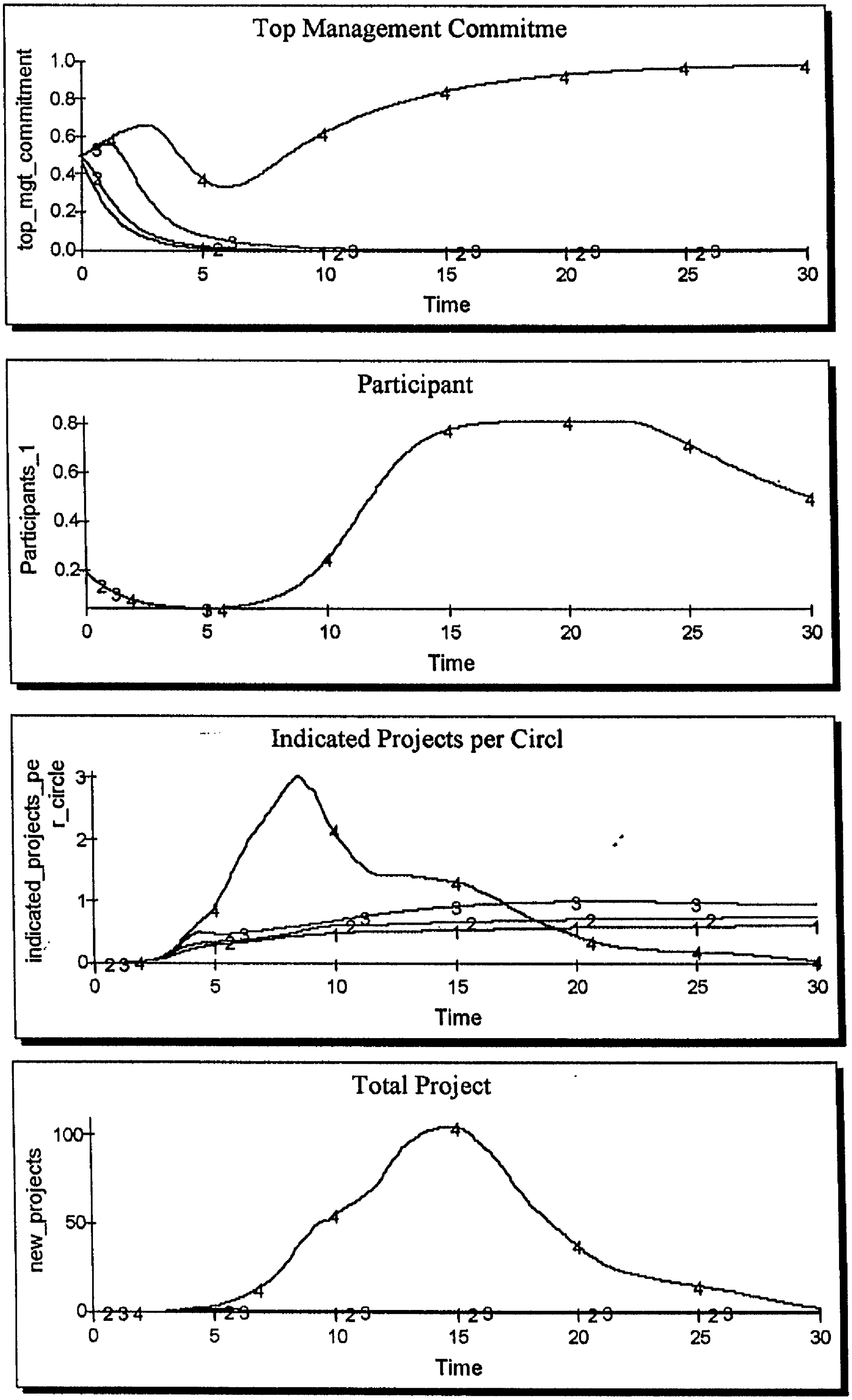


Figure A4.18 Results of varying the participation target under lo conditions and unsupportive policy .

the low target of 20 projects that peaked at year 10 but declined only before year 15. This highlights the reinforcing effect of an unsupportive policy. Poor performance is penalised with the withdrawal of resources leading to earlier declines. Good performance is rewarded with more resources that sustain the improvement efforts.

The next sets of runs dealt with testing a supportive policy on low and high conditions. The resulting behaviour is similar to earlier runs where both total projects and participation increased then declined. Figure A4.16 and A4.17 show that under the supportive policy at both low and high conditions, the major variables traced the same behaviour path even as target was raised from 20 to 80. The behaviour is both numerically and behaviourally insensitive to these changes in targets.

The initial performance of the system triggered the allocation of more resources to the programme. The additional resources were dependent on the gap between target and current performance. More resources were made available as this goal discrepancy increased. Thus, large amounts of resources were committed at the start of the programme when the greatest discrepancies occurred as the total projects was naturally at its minimum. In the mean time, total projects were gradually growing because the motivational variables are not being hindered by any resource constraints, and slowly closing in on the targets. At this time when the performance has achieved its goals, no additional resources are required, and are simply maintained at this level. In effect, the supportive policy provided the necessary support to bring it to the same performance, allocating more when the target was higher. This accounts for the same identical behaviour path for each of the variables.

A4.4.2 Percent participation as the performance measure

The percentage participation in the organisation is the relevant measure for organisations that focus on the goal of 'involving everyone'. Some organisations, including two case studies discussed in this research, are concerned with the total participation of the all the members of the organisation. The level of participation represents the degree of success of the programme in encouraging its members to take a shared responsibility for satisfying the customer. It may be considered as a pseudo measure of the required change in culture.

Figure A4.18 shows the results for low conditions-organisation with a non-supportive policy. The participation level continued its decline for the first three trials where they involved targets of 60 percent, 40 percent, 20 percent and 10 percent participation (lines 1, 2, 3 and 4, respectively). The initial decline, as observed earlier, is caused by the momentum provided by the low conditions of the organisation. The falling level of participation against the standards resulted in lower motivation and less resources. This further pushed the participation towards zero. Line 4 is an exception to this pattern.

As the target is decreased, the rate of decline also decreased. This is indicated by the upper and rightward shift of the curves. This was caused by slightly more available resources due to a better performance against this lower target. These shifts are reflected in similar rightward shifts in top management commitment (topmost graph). This led to an incremental increase in satisfaction, perceived support and participation levels, which in turn, led to an improvement in commitment and

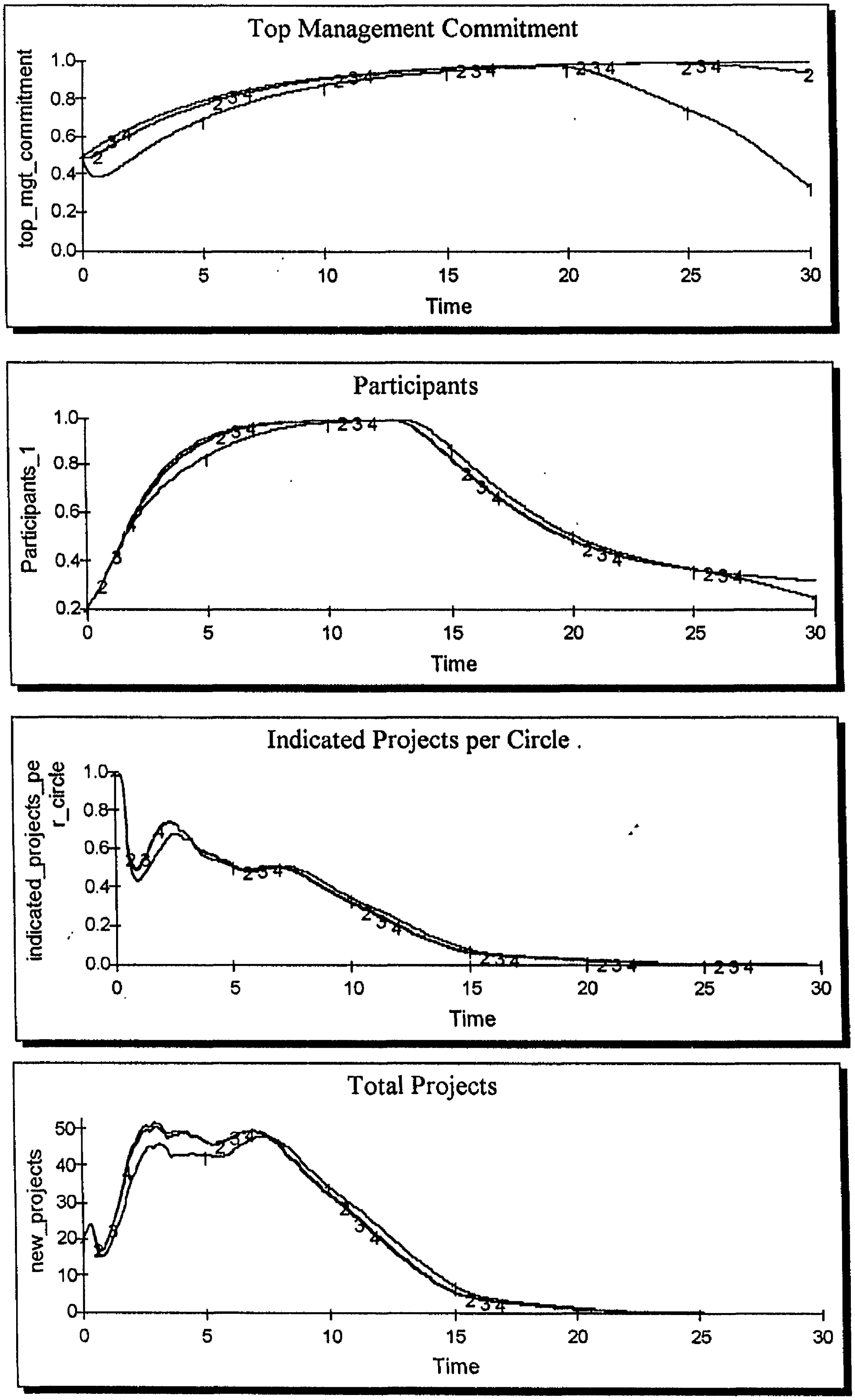


Figure A4.19 Results of varying the participation target under hi conditions and unsupportive policy .

eventually, slightly more resources. The results of this chain of effects are more apparent in line 4 where the target is a low 10 percent participation.

The lowest target of 10 percent participation was easiest to achieve, since starting participation was 20 percent. Thus, at the outset, when participation exceeded the target, additional resources were allocated. This allowed the satisfaction and perceived variables to improve, and raised the motivation to participate. This led to a recovery of the participation rate and more additional resources. The eventual decline was due to difficulty.

Figure A4.19 shows the case for a high condition organisation and the same unsupportive policy. As the targets were decreased, the participation levels remained basically the same. As in the earlier cases, the initial improvement in participation was brought about by the impetus from high conditions. This initially improving participation level encouraged top management to commit more resources, which, in turn led to more participation and improvement. As the targets were decreased, the level of participation showed better ratios, thus there was higher commitment and more resources. The decline of participation was caused by the effects of difficulty from increased total projects.

Figure A4.20 and A4.21 show the same effects of the preceding section when a supportive policy based on participation levels is used. Each of the trials in both the low and high conditions followed the same time path. The policy adjusted the required resources as to result in the same level of activity and participation.

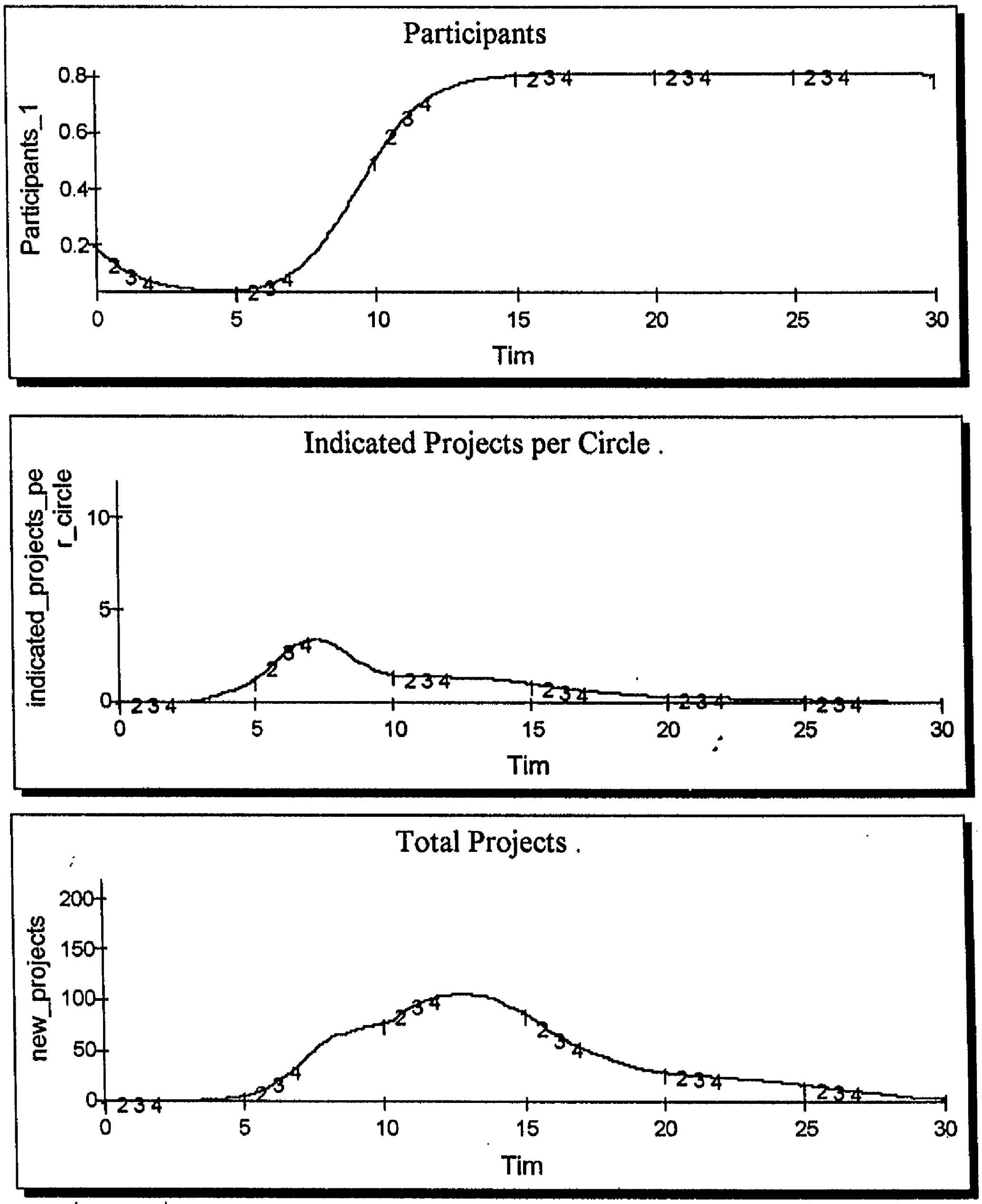


Figure A4.20. Results of varying the participation target under lo conditions but supportive policy .

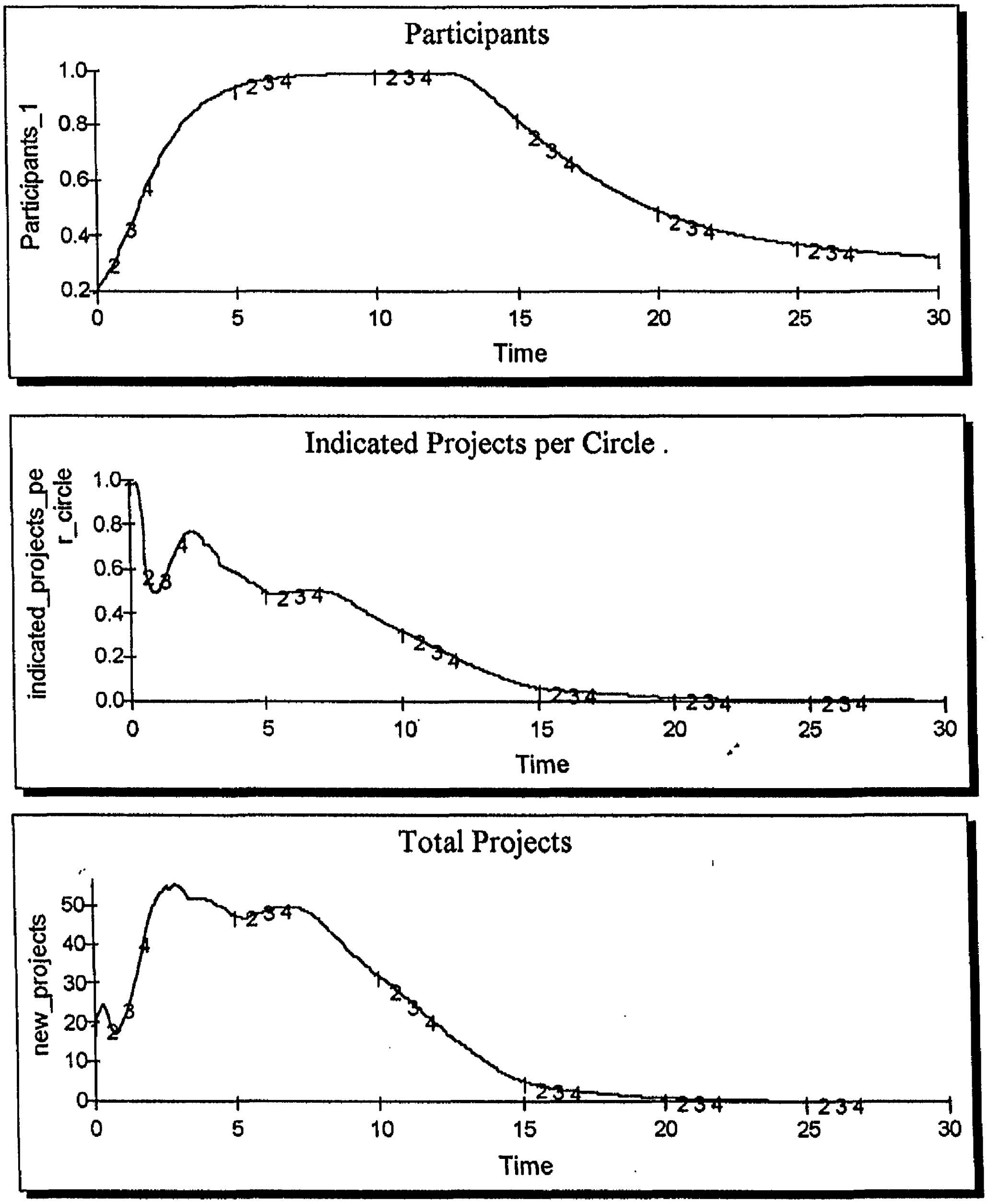


Figure A4.21 Results of varying the participation target under hi conditions and supportive policy .

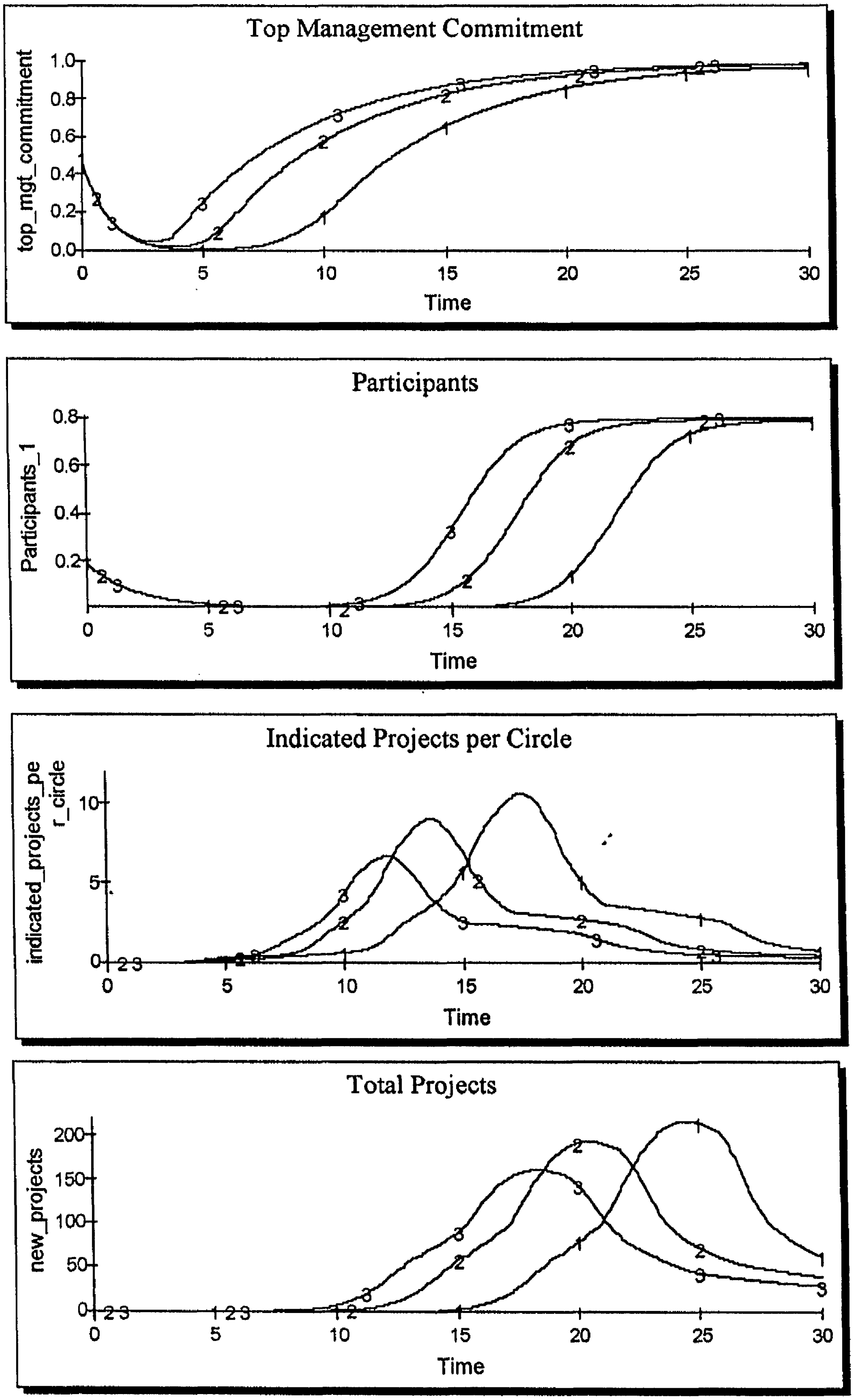


Figure A4.22. Results of varying the indicated projects target under lo conditions and unsupportive policy .

Moreover, the results in these runs are consistent with the earlier observation that low conditions generate more projects than high conditions.

A4.4.3 Indicated projects as the performance measure

The indicated number of projects reflects the motivation to propose projects as dictated by the motivation to hold meetings, level of ability and the level of difficulty. As an average figure, it reflects the varying motivation and abilities of the different circles. It is a rather conceptual variable rather than a concrete and tangible measure. It aims to standardise the performance of all teams by encouraging and challenging the low performers. Ultimately, improving indicated number of projects will increase total projects and contribute to continuous improvement.

Figure A4.22 shows that top management commitment was initially falling due to the unfavourable results in indicated number of projects. This, in turn, was due to the relatively long development time of motivation to hold meetings and ability. However, there was a continued gradual increase in indicated projects as the motivation to hold meetings reflected the still significant level of resources. This gradual increase encouraged a marginal but steady increase in top management commitment and additional resources. Eventually the increased resources affected perceived support and satisfaction as to reverse participation levels. These interactions yielded a huge number of projects, although realised only at a later stage.

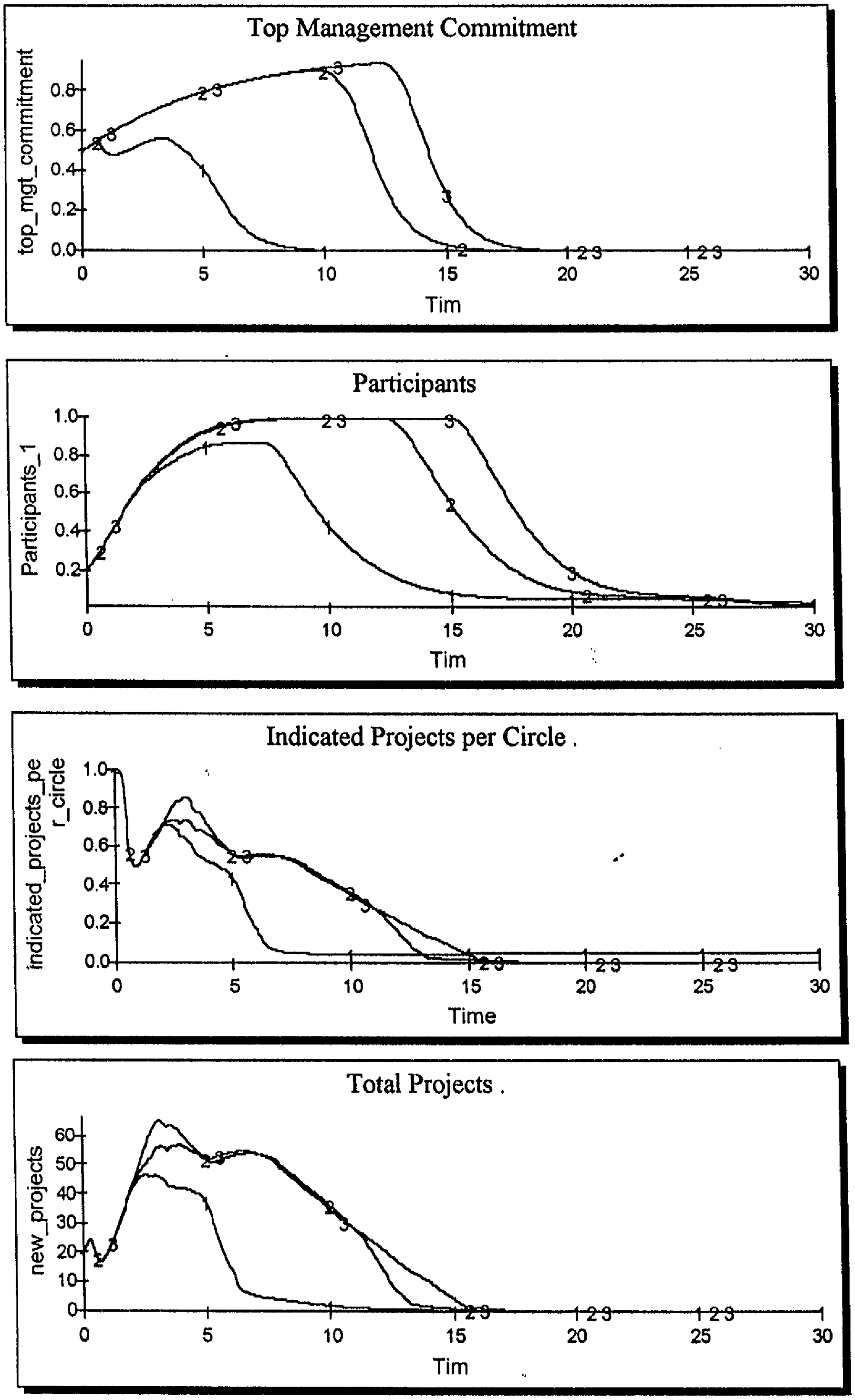


Figure A4.23 Results of varying the indicated projects target under hig conditions but unsupportive policy .

There are two interrelated effects of these interactions. As the target decreased, the significant improvements in indicated projects appeared earlier. Lower targets, as they are easier to achieve, do not prematurely constrain resources. And the availability of resources facilitates the improvement of the satisfaction and perceived support variables. Thus at lower targets, there are more resources that encourage the proposal of more projects. The effect of more resources is also reflected in the early recovery of participation rates.

Corollary to early improvement is the early decline. This is similar to earlier experiments where difficulty affected rewards satisfaction and learning. As a result, there were fewer projects as the target was lowered (bottom graph, Figure A4.22).

High conditions led to a boom-bust behaviour of participation and the differences in the trials were the rates and timing of the decline (Figure A4.23). The favourable conditions indicated an inverse relationship between the magnitude of the target and resulting total projects.

The immediate effect of high conditions is to increase the level of participation. This impacts on the temporal resources of top and middle management and the TQM staff. Thus, there is an immediate depletion of the available facilitation time resulting in low perception of support. This, in turn, diminishes the motivation to hold meetings and eventually indicated projects. This decline is reversed when ability improves. Thus, indicated projects initially declined and shortly recovered. This recovery motivated top management to commit more resources, further improving satisfaction and perceived support. However, at the higher targets, there

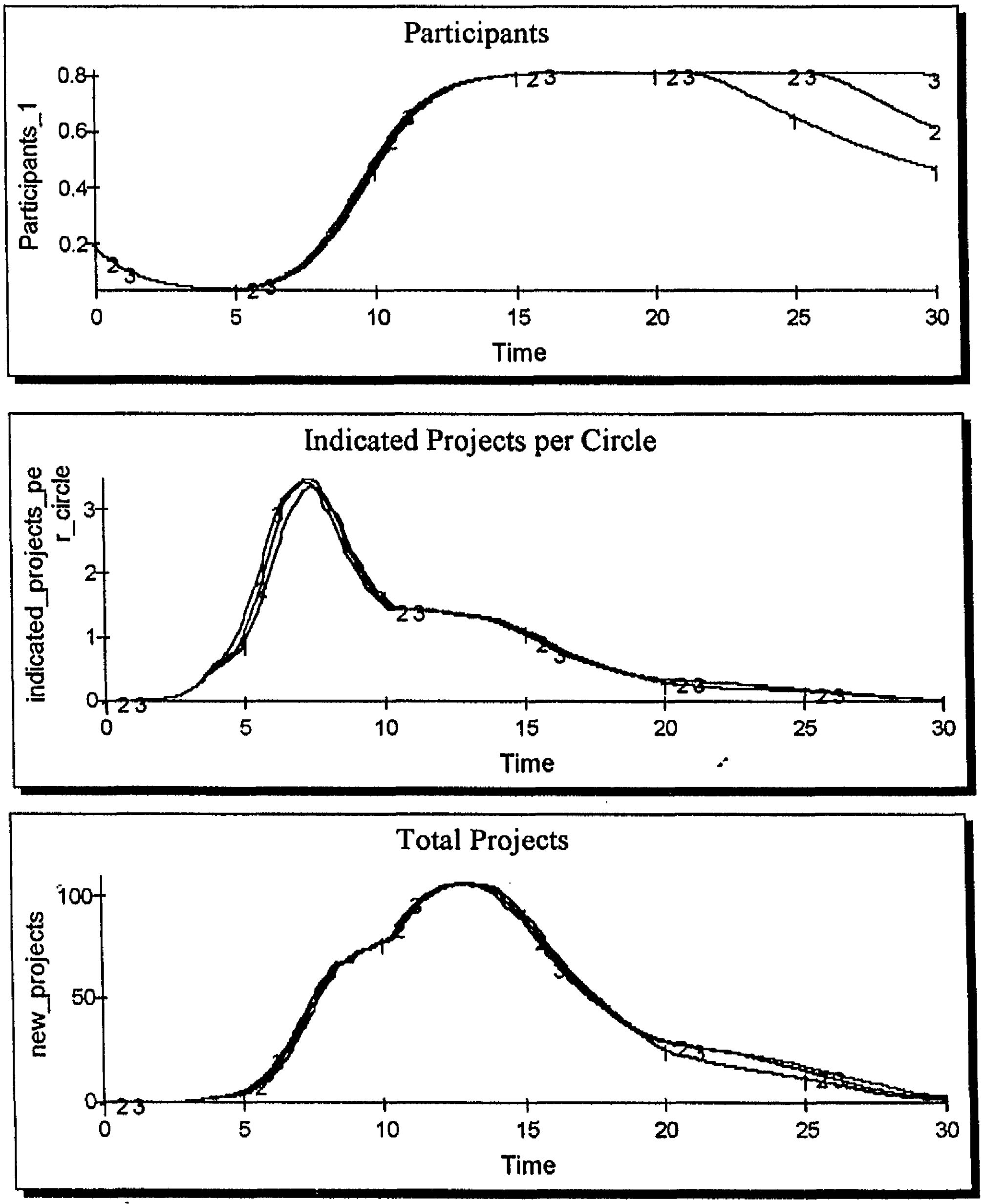


Figure A4.24. Results of varying the indicated projects target under lo conditions and supportive policy.

are less available resources. Inadequate resources hastened the decline of both participation and indicated projects. But when resources were increased, the motivation to participate and hold meetings stayed high. Their combined effect led to more total projects as targets were lowered.

Figure A4.24 shows the result of a supportive policy at low conditions. The graphs show that behaviour is numerically sensitive to changes in target, unlike the earlier supportive policy cases that were insensitive. Decreasing the target improved on the motivation to participate mainly as the targets were easier to attain. This allowed participation to stay at its peak longer. However, total projects were not as sensitive, as they kept their pattern with minor numerical adjustments.

Closer investigation of the motivation to participate showed that the cause of the differences in behaviour was due to the satisfaction from contribution. Varying the target for indicated projects, not only affected the decision to commit resources but also the dynamics of contributions. The target represents the implicit goal of the improvement teams which is the basis for the expectations for contributions. The contribution ratio, and the satisfaction derived from it, is based on these expectations. Thus, as the target increased, the contribution ratio went down. The lower contribution ratio decreased the expected contributions in the next cycle, which in turn, increased the contribution ratio. The overall outcome of the interactions of the contribution variables is a higher satisfaction due to contribution, a level that sustained the motivation to participate.

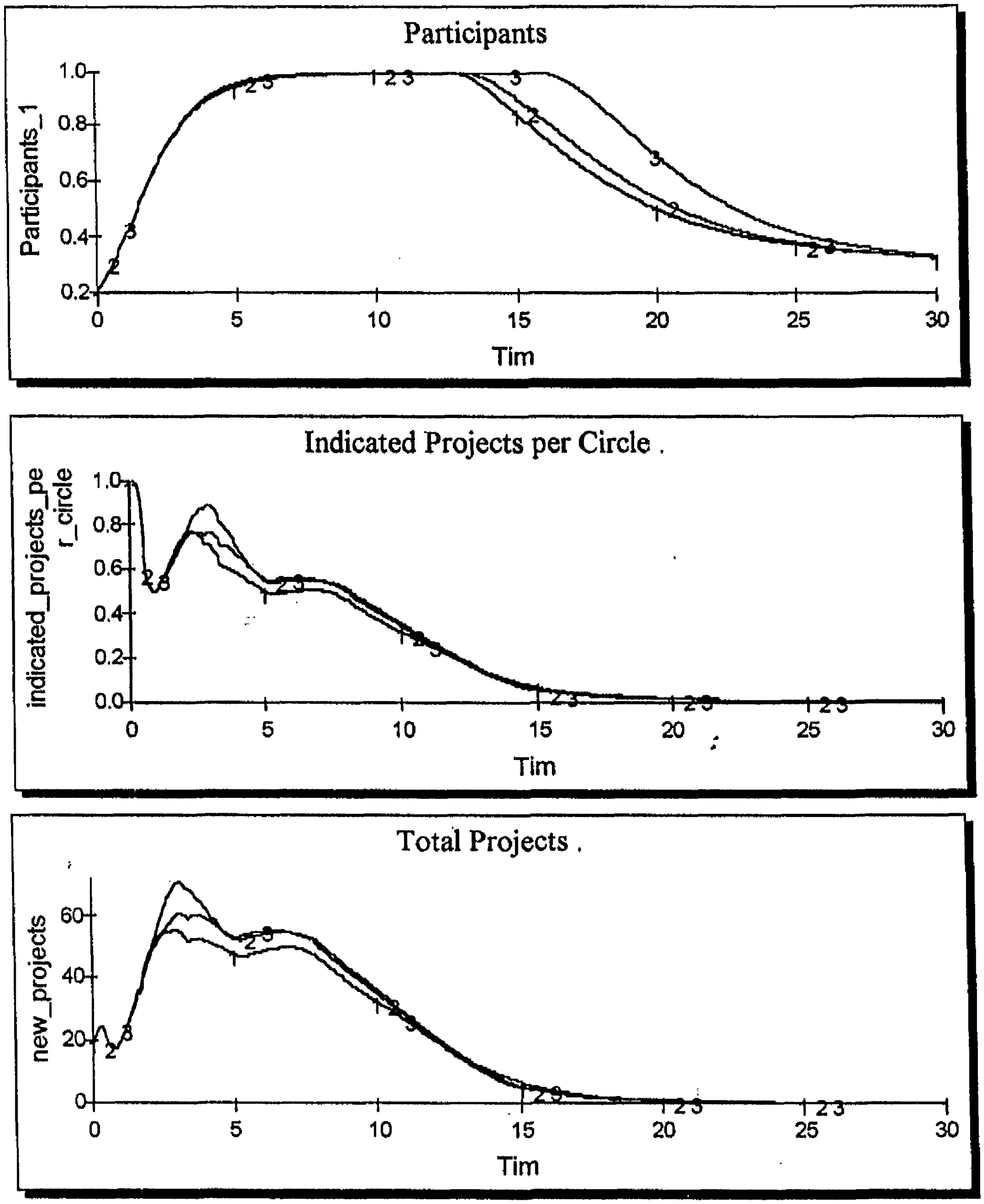


Figure A4.25 Results of varying the indicated projects target under hig conditions and supportive policy .

The same dynamics were observed in the corresponding high conditions tests. The participation levels stayed at the peak longer when the targets were lowered, but total projects remained essentially the same (Figure A4.25). The contribution satisfaction was also the cause of the sustained motivation to participate.

A4.4.4 Percentage meetings held as the performance measure

The percentage meetings indicate the actual number of meetings held against the theoretical number of meetings for the period. Hence, it reflects the actual performance against plans. Mainly as meetings are voluntary decisions, the performance measure represents the effort by the quality circles to become active participants in the quality programme. The number of meetings, too, influences the number of projects that can be proposed. Thus, monitoring meetings can ultimately affect the goal of maximising quality improvement.

The first set of tests in Figure A4.26 represents the low conditions-unsupportive policy case. The percent participation showed a pattern that grew from a very late and comparatively small recovery to a full recovery. The resulting total projects also followed the same pattern of delayed improvement, with the third run showing an extreme case of a peak and decline.

Similar to the earlier runs at low conditions and unsupportive policy, the performance indicator took long to improve. This starting behaviour of participation is due to the effects of the low initial conditions, whilst the behaviour of percentage

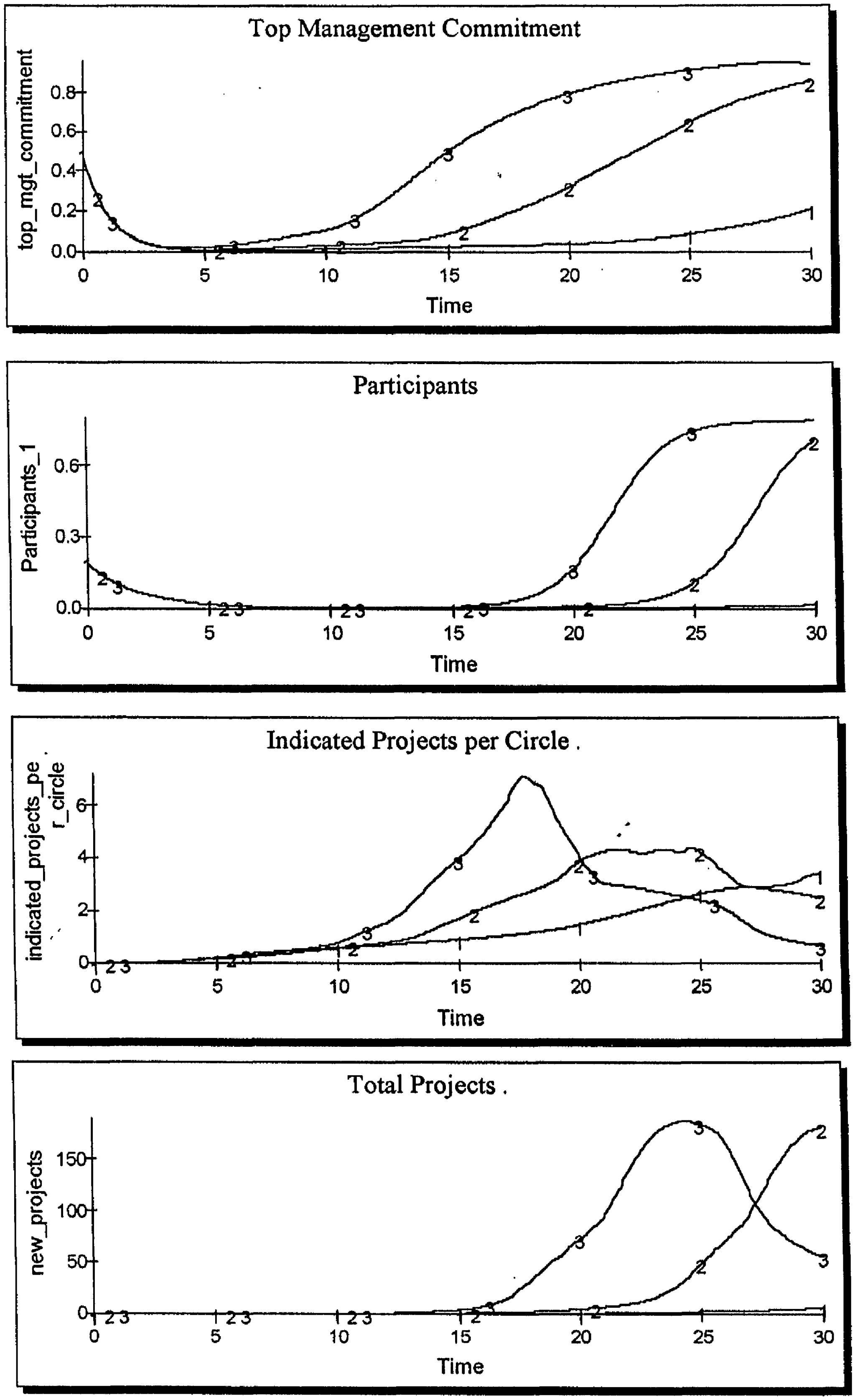


Figure A4.26 Results of varying the percentage meetings held target und low conditions and unsupportive policy .

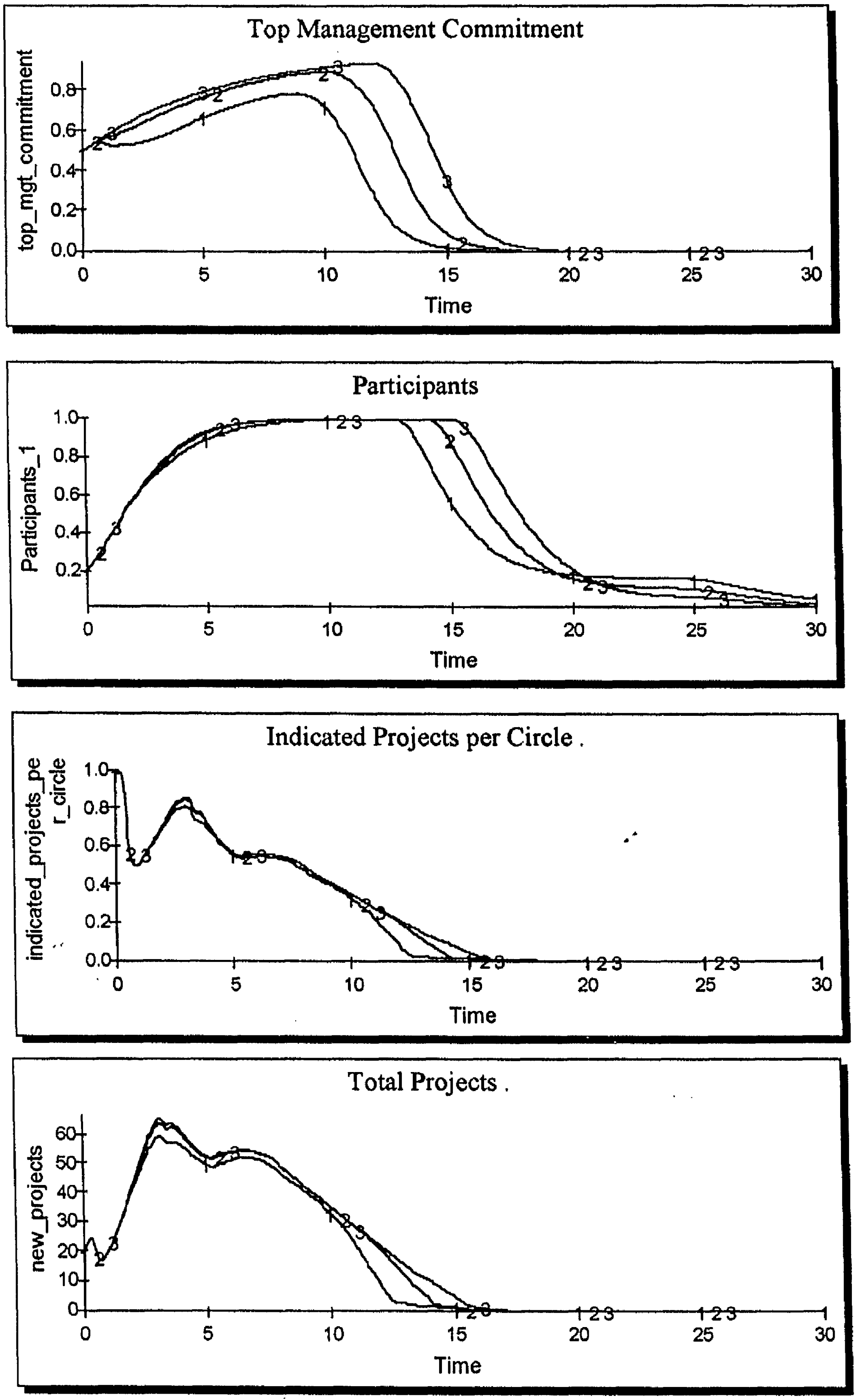


Figure A4.27 Results of varying the percentage meetings held target and high conditions and unsupportive policy .

meetings held was naturally low due to the process delays of building ability. Due to the few meetings held at the beginning, available resources were correspondingly being reduced. However, the natural growth of ability gradually pushed the motivation to hold meetings until it approached the targets. This positive trend motivated top management to commit more resources and consequently improved satisfaction and the motivation to participate. Thus, there were more resources and earlier improvement in participation when the target was lowered because it yielded a higher relative performance.

It may be noted that the reduction of resources did not drastically hinder the growth of indicated projects, nor prevent participation from recovering. This is explained by the relative isolation of the motivation to hold meetings from these resources. This allowed meetings held to increase, unlike the experiments with participation target where resources had direct impact on motivation to participate. In this latter case, participation did not recover.

The participation level in the high condition case with the unsupportive policy showed little changes at the beginning as the targets were decreased from 100 percent to 50 percent meetings held, as Figure A4.27 indicates. The starting years were still largely unaffected by resource allocations and mainly pushed by the initial motivation to participate. However, the rightward shifts in participation reflect an extended period where participants were motivated. There is more participation because there are additional resources available for the programme. This is a result of the increasing percentage meetings, and the lower standards amplify such improvements. But indicated projects dropped to zero at around time 15. This brought total projects to zero as well.

Figure A4.28 and A4.29 show the supportive policy as applied to both low and high conditions, respectively. These graphs reveal an insensitivity to changes in the target. The adjustment process, as in the earlier runs, corrected the gaps between performance and standard with a proportionate quantity of resources. Thus, the outcomes were not affected by changes in targets.

The preceding experiments that involved a feedback from performance indicators highlighted the advantages of the TQM philosophy in providing more support. A comparison of the total projects generated by the two polices, as presented in Table A4.6, shows that generally there are more projects in the supportive policy. As noted earlier, the supportive policy allocates the proportional resource requirements to close the gap between the current performance and the standard. Thus, this loop forms a balancing loop that corrects and adjusts performance to the standard. On the other hand, the unsupportive policy reinforces the trend of the current performance. High performance encourages the allocation of more resources whilst lower performance lead to the withdrawal of these resources. Conditions become more favourable when current performance is good. And when the performance is low, the conditions become worse. This was adequately described by Lawler and Mohrman (1985; 1987).

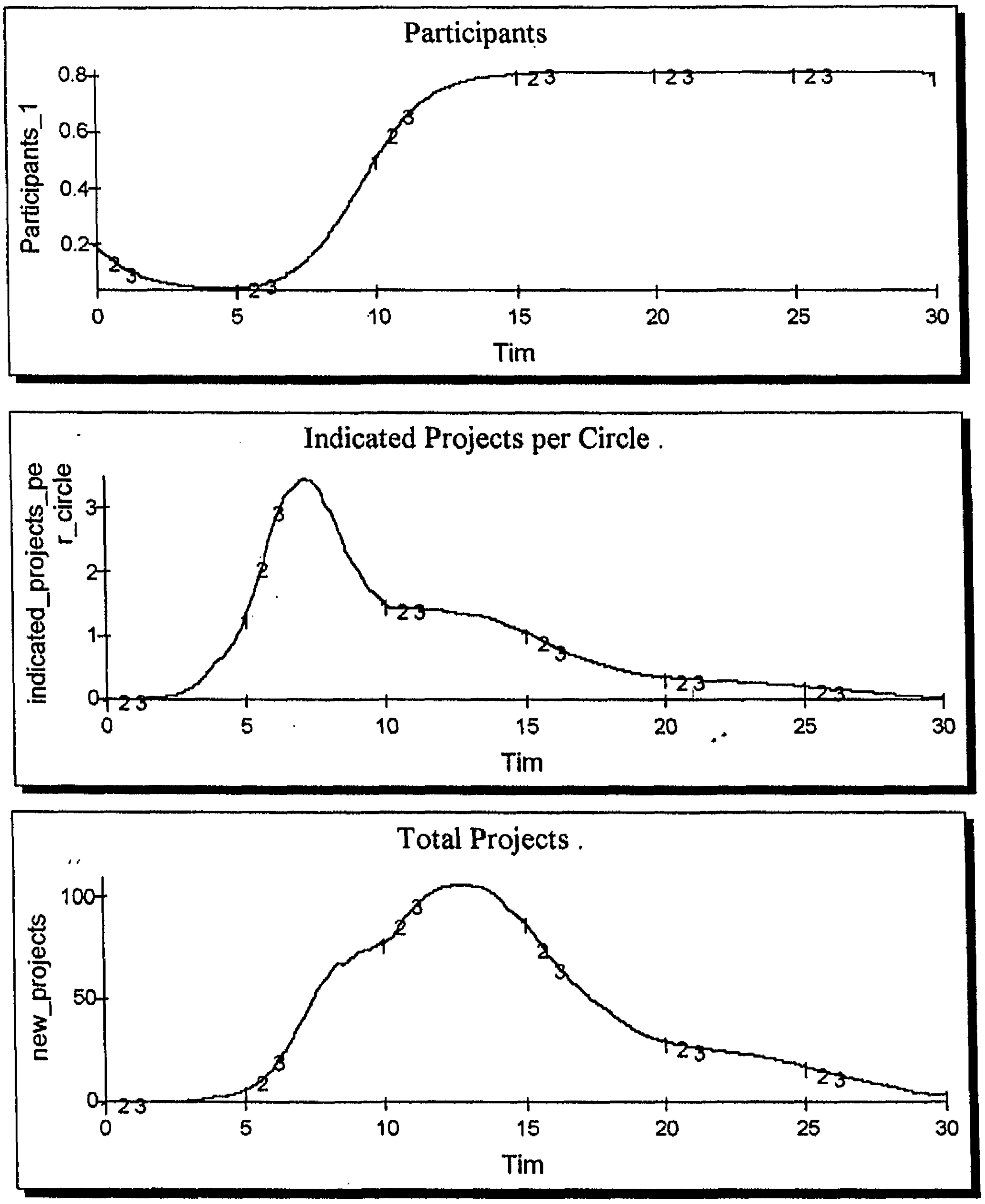


Figure A4.28 . Results of varying the percentage meetings held target und low conditions and supportive policy .

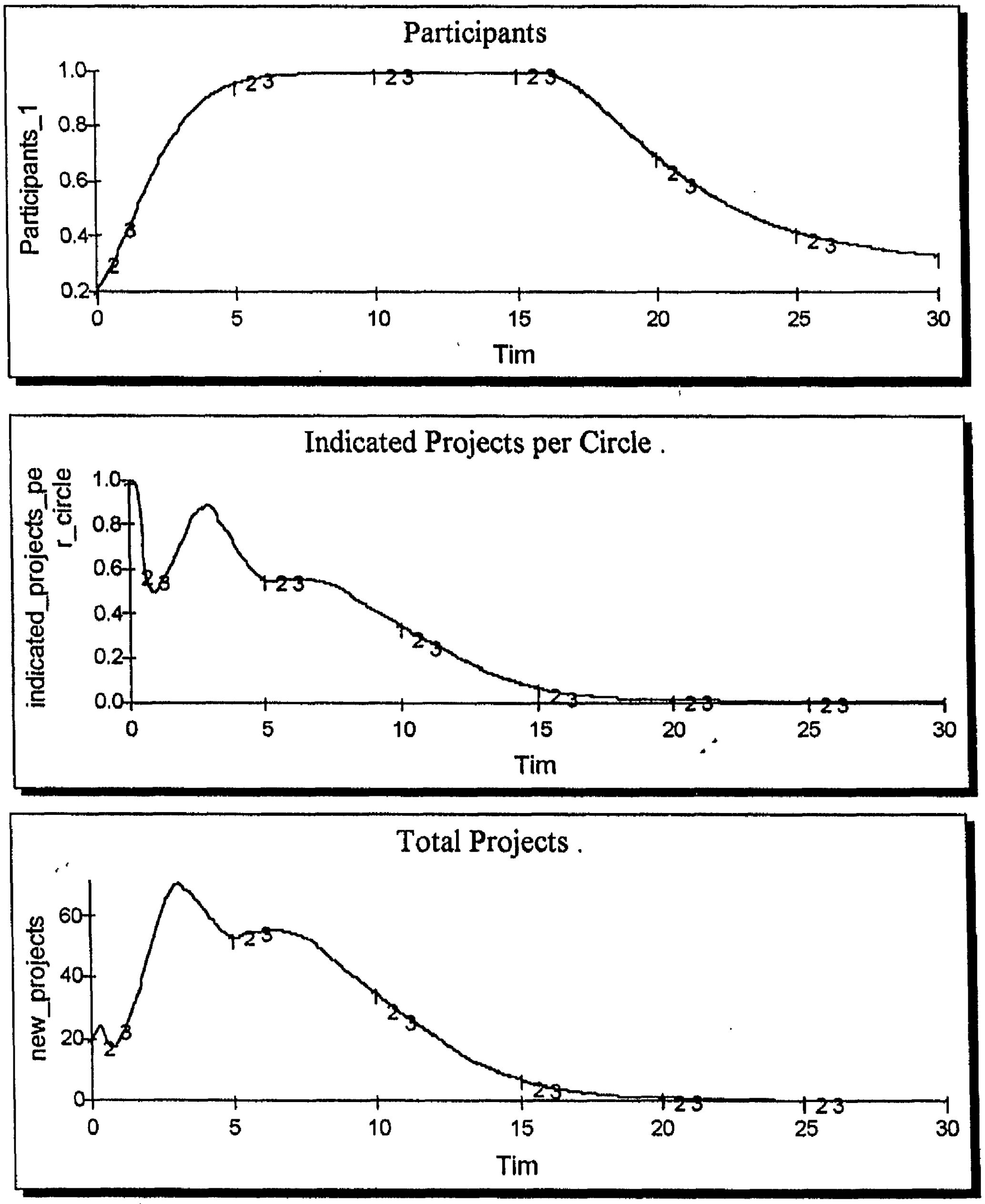


Figure A4.29. Results of varying the percentage meetings held target und high conditions and supportive policy .

Table A4..6. Comparative results of the experiments with feedback structure

Performance measure	Not supportive policy		Supportive policy	
Target	**Low conditions**	**High conditions**	**Low conditions**	**High conditions**
Total projects				
20 projects	4.00	516.80	1113.70	544.22
40 projects	4.00	108.68	1113.71	544.22
80 projects	4.00	61.79	1113.79	544.22
Participation				
10 percent	1088.56	533:94	1169.17	543.28
20 percent	32.89	533.94	1169.17	543.28
40 percent	14.53	534.16	1169.17	543.28
60 percent	9.32	525.68	1169.17	543.28
Indicated projects				
0.25 projects	1538.04	575.51	1169.15	607.60
0.50 projects	1697.57	531.93	1159.51	586.95
1.00 projects	1647.89	237.85	1113.80	546.46
Percentage				
meetings	1466.41	576.23	1169.15	607.58
50 percent	709.34	556.52	1169.16	607.70
75 percent	46.91	503.04	1169.23	607.95
50 percent				

A second observation from the results concerns the numerical and behavioural insensitivity of the supportive policy tests, on one hand, and the inverse relationships between outcomes and targets in the non-supportive policy, on the other hand. The supportive policy yields insensitive results mainly because of its adjusting mechanism. Resources are allocated as to keep the system to its implicit goals and the target. The implicit goals are determined by the maximum available resource. This is best understood with the influence diagram of Figure A4.30.

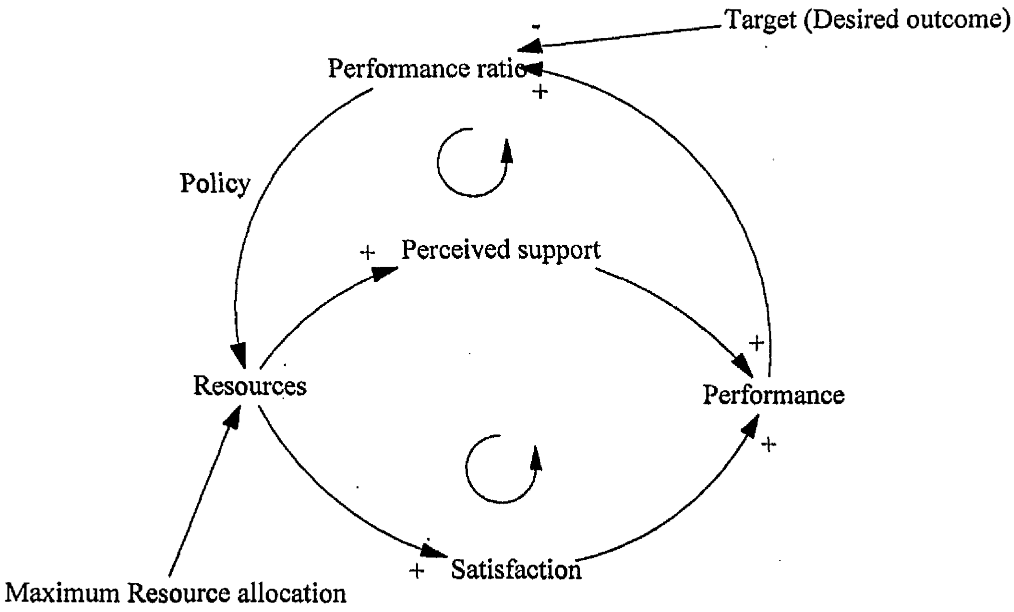


Figure A4.30. Feedback loops created by the performance evaluation based on target.

The performance based on any of the indicators is compared with the desired performance or target. This comparison is represented by a fraction of performance against target. A higher performance leads to a high performance ratio. The supportive policy maintains the level of resources when the performance ratio is equal to or greater than 1.0 (where performance is better than the target). Otherwise, resources are added. Thus, the head of the arrow leading to resources will have a negative sign, or an opposite effect to that at its tail. This makes two balancing loops. Resources will be made available until performance reaches the target, or until the maximum limit of allocation is reached. Upon reaching the target, the level of support is made more or less constant. Thus, this policy always brings the system to the same optimised output.

In contrast, the arrowhead leading to resources is a plus sign in the short-termist, unsupportive policy case, as the policy follows the changes in the performance ratio. When the ratio is low, resources are also low. When the ratio is high, more resources are added. This makes two reinforcing loops. These can be virtuous circles that reinforce success, or they can be vicious circles that lead to collapse. These two behaviour patterns were seen in the preceding experiments.

As indicated from the previous section on resource allocation, the system is numerically sensitive to changes in resources. Thus, it follows that the system is similarly sensitive to changes in targets that determine the level of resources allocation. Table A4.7 summarises the outcomes of the various tests in terms of their numerical sensitivity.

Table A4..7. Summary of target-outcome relationships.

Performance measure	**Unsupportive policy**		**Supportive policy**	
Target	**Low conditions**	**High conditions**	**Low conditions**	**High conditions**
Total projects	insensitive	inverse	insensitive	insensitive
Participation	inverse	insensitive	insensitive	insensitive
Indicated projects	no direct relationship	inverse	inverse	inverse
Percentage meetings	inverse	inverse	insensitive	insensitive

The table shows that the use of indicated projects as performance measure appears to be an exception to these observations. The corresponding supportive policy tests do not indicate the same insensitivity that the other tests yielded. This is explained by the additional effects of varying the target in this simulation runs. As noted earlier, the indicated projects target not only serves as a target for management but also for the TQM participants. As such, it affects the expected contributions and the satisfaction due to contributions. This leads to a chain of effects in the system. Thus, the additional dynamics introduced by the indicated projects target effectively removed the insensitivity of the system and made the outcomes inversely related to the target changes.

Two other cells in the unsupportive columns in Table A4.7 appear to be exceptions to the general observations of an inverse relationship between targets and outcomes. The tests involving low conditions using total projects as the target and high conditions with participation as the target revealed an insensitivity to target variations. Using total projects as the target, the insensitivity is due to the inability of initial performance to register any significant improvement. Even at the lowest target level, the performance ratio is still marginal. In other words, the targets are very high compared to the initial performance, which is entirely due to the starting conditions of the organisation. And the failure to create significant improvement at the outset was compounded by the withdrawal of resources in both cases.

On the other hand, when participation levels was used as the target under high conditions, the initial conditions provided the momentum to keep these levels increasing and closing in on the gap with the targets, regardless of the magnitude of the target. In effect the withdrawal of resources did not prevent participation from increasing. Eventually, the targets were reached and resources were added.

In sum, the resource allocation policy added some dynamics by controlling the level of resources. However, these additional dynamics did not drastically change the behaviour of the system. The same patterns of behaviour were observed. Only the numerical sensitivity were affected by changes in targets.

A4.5 Summary and Conclusions

Forrester and Senge (1980) state that:

> "Validation is the process of establishing confidence in the soundness and usefulness of a model. Validation begins as the model builder accumulates confidence that a model behaves plausibly and generates problem symptoms or modes of behavior seen in the real system. ... one tests a system dynamics model against a diversity of empirical evidence, seeks disproofs, and develops confidence as the model withstands tests." (p 210 - 211)

The process of establishing confidence in the TQM model began as early as Chapter 8 where the formal model was presented. The constant reference to the case study observations, to TQM literature, and to organisational theory, form the major part of structural tests; in particular, structural verification, parameter verification, dimensional consistency and boundary adequacy tests. Chapter A3 continued the validation process by testing the initial behaviour of this formal model and comparing the results with reported and postulated behaviour patterns.

In the present chapter, more tests, including others that were not presented here, were conducted to focus on the behaviour patterns generated. The tests that were presented in this chapter highlighted certain aspects of the model and the correspondence with some generally observed practices in the real system.

This chapter would prefer to use the term 'scenario analysis' for the tests that were conducted, instead of the more typical term, 'parameter sensitivity'. The former term more clearly represents and reflects the conditions in the implementation of the TQM programme. The term highlights the meanings of the parameters and their magnitudes, rather than focusing on the mathematical significance of the numbers. In other words, the exercise is not based on abstract mathematical concepts, but is founded on typical organisational situations, conditions and strategies. Taken from this perspective, the resulting behaviour from the tests finds some correspondence with some observed real world patterns.

The behavioural tests conducted in this chapter addressed the sensitivity of the system to changes in organisational conditions or strategies, as represented by the parameter values. Indeed, it was shown that the model was behaviourally insensitive to these adjustments and modifications as it followed the same pattern of behaviour that was observed in the base runs of Chapter A3. It was, however, revealed that the system is more numerically sensitive to certain changes. This insensitivity led to changes in phases and amplitude of the resulting behaviour, even as it maintained its original shape.

The behaviour sensitive tests, on the other hand, revealed some interesting insights. The behaviour of the system is largely dependent on the initial conditions: initial participation and starting organisational conditions. From a certain perspective, the system was not exactly behaviourally sensitive to initial participation if the uncontrolled decline pattern generated by 100 percent initial participation is viewed as a special case of the other patterns that involved recovery.

However, the sensitivity effects of starting organisational conditions were more revealing. The high conditions yielded apparently different behaviour patterns[23] than the low and medium conditions. These experiments highlighted the extended effects of past experiences on the starting behaviour of the system. The comparative results further examined the observations from the Chapter A3, that early and immediate declining trends in TQM implementation are a product of poor organisational conditions, or low perceptions and satisfactions in the past.

More importantly, these initial conditions runs showed that some of the postulated behaviour of TQM programmes are not necessarily accurate. In particular, the Pasternak and Berry (1994) diagram that showed a gradually increasing graph is only possible if there were positive organisational conditions both in the present and the past. Nevertheless, the model is able to reproduce this experience-based postulated behaviour. The insights derived from the formal TQM model goes beyond the optimistic and simplistic assumptions of Pasternak and Berry model.

The boom bust behaviour patterns of participation and top management commitment from of the experiments appear to be simpler versions of the Atkinson

[23] On one perspective, it is still possible to argue that these behaviour patterns are not very different. The immediate positive ramp of the participation in the high conditions test can be argued to be simply a change in phase of the low conditions test. The behaviour pattern for indicated projects are generally the same anyway. But for the purposes of highlighting the impact of different conditions, it is better to take these as behaviour sensitivity.

(1990) graph. Whilst Atkinson suggested that the fluctuations in the feelings and attitude to TQM were related to changes in situational reactions, the preceding experiments were responses to managerial expressions of commitment to the programme. Similarly, middle management involvement fluctuates with perceptions of top management commitment, demands of participation and perceptions of insecurity and fear. Perceptions of top management visibility are determined by increasing demands on the limited management attention to TQM activities and participants, even as actual devoted time is kept constant. The additional feedback loop that monitored performance indicators influenced the level of actual commitment and level of resources. This added some more dynamics but still resulted into similar patterns of rise and declines.

Lastly, the generalised suggestions of Ramsey (1977) on cycles of control and Marchington et al (1992) on the waves of participation efforts are also replicated by the simulation runs in this chapter. However, the reasons for the rise and fall of participation efforts are different from those of Ramsey, Marchington and his colleagues. The programme declines in the short term because of inadequate resources. In the longer term, the negative effects of problem and improvement area complexity, difficulty and frustration make a sustainable programme a rather remote possibility. It may be suggested that because of this inevitable decline of the programme other new programmes that offer relief and hope to managers and practitioners may be tried after TQM is abandoned.

Thus, it becomes clearer why there is a growing gulf between TQM cynics and advocates. The cynics tend to highlight the negative aspects of the TQM programme citing disappointing results and low participation rates whilst advocates, on the other hand, claim otherwise. The simulation runs in this chapter showed that both sides are actually right because the model can both show an immediate decline and an upward trend in the programme's main indicators. The starting behaviour depends more on the initial organisational conditions rather than on the present efforts and resources. This suggests that comparison of company experiences should also consider the past and prevailing conditions of the organisation as these form part of the foundations of the TQM programme's ability to achieve its goals and objectives.

Moreover, the model also highlights the unintended undesirable effects of management's own responses to the performance indicators of the system. In particular, the reinforcing loops introduced by the non-supportive short-termist policy can hasten the decline of the system, as it prematurely constrains the resources. Although the resources experiments showed that the system is behaviourally insensitive to changes, the numerical sensitivity had further impact with the introduction of a resource allocation policy, and affects the timing of the trends. Thus, earlier failure is observed in the unsupportive policy case.

Several points about the unsupportive policy case were underlined in these simulation runs. The first deals with temporal considerations in the resource policy implementation. The time delay between the satisfaction and perceived support variables affected by changes in the resource levels, and the performance indicator has a large effect on the behaviour of the system. The magnitude of the performance indicator reflects the effects of past performance. Thus, the longer this delay is, or the more process delays are involved, the more inaccurate is the information reflected in the performance indicator. Basing the responses of management from the information provided for by the long delayed indicator could lead to erroneous conclusions and lower resource allocation.

The second temporal consideration is the natural tendency of the variables to follow a certain initial behaviour. These indicators have a natural behaviour pattern dictated by the initial conditions and not by the present efforts. Judging performance from this natural development can also lead to early withdrawal of resources which constrains performance.

A third consideration in the design of a resource allocation policy is the setting of the targets. In an unsupportive environment, higher targets led to earlier declines. These expectations actually underestimate the performance of the system. The result is a premature judgement that the system fails and consequently results to the reduction of available resources.

These three considerations distort the information provided for by the performance indicators as they do not necessarily reflect the performance of the system. Typically, the indicator is expected to represent success or failure of efforts. However, due to the complications introduced by process time delays, natural reactions to initial conditions and relativity of performance due to targets, management may interpret these signals as failures (or successes) and act accordingly. This action can speed up the decline (or climb) of the programme.

It may be surmised that in the real system, management is not aware that evaluation policies have inherent weaknesses such as those discussed here. Nor are they conscious of the negative effects that dwindling resources on the perceptions and satisfaction of the participants. They may feel that they are caught in a series of failure as greater efforts such as maintaining the level of resources do not produce the desired effect of improvement, not realising that information from the chosen indicator is delayed at best, inaccurate and unreliable at worse.

The typical explanation for the declining trends of participation and total projects is that the programme is ineffective, theoretically flawed or some other fundamental argument against the principles of the TQM. This inability of TQM to deliver on its benefits in the short term of the programme can lead to a new search for more effective programmes.

The abandoning of the TQM programme by top management, however, does not represent an end to the other members of the organisation. The experience with the abandoned programme, especially if it involved the reduction of resources, may become ingrained in the employees' minds. Perceptions and dissatisfactions accumulate in the people's memory and soon become the initial organisational conditions for the next change programme. These negative impressions from an abandoned programme become more difficult to correct and overcome as they pile up over the years of several attempts for change. And this leads to another circle of failures, and each attempt being labelled the 'flavour of the month'.

These points suggests that apart from the understanding of the principles of TQM, top managers also need to understand some subtleties that are inherent in the system interactions. Learning about these less visible interactions could provide some leverages to help improve system performance.

One specific example of such adjustment and appreciation of system interactions was the strategy taken by Company case B. Their TQM programme did not involve any evaluation of the results even as output such as the number of suggestions received were recorded and monitored.

> "We believed that we were still in the learning stage and it was unfair to measure and assess our progress from those initial efforts. Later, when we have proved that we are good and have learned our lessons well, then we can set targets, measure and evaluate our efforts" (Macapagal, 1996).

Indeed, it was only after five years into the programme that plans to identify performance measures, benchmarks and targets were undertaken. Macapagal (1996) attributes the current upward trend in suggestions to this strategy that they adopted.

These earlier observations, however, do not generally apply to the supportive case. The supportive policy is not sensitive to upward changes in the performance indicator but becomes active only when there is a downward change so that more resources are allocated. Thus, any errors reflected in the indicators do not adversely affect the programme, as levels of resources are either maintained or increased and never withdrawn. In effect, the system is insensitive to changes in performance and moves only towards improvement. The balancing loops created by the supportive policy always bring the system to its goal regardless of the chosen performance indicator nor the set target. The simulation runs in this chapter have shown that this core principle of TQM indeed leads to a more stable system than a short-termist unsupportive policy.

In sum, this chapter tested the simulation model's usefulness by relaxing the narrow assumptions made in Chapter A3. The results of these experiments closely reflect and represent many of the issues that have been earlier suggested in the literature. The analysis has highlighted the ability of the model to replicate and explain the general observations in TQM studies and experiences.

After the models robustness and consistency was tested in Chapter A3 and A4, the next task is to replicate the historical data from an actual case. This tests the model's consistency and ability to replicate reality. The results of this effort are reported in Chapter 9 in Volume 1.

APPENDIX A
INTEREST IN TOTAL QUALITY MANAGEMENT

During the course of the research, there was a growing concern for the success of TQM programmes. There were increasing reports of failed TQM efforts, and consequently, there was more disenchantment with its promised benefits. Indeed, there were papers that was dismissing TQM as a "dying fad" (Jackson, 1995; Jacob, 1993). As early as 1992, Gill and Whittle (1992) saw the downtrend in TQM, as they believed that TQM was similar to Management by Objectives (MBO) and Organization Development, which followed life cycles. They noted that TQM was in its late "adolescence" and about to reach its maturity stage. They suggested that this stage lasts around ten years, during which time signs of decline become evident.

This issue seems to affect the objectives of this study. The stage at which TQM is in the present or at the conclusion of this study could affect the arguments as well as conclusions of this research. Whilst the main objective of the study aims at the better understanding of the TQM implementation process, it is ultimately concerned with improving the performance of TQM programmes. Thus, the focus of the discussions and analyses as well as the suggestions in this report could shift as a different set of audience may be addressed to at a different phase. If TQM were at its initial decline, when problems and difficulties are just beginning to develop, the intended audience could be both practitioners and researchers. On the other hand, if TQM were at its lower decline phase, when it is almost dead, perhaps the discussion should focus more on the theoretical aspects as practitioners will be assumed to be totally disinterested at this stage. Collins (1994) suggests that this is a "post-mortem" analysis of a dead change management technique.

Thus, a small effort (small enough not to side track the thrust of this research) to determine interest in TQM was initiated. The effort was not meant to be neither exhaustive nor scientific. It was only intended to generally measure of the interest in TQM, at least in publications. It may be argued that if it is still mentioned in publications, then there is still interest in TQM, even if it were only for criticism. Even in this latter case, the efforts to investigate TQM do not become useless and a waste of time and effort. Indeed, this study aims to contribute to the discussion of issues in TQM.

Following a general procedure of reviewing existing literature (e.g., Hackman and Wageman, 1995), the ISI BIDS Database Index were searched for articles that included the term TQM and results plotted over the years. For comparison, the articles written about quality circles were also tabulated and graphed. The results are shown in Figure A.1.

The first graph shows that at the beginning of this research (1993-94), TQM, as reflected by the number of articles published, was most attractive to writers and researchers. That is, the rate at which new articles were written was highest prior to this time, this period being the basis for justifying this researcher's interest in TQM field.

The graph of TQM articles seems to reflect the arguments of Gill and Whittle (1992) that TQM follows a life cycle. There were few articles in the 1980s and at the beginning of the 1990s. Then, there was a rapid increase in the number of articles, but which appeared to have peaked in 1995. The graph for quality circle articles (second graph) shows a closer resemblance to the life cycle graph, as it seems to have a full cycle. After its peak in the middle of the 1980s, there is a clear declining trend. In this latter stage, there are not more than 20 articles per year written about quality circles. Still later, the publications seemed to have settled to a low equilibrium point.

Moreover, the lower graph also appears to reflect the theory that at the decline of a management technique, a new technique is "born" to replace the dying programme (Bounds, et al, 1994; Gill and Whittle, 1992; Khun, 1962). During the peak of the quality circle literature, TQM writings are almost nil. By the late 1980s, a few articles about TQM begin to come out. At this time, quality circle literature is diminishing so that TQM publications appear to replace the interest in circles. Tuckman (1995) observed that at this time, quality circles were regarded as failures. Moreover, the problems faced by circles led to the realisation that a broader programme is necessary to support circles, as in the experience of Company case C.

If TQM literature follows the trend followed by quality circles, and if TQM literature is a good indicator of interest in TQM, then it may be suggested that TQM has reached its maturity and will soon decline. Whilst some explained that the decline is due to disinterest because of its failure to deliver on its benefits, it may also be argued that fewer publications may also mean that quality and TQM has become an integral part of the organisation and thought processes of practitioners, consultants and academics. In other words, TQM has become part of conventional wisdom and thus, does not require further discussion. This might have been the case at OKI (UK) where all the concepts of TQM have been integrated in their organisation and do not constitute a separate programme. Nevertheless, this simple measure of interest in TQM suggests that TQM is not yet passé, and the findings in this study could still find some use to others who are still into TQM. The theoretical findings, on the other hand, could also find some use into explaining the declining trend of TQM.

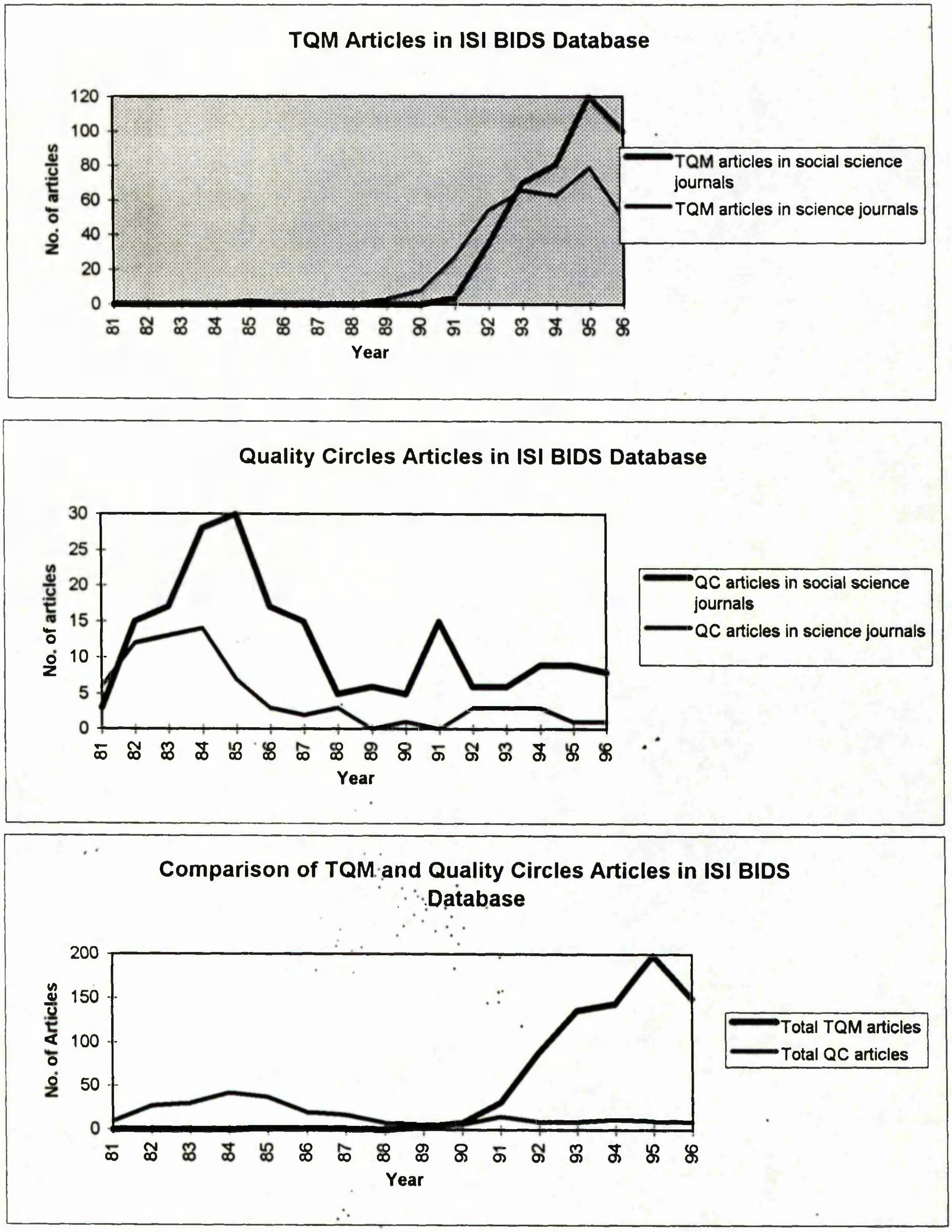


Figure A1.1. Annual TQM and quality circle publications in ISI BIDS Database

APPENDIX B
SOME APPROACHES TQM IMPLEMENTATION

This appendix briefly outlines the approaches of three of the most prominent and respected proponents of TQM, Philip Crosby, W. Edward Deming and Joseph Juran, to illustrate their different beliefs about quality and varied approaches to TQM. Some of their fundamental philosophies are also mentioned.

B1. W. EDWARD DEMING

W. Edward Deming is credited for teaching and spreading the concepts of quality in Japan after World War II. He gave a series of lectures to Japanese managers, which focused on manufacturing variability and encouraged managers to understand the difference between special causes and common causes of variability. Expanding Shewhart's statistical approach to quality, he also encouraged the Japanese to adopt a systematic approach to problem solving, which later became known as the Deming cycle of PDCA (Plan-Do-Check-Act) cycle. Moreover, he pushed senior managers to become actively involved in their company's quality improvement efforts. Later, he produced his 14 Points for Management to help practitioners understand and implement the necessary transformation centred on quality.

Deming's 14 Points

1. Create constancy of purpose to improve product and service.
2. Adopt new philosophy by management learning responsibilities and taking leadership for change.

3. Cease dependence on inspection to achieve quality by building quality into the product.
4. End awarding business on price; instead minimise total cost and move towards single suppliers for items.
5. Improve constantly and forever the system of production and service to improve quality, productivity and to decrease cost.
6. Institute training on the job.
7. Institute leadership; supervision should be to help do a better job.
8. Drive out fear so that all may work effectively for the organisation.
9. Break down barriers between departments; research, design , sales and production must work together to foresee problems in production and use.
10. Eliminate slogans, exhortations and numerical targets for the workforce. Such exhortations are diversory as the bulk of the problems belong to the system and are beyond the power of the workforce.
11. Eliminate quotas or work standards, and management by objectives or numerical goals; substitute leadership.
12. Remove barriers that rob people of their right to pride of workmanship.
13. Institute a vigorous education and self-improvement programme.
14. Put everyone in the company to work to accomplish the transformation.

B2. JOSEPH JURAN

Joseph Juran's first claim to international fame was the publication of his book, *Quality Control Handbook* in 1951. In 1954, he was invited to Japan to conduct seminars for top and middle level executives. His lectures were focused on planning, organisational issues, management's responsibility for quality, and the need to set goals and targets for quality improvement. He emphasised that quality should be conducted as an integral part of management control. He organised his philosophy and approach to quality around his quality trilogy of quality planning, quality control and quality improvement.

Juran's Quality Planning Roadmap

1. Identify who are the customers.
2. Determine the needs of those customers.
3. Translate those needs into our language.
4. Develop a product that can respond to those needs.
5. Optimise the product features so as to meet our needs as well as customer needs.
6. Develop a process which is able to produce the product.
7. Optimise the process.
8. Prove that the process can produce the product under operating conditions.
9. Transfer the process to Operations.

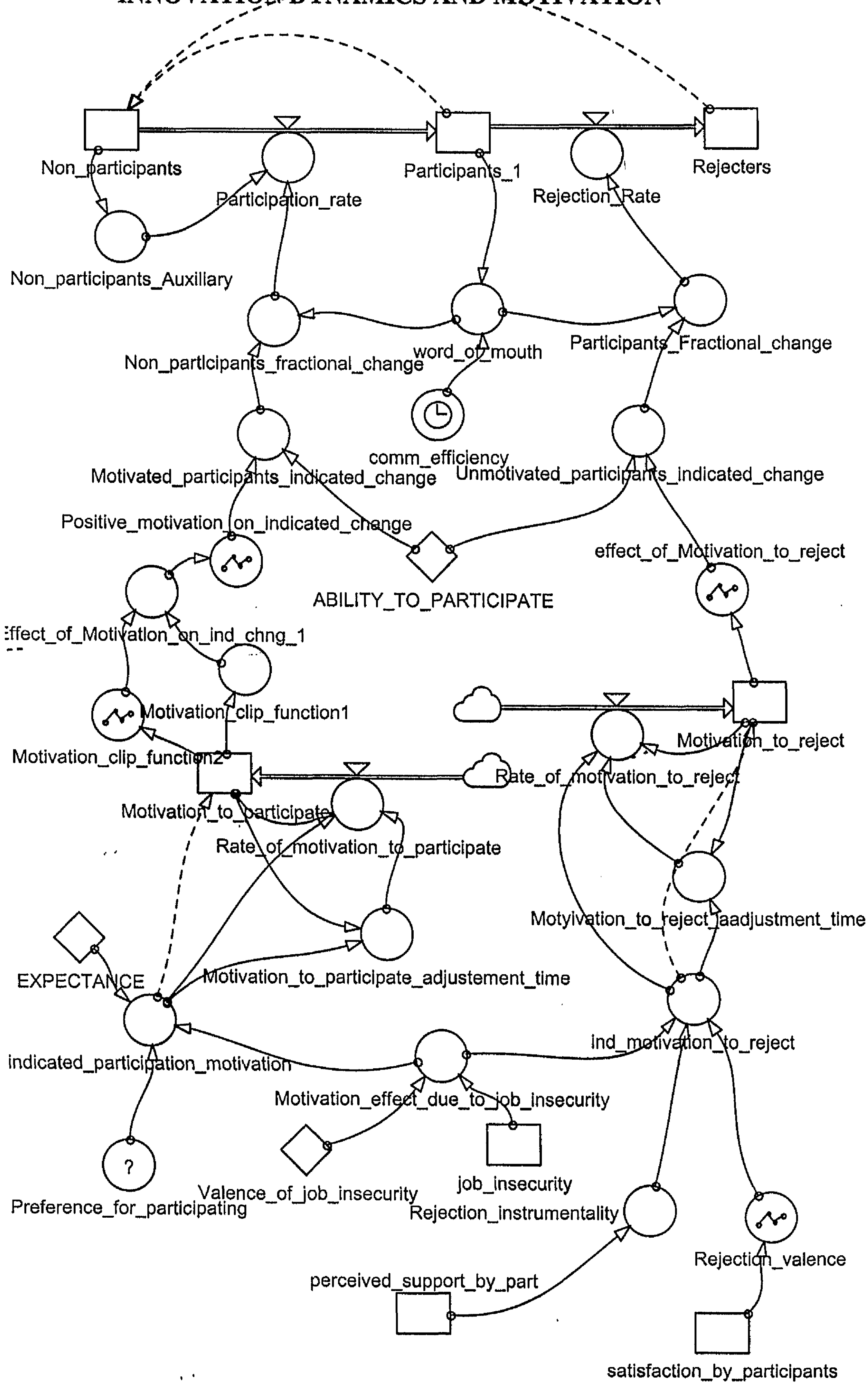
B3. PHILIP CROSBY

Philip Crosby was a quality manager on the first Pershing missile project. He was a Corporate Vice President and Director for Quality of ITT. He became a more prominent quality figure with the publication of his book, *Quality is Free*, in 1979. His main philosophies centre on the concepts of *Do it Right the First Time* and *Zero Defects.* He considers traditional quality control, acceptab;le quality limits and waivers of sub-standard products to represent a failure than assurance of success. He believes that management sets up an environment that enables workers to produce quality products and services; and workers are involved in operational difficulties and draws management's attention to these possible areas for improvement. He views quality improvement as a process rather a programme that has an end.

Crosby's 14 Steps to Quality Improvement

1. Make it clear that management is committed to quality.
2. Form quality improvement teams with senior representatives from each department.
3. Measure processes to determine where current and potential quality problems lie.
4. Evaluate the cost of quality and explain its use as a management tool.
5. Raise the quality awareness and personal concern of all employees.
6. Take actions to correct problems identified through previous steps.
7. Establish progress monitoring for the improvement process.
8. Train supervisors to actively carry out their part of the quality improvement programme.

INNOVATION DYNAMICS AND MOTIVATION



job_insecurity
INIT 0
This represents a long term average of the belief that participation efforts will lead to possible displacement or down-sizing.

Motivation_to_participate
INIT indicated_participation_motivation
+dt*Rate_of_motivation_to_participate
This level variable represents a long term average of the force of motivation to participate.

Motivation_to_reject
INIT ind_motivation_to_reject
+dt*Rate_of_motivation_to_reject
This variable represents the long term average of the motivation to reject the participation efforts.

Non_participants
INIT 1-Participants_1-Rejecters
-dt*Participation_rate
This level variable represents the fraction of employees who "wait-and-see" the other employees who are participating. Their decision to participate is based on their perception of positive experiences of the participating employees.

Participants_1
INIT .2
+dt*Participation_rate
-dt*Rejection_Rate
This level variable represents the fraction of employees who are presently participating in the programme.

perceived_support_by_part
INIT 0
This level variable represents the long term average of perceived support by PARTICIPANTS.

Rejecters
INIT 0
+dt*Rejection_Rate
This level variable represent the fraction of employees who have totally rejected the programme and will be unwilling to join the programme in the future.

satisfaction_by_participants
INIT -1
This level variable represents the long term average of satisfaction derived by participants. It takes a value between -1.0 and 1.0.

Participation_rate
= Non_participants_Auxiliary*Non_participants_fractional_change
Rate at which the non participants become attracted and converted to active participants.

Rate_of_motivation_to_participate
= IF(indicated_participation_motivation<0.000001,(-Motivation_to_participate/.0625), (indicated_participation_motivation-Motivation_to_participate)/ Motivation_to_participate_adjustement_time)
This rate represents the amount of change per month that the current motivation has on the long term average of motivation to participate.

Rate_of_motivation_to_reject
= (ind_motivation_to_reject-Motivation_to_reject)/ Motyivation_to_reject_aadjustment_time
This variable is the rate of change for the motivation to reject.

Rejection_Rate
= Participants_Fractional_change
Rate at which participants are unsatisfied and demotivated as to reject the programme and become rejecters

- comm_efficiency
  = 1-STEP(0,10)
  This represents the efficiency of communication within the organisation. In the company case study, this variable is set to 1.0 to indicate the availability of various communication facilities such as meetings, bulletin boards and newsletters.
- Effect_of_Motivation_on_ind_chng_1
  = Motivation_clip_function1+Motivation_clip_function2
  This is an auxiliary variable that determines the indicated fractional change. It makes certain that the effect of motivation to participate will have a negative effect at lower values and positive at higher values.
- effect_of_Motivation_to_reject
  = GRAPH(Motivation_to_reject,0,0.1,[0,0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8,0.9,1"Min:0;Max:1"])
  This represents a transformation function to indicate the effect of the rejection motivation on the percentage of participants who will reject and abandon the programme
- ind_motivation_to_reject
  = (Rejection_valence*Rejection_instrumentality)+(-Motivation_effect_due_to_job_insecurity/2)
  This variable the combined effects of the negative motivation from the participation efforts and effects due to job insecurity that is experienced in the current time t.
- indicated_participation_motivation
  = (Motivation_effect_due_to_job_insecurity+Preference_for_participating)* EXPECTANCE
  This variable represents the strength of the motivation based on the short term experience derived from satisfaction, perceived support, effect of job security and subjective belief that the employee can participate (or expectance).
- Motivated_participants_indicated_change
  = Positive_motivation_on_indicated_change*ABILITY_TO_PARTICIPATE
  When its value is positive, it represents the fraction of non-participants who want to participate.
- Motivation_clip_function1
  = IF(Motivation_to_participate<0.16,0,Motivation_to_participate)
  This auxiliary variable clips the values of motivation to participate at less than 0.07, and allows its companion variable Clip 35 to negative values when motivation to participate is between 0.0 and 0.07
- Motivation_clip_function2
  = IF(Motivation_to_participate>0,GRAPH(Motivation_to_participate,0,0.02,[-0.1,-0.097,-0.093,-0.085,-0.071,-0.045,-0.023,-0.008,0,0,0"Min:-0.1;Max:0"]),0)
  Another auxiliary variable that indicates a negative effect at lower positive values of the motivation to participate.
- Motivation_effect_due_to_job_insecurity
  = job_insecurity*Valence_of_job_insecurity
  This variable represents the strength of avoidance of participation; or strength of rejection that is due to job insecurity.
- Motivation_to_participate_adjustement_time
  = IF(Motivation_to_participate>indicated_participation_motivation,1/12,12/12)
  This is an assymetric adjustment time variable.
- Motyivation_to_reject_aadjustment_time
  = IF(Motivation_to_reject<ind_motivation_to_reject,6/12,24/12)
  This is an assymetric time function.
- Non_participants_Auxiliary
  = MAX(Non_participants,0)
  This is an auxiliary variable that assures that the input variable to participation rate is 0 or a positive number.
- Non_participants_fractional_change
  = Motivated_participants_indicated_change*word_of_mouth
  This variable indicates the participants that are well satisfied as to encourage non participants to become active participants.

Participants_Fractional_change
= Unmotivated_participants_indicated_change*word_of_mouth
These are the fraction of participants who are not satified and not motiavted

Positive_motivation_on_indicated_change
= GRAPH(Effect_of_Motivation_on_ind_chng_1,0,0.1,
[0,0.01,0.03,0.07,0.15,0.34,0.53,0.75,0.89,0.98,1"Min:0;Max:1"])
This variable assures that the effect of motivation on participation is not negative

Preference_for_participating
= Inst_of_accptd_sugg*Val_of_accptd_sugg
This variable represents the strength of motivation to participate based on satisfaction and perceived organisational support.

Rejection_instrumentality
= 1-perceived_support_by_part
This variable reflects the inadequacy of perceived support for the programme and thus indicates the belief that efforts to participate do not lead to actual participation.

Rejection_valence
= GRAPH(satisfaction_by_participants,-1,0.1,
[0.5,0.498,0.496,0.493,0.485,0.465,0.434,0.384,0.305,0.184,0"Min:0;Max:0.5"])
This variable converts the negative satisfaction to a positive effect of valence to reject. In other words, dissatisfaction results to the preference for rejecting and avoiding participation efforts.

Unmotivated_participants_indicated_change
= effect_of_Motivation_to_reject*ABILITY_TO_PARTICIPATE
This variable indicates the fraction of the current participants who are rejecting the programme due to their dissatisfaction.

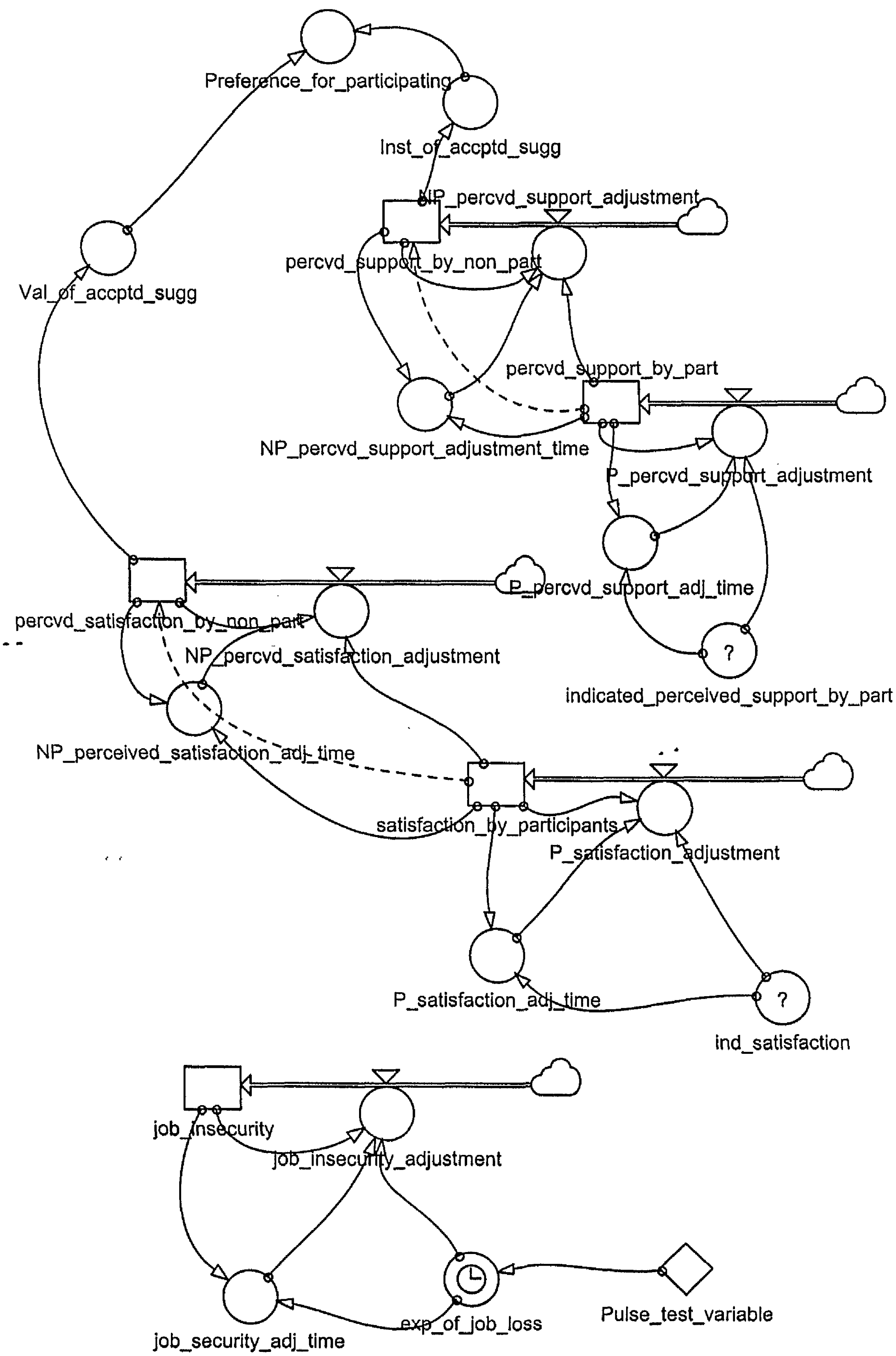
word_of_mouth
= Participants_1*comm_efficiency
This indicates the percentage of participants who are touched and influenced by communication facilities.

ABILITY_TO_PARTICIPATE
= 1
The ability to participate represents the capacity to join the programme through their ability. Since the company provided for initial training then this ability is set to 1.0 .

EXPECTANCE
= 1
This is the subjective belief that the employee can participate in the programme.

Valence_of_job_insecurity
= -1
This is the negative valence or the avoidance of participation due to the the possibility that participation will bring threats to job security

PREFERENCE FOR PARTICIPATION DYNAMICS



job_insecurity
INIT 0
+dt*job_insecurity_adjustment
This represents a long term average of the belief that participation efforts will lead to possible displacement or down-sizing.

percvd_satisfaction_by_non_part
INIT satisfaction_by_participants
+dt*NP_percvd_satisfaction_adjustment
This variable indicates the long term average of satisfaction by NON PARTICIPANTS.

percvd_support_by_non_part
INIT percvd_support_by_part
+dt*NP_percvd_support_adjustment
This variable represents the perception of organisational support by NON PARTICIPANTS as a first order delay of perceived support by PARTICIPANTS and indicates the instrumentality of participation efforts.

percvd_support_by_part
INIT 0
+dt*P_percvd_support_adjustment
This level variable represents the long term average of perceived support by PARTICIPANTS.

satisfaction_by_participants
INIT -1
+dt*P_satisfaction_adjustment
This level variable represents the long term average of satisfaction derived by participants. It takes a value between -1.0 and 1.0.

job_insecurity_adjustment
= (exp_of_job_loss-job_insecurity)/job_security_adj_time
This is the rate at which the long term job insecurity changes

NP_percvd_satisfaction_adjustment
= (satisfaction_by_participants-percvd_satisfaction_by_non_part)/ NP_perceived_satisfaction_adj_time
This is the averaging rate for satisfaction perceived by non participants

NP_percvd_support_adjustment
= (percvd_support_by_part-percvd_support_by_non_part)/ NP_percvd_support_adjustment_time
This is the rate at which perceived support by non particiopants changes

P_percvd_support_adjustment
= (indicated_perceived_support_by_part-percvd_support_by_part)/ P_percvd_support_adj_time
This variable represents the rate of adjustment of perceived support by participants

P_satisfaction_adjustment
= (ind_satisfaction-satisfaction_by_participants)/P_satisfaction_adj_time
This is represents the long term averaging process of satisfaction enjoyed by participants

exp_of_job_loss
= 0+PULSE(Pulse_test_variable, 1, 200)+PULSE(0,1.5,200)
This variable indicates the experience of job loss and contributes to the memory of job insecurity.

ind_satisfaction
= GRAPH(ind_satisfaction_1,-1,0.35,[-1,-0.78,-0.54,-0.26,0.01,0.37,0.7,0.89,0.95,0.97,1"Min:-1;Max:1"])
This variable indicates the experience of satisfaction from the participation efforts and takes a value between -1.0 and 1.0, inclusive.

indicated_perceived_support_by_part
= (effect_of_facilitation_on_perceived_support+effect_of_training_time_ratio)+ effect_of_middle_management_support_on_perceived_support+ effect_of_perceived_budget_availability_on_perceived_support+ effect_of_top_management_visibility_on_perceived_support
This variable indicates the short term or current perception of support. by participants.

Inst_of_accptd_sugg
= percvd_support_by_non_part
This variable represents the subjective belief that efforts to participate will actually lead to participation.

job_security_adj_time
= IF(exp_of_job_loss>job_insecurity,3/12,12/12)
This is an assymetric time adjustment variable. It assumes that higher current perceptions of job insecurity have stronger influences on the long term perceptions of job insecurity

NP_perceived_satisfaction_adj_time
= IF(percvd_satisfaction_by_non_part>satisfaction_by_participants,1/12,6/12)
This is aan assymetric adjustment time of the perceived satisfaction by non participants. It assumes that observed lower satisfaction levels have stronger influence on the long term perceptions of satisfaction

NP_percvd_support_adjustment_time
= IF(percvd_support_by_non_part>percvd_support_by_part,1/12,6/12)
This variable represents the assymetric averaging time for perceived support by non participants. It assumes that unfavourable perceptions more strongly affects the long term perceptions than favourable current percentlons

P_percvd_support_adj_time
= IF(percvd_support_by_part>indicated_perceived_support_by_part,1/12,3/12)
This is an assymetric averaging time of perceived support by participants. This assumes that unfavourable current perceptions have stronger influence on the long term average than favourable perceptions

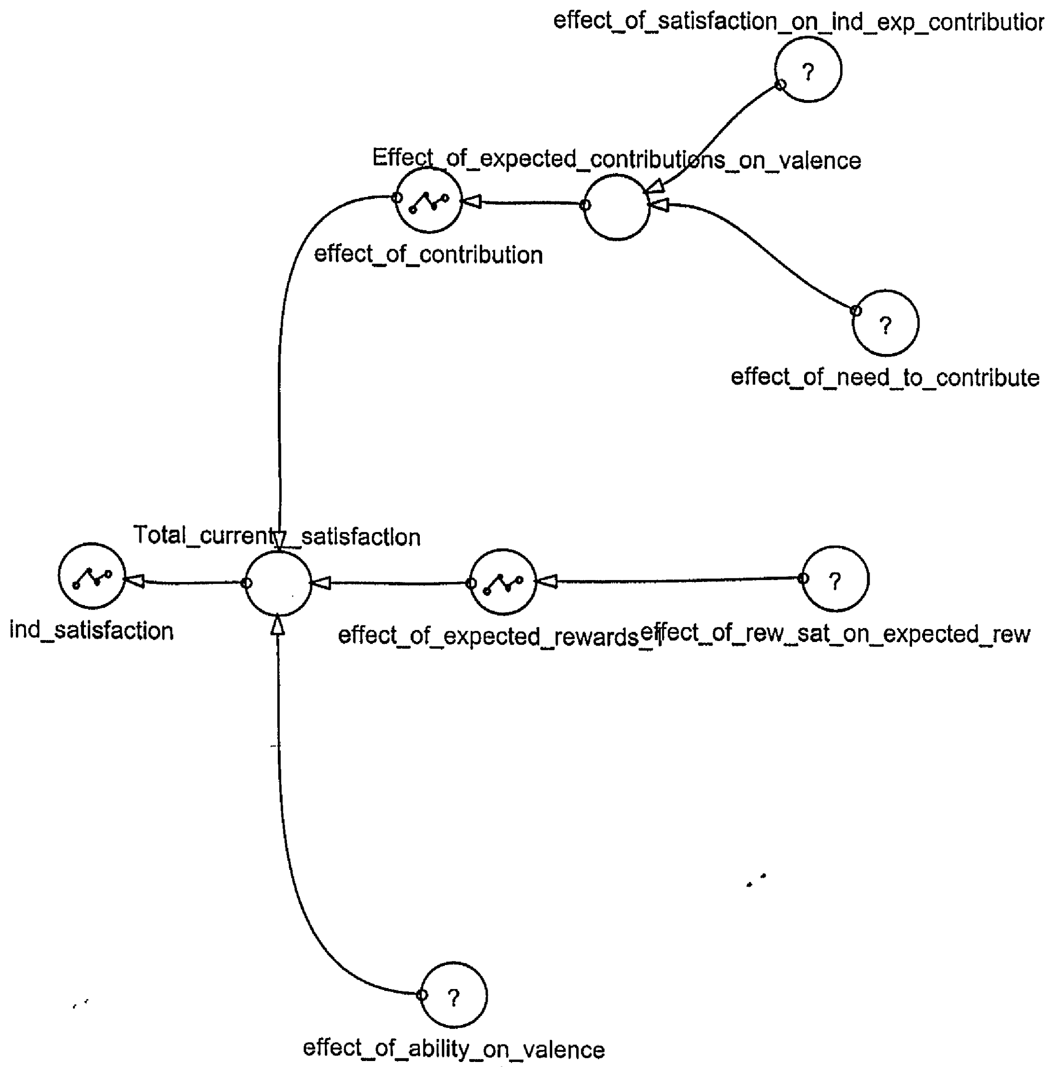
P_satisfaction_adj_time
= IF(satisfaction_by_participants>ind_satisfaction,1/12,12/12)
This is an assymetric averaging time of satisfaction enjoyed by participants. It assumes that lower levels of satisfaction have stronger influences than higher levels on the long term average of satisfaction

Preference_for_participating
= Inst_of_accptd_sugg*Val_of_accptd_sugg
This variable represents the strength of motivation to participate based on satisfaction and perceived organisational support.

Val_of_accptd_sugg
= MAX(percvd_satisfaction_by_non_part,0)
This auxiliary variable transforms and assures that valence for participation is non-negative. This constrains the motivation to take values between 0.0 and 1.0.

Pulse_test_variable
= 0
This is a test variable that inputs a pulse into the perceptions of job insecurity

VALENCE DYNAMICS



effect_of_ability_on_valence

= MIN(GRAPHLINAS(Ability,0,0.25,[-0.33,-0.31,-0.261,-0.142,0.082,0.324,0.463,0.518,0.571,0.588,0.6"Min:-0.33;Max:0.6"]),1.0)

This is a non-linear transformation function representing the influence of ability on the total current satisfaction.

effect_of_contribution

= GRAPH(Effect_of_expected_contributions_on_valence,0,0.15,[-0.33,-0.324,-0.281,-0.183,0,0.27,0.45,0.55,0.62,0.67,0.7"Min:-0.33;Max:0.7"])

This is a non linear transformation function that indicates the expected satisfaction from contributions as it impact on total satisfaction.

Effect_of_expected_contributions_on_valence

= effect_of_need_to_contribute*effect_of_satisfaction_on_ind_exp_contributions

This variable converts the product of effects of the need to contribute and satisfaction fro contributing into the valence for participating.

effect_of_expected_rewards_1

= GRAPH(effect_of_rew_sat_on_expected_rew,0,0.1,[-0.33,-0.324,-0.313,-0.289,-0.2,0,0.42,0.71,0.9,0.98,1"Min:-0.33;Max:1"])

This is a non linear transformation function that indicates the satisfaction from rewards as it impact on total current ssatisfaction.

effect_of_need_to_contribute

= GRAPH(contributions_ratio,0,0.1,[2,1.51,1.28,1.17,1.1,1.05,1.03,1.02,1.01,1,1"Min:1;Max:2"])

This variable indicates the inverse effect of the need to contribute on expected contributions. Together with the effect of satisfaction from the contribution motive results in the factor that determines the strength of its effect on preference

effect_of_rew_sat_on_expected_rew

= GRAPH(rewards_satisfaction_by_participants,0,0.1,[0.001,0.23,0.42,0.58,0.71,0.8,0.86,0.91,0.96,0.99,1"Min:0;Max:1"])

This variable is a non linear function based on satisfaction from rewards that contributes to the total valence for participation.

effect_of_satisfaction_on_ind_exp_contributions

= GRAPH(satisfaction_with_contributions,0,0.1,[0,0.02,0.05,0.1,0.18,0.36,0.59,1,1.25,1.39,1.5"Min:0;Max:1.5"])

This variable indicates the strength of the effect of satisfaction with the contribution motive on the preference, or valence, for participating in the TQM programme.

ind_satisfaction

= GRAPH(Total_current__satisfaction,-1,0.35,[-1,-0.78,-0.54,-0.26,0.01,0.37,0.7,0.89,0.95,0.97,1"Min:-1;Max:1"])

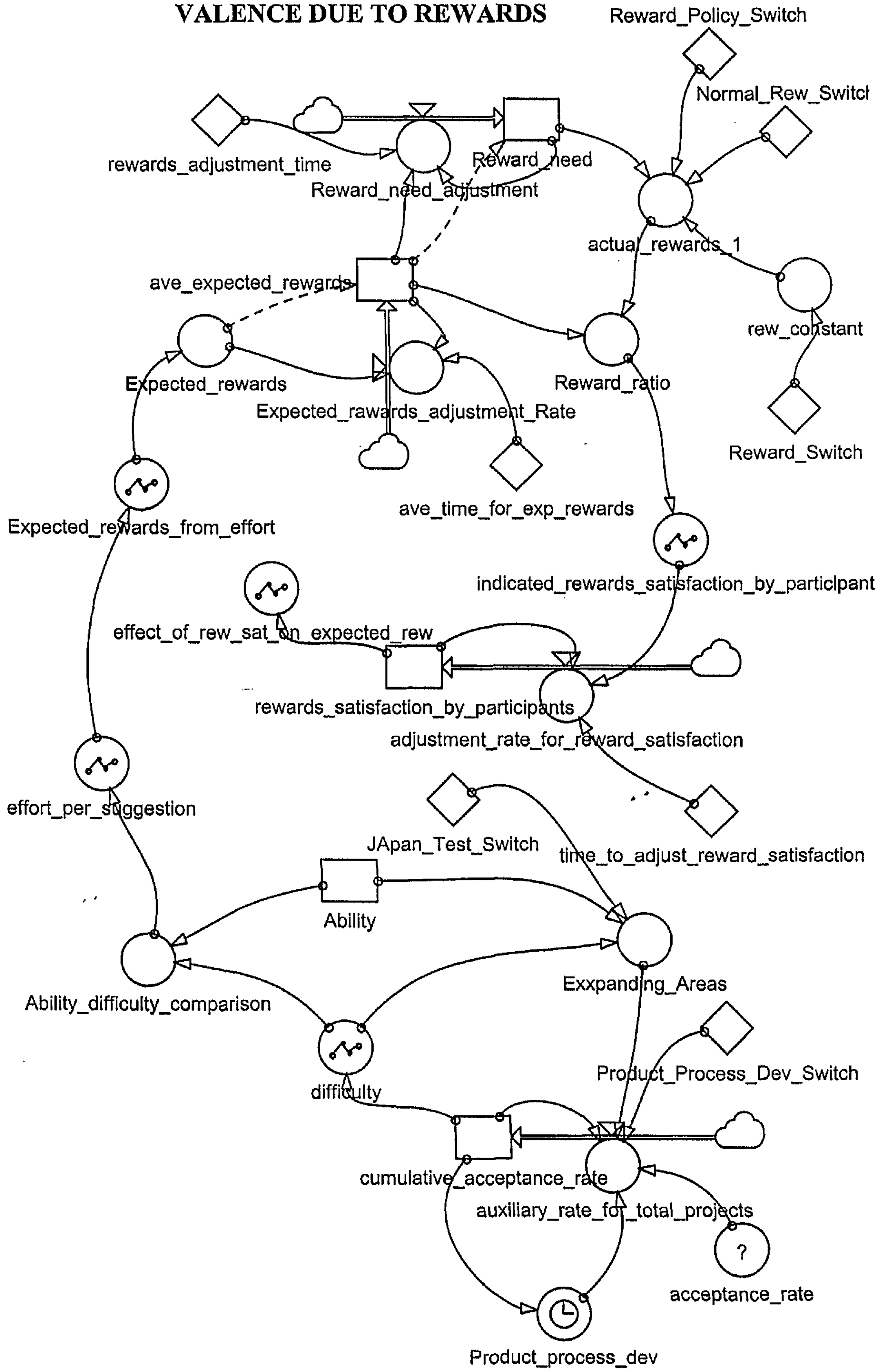
This variable indicates the experience of satisfaction from the participation efforts and takes a value between -1.0 and 1.0, inclusive.

Total_current__satisfaction

= effect_of_ability_on_valence+effect_of_contribution+effect_of_expected_rewards_1

This totals the current satisfaction effects of ability, contribution and rewards

VALENCE DUE TO REWARDS



Ability
INIT .01
This variable represents the available units of knowledge to formulate new suggestions.

ave_expected_rewards
INIT Expected_rewards
+dt*Expected_rawards_adjustment_Rate
This is the long term average expected rewards

cumulative_acceptance_rate
INIT 0
+dt*auxiliary_rate_for_total_projects
Year to date totai of accepted proects

Reward_need
INIT ave_expected_rewards
+dt*Reward_need_adjustment
This estimates the reward that is expected from the current efforts exerted.

rewards_satisfaction_by_participants
INIT -1
+dt*adjustment_rate_for_reward_satisfaction
This is the long term average of satisfaction due to rewards

adjustment_rate_for_reward_satisfaction
= (indicated_rewards_satisfaction_by_participants-rewards_satisfaction_by_participants)/ time_to_adjust_reward_satisfaction
This is the rate at which satisfaction due to rewards is averaged

auxiliary_rate_for_total_projects
= (IF(Exxpanding_Areas=1,-cumulative_acceptance_rate/0.0625,acceptance_rate))+ (Product_process_dev*Product_Process_Dev_Switch)
This represents several policies that negates the cumulative acceptance rate to indicate a shift in difficulty curve

Expected_rawards_adjustment_Rate
= (Expected_rewards-ave_expected_rewards)/ave_time_for_exp_rewards
This is the rate at which expected rewards are averaged

Reward_need_adjustment
= (ave_expected_rewards-Reward_need)/rewards_adjustment_time
This is the rate at which the reward need is adjusted

Ability_difficulty_comparison
= MAX(difficulty-Ability,0)
This difference of Difficulty and Ability variables represent the adequacy (or inadequacy) of the present knowledge of employees to make new suggestions. Such adequacy determines the amount of effort that is expended to make new suggestions.

acceptance_rate
= percent_acceptance*for_study/time_to_study
This rate variable represents the average number of suggestions that are accepted.

actual_rewards_1
= (rew_constant*Normal_Rew_Switch)+(Reward_need*Reward_Policy_Switch*(1-Normal_Rew_Switch))
This lrepresents the actual rewards provided by the organisation. It includes a switch function to switch on the generous reward policy

difficulty
= GRAPHLINAS(cumulative_acceptance_rate,0,5, [0.7,0.72,0.76,0.84,0.95,1.08,1.28,1.5,1.75,2,2.32"Min:0;Max:3"])
This variable represents the units of knowledge required to formulate new suggestions.

effect_of_rew_sat_on_expected_rew
= GRAPH(rewards_satisfaction_by_participants,0,0.1, [0.001,0.23,0.42,0.58,0.71,0.8,0.86,0.91,0.96,0.99,1"Min:0;Max:1"])
This variable is a non linear function based on satisfaction from rewards that contributes to the total valence for participation.

effort_per_suggestion
= GRAPHLINAS(Ability_difficulty_comparison,0,0.1,
[0,0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8,0.9,1"Min:0;Max:1"])
This is a transformation function that directly relates the knowledge adequacy to the expected effort to make new suggestions.

Expected_rewards
= Expected_rewards_from_effort*1
This is the adjusted rewards as affected by effort exerted to generate new ideas for improvement (where 1.0 is the expected reward)

Expected_rewards_from_effort
= GRAPHLINAS(effort_per_suggestion,0,0.5,
[1,1.125,1.25,1.375,1.5,1.625,1.75,1.875,2,2.125,2.25"Min:0;Max:2.5"])
This variable represents the influence of the required effort to make new suggestions on the average expected rewards.

Exxpanding_Areas
= IF(Ability>difficulty,0,1)*JApan_Test_Switch
This represents the Japanese policy to expand the area of concern of quality circles when the difficulty level is higher the current level of ability

indicated_rewards_satisfaction_by_participants
= GRAPH(Reward_ratio,0,0.1,[0,0.01,0.02,0.05,0.14,0.3,0.51,0.75,0.91,0.97,1"Min:0;Max:1"])
This is a transformation function that indicates the effect of the reward ratio on the satisfaction due to rewards.

Product_process_dev
= PULSE(-cumulative_acceptance_rate,15,5)
This represents the effect on product and process development on cumulative acceptance rate. What this function does is to represent the development of a new product or process with a pulse every five years. This shifts the difficulty curve every five years

rew_constant
= 10*Reward_Switch
The amount of reward that is provided for. The switch variable can also make this unavailable

Reward_ratio
= actual_rewards_1/ave_expected_rewards
This variable compares the available actual rewards with the expected rewards.

ave_time_for_exp_rewards
= 8/12
This is teh averaging time for expected rewards

JApan_Test_Switch
= 0
This is a switch variable that toggles between 0.0 (to indicate that the Japanese policy of expanding areas is off) and 1.0 (to indicate that the policy is adopted and implemented).

Normal_Rew_Switch
= 1
This is a variable that toggles between 0.0 and 1.0 to idnicate availability of rewards

Product_Process_Dev_Switch
= 0
This is policy switch variable that toggles between 0.0 (to indicate the product development policy is switched off) and 1.0 (to indicate activation of this policy).

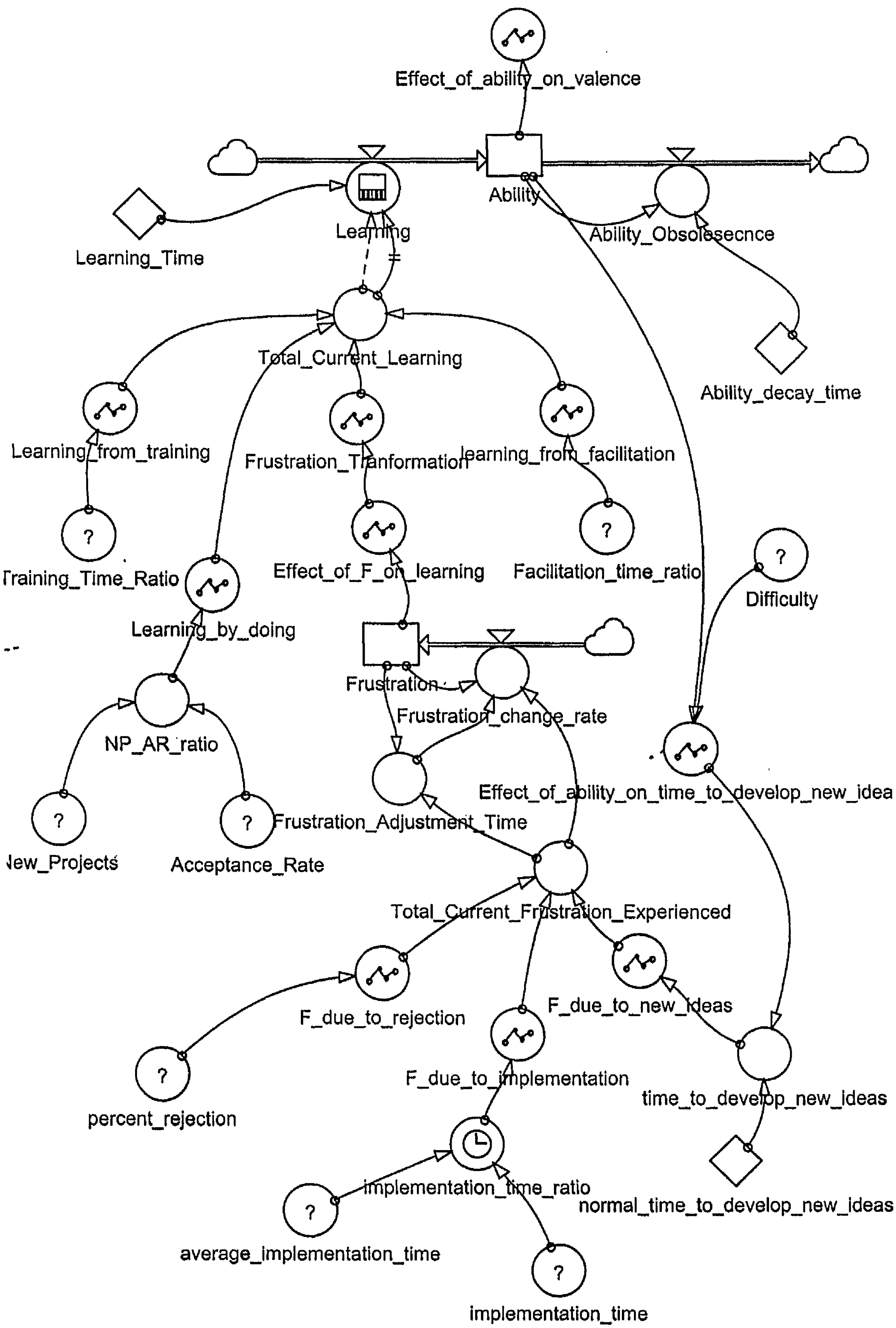
Reward_Policy_Switch
= 0
This is a switch variable that indicates the availability of the reward policy

Reward_Switch
= 0
This variable turns on or off the reward constant

rewards_adjustment_time
= 1
This is the time needed to adjust reward need

time_to_adjust_reward_satisfaction
= 12/12
This is the adjsutment time for satisfaction for rewards

VALENCE DUE TO LEARNING AND ABILITY



Ability
INIT .01
-dt*Ability_Obsolesecnce
+dt*Learning
This variable represents the available units of knowledge to formulate new suggestions.

Frustration
INIT 0
+dt*Frustration_change_rate
This variable represents the level of accumulated frustration due to difficulty of generating new ideas or solutions to problems; delayed implementation of projects and due to rejection of proposed projects.

Ability_Obsolesecnce
= Ability/Ability_decay_time
This variable represents the amount of knowledge that becomes obsolete and unusable with the passage of time.

Frustration_change_rate
= (Total_Current_Frustration_Experienced-Frustration)/Frustration_Adjustment_Time
This is the rate at which the level of frustration increases or decreases due to the currecnt experiences of frustration..

Learning
= DELAYINF(Total_Current_Learning, 2*Learning_Time,2,Total_Current_Learning)
This variable represents the total amount of knowledge that is acquired through training and facilitation and moderated by the frustration levels.

Acceptance_Rate
= percent_acceptance*for_study/time_to_study
This rate variable represents the average number of suggestions that are accepted.

average_implementation_time
= ((5*Implementation_time_switch)+(1000*(1-Implementation_time_switch)))/12
This is the long time average of implementation time. However, it includes the implementation switch to experiment with two different values of implementation time : 1000 months for a traditionally non-implementing organisation and 5 months, which is for the improved realistic case that adopted an aspect of TQM

Difficulty
= GRAPHLINAS(cumulative_acceptance_rate,0,5,
[0.7,0.72,0.76,0.84,0.95,1.08,1.28,1.5,1.75,2,2.32"Min:0;Max:3"])
This variable represents the units of knowledge required to formulate new suggestions.

Effect_of_ability_on_time_to_develop_new_ideas
= GRAPHLINAS(Difficulty-Ability,-1,0.2,
[0.79,0.88,1.07,1.43,1.8,2.21,2.61,2.96,3.27,3.51,3.73"Min:0;Max:5"])
This table function suggests that as difficulty dominates ability, the time to develop new ideas increases.

Effect_of_ability_on_valence
= MIN(GRAPHLINAS(Ability,0,0.25,[-0.33,-0.31,-0.261,-0.142,0.082,0.324,0.463,0.518,0.571,0.588,0.6"Min:-0.33;Max:0.6"]),1.0)
This variable represents the influence of the level of ability on the present experience of satisfaction (indicated satisfaction)

Effect_of_F_on_learning
= GRAPHLINAS(Frustration,0,0.5,[1,1,0.99,0.95,0.89,0.79,0.71,0.64,0.59,0.57,0.55"Min:0;Max:1"])
This variable represents the effect of frustration on learning. As frustration increases, this function diminishes the effective knowledge derived from training and facilitation. It must be noted that this is a decreasing function with its minimum at zero.

F_due_to_implementation
= GRAPHLINAS(implementation_time_ratio,0,0.2,
[0,0,0.001,0.001,0,0,0.015,0.038,0.08,0.116,0.127"Min:0;Max:0.25"])
This variable represents the frustration that is developed from delayed implementation of accepted suggestions.

F_due_to_new_ideas

= GRAPHLINAS(time_to_develop_new_ideas,0,0.2,
[0,0.007,0.011,0.017,0.022,0.029,0.039,0.053,0.071,0.086,0.101"Min:0;Max:0.3"])

This variable represents the frustration that develops when it takes longer to develop new ideas.

F_due_to_rejection

= GRAPH(percent_rejection,0,0.1,
[0,0.068,0.112,0.146,0.172,0.191,0.208,0.224,0.237,0.247,0.25"Min:0;Max:0.25"])

This variable represents the frustration developed from the rejection of suggestions.

Facilitation_time_ratio

= actual_facilitation_time/Facilitation_needs

This variable compares the actual time spent for facilitation with the requirements of the task.

Frustration_Adjustment_Time

= IF(Frustration<Total_Current_Frustration_Experienced,3/12,6/12)

This is an assymetric time function for the accummulated level of frustration to adjust to current experience. When Current Frustraton is higher than Frustration, then the adjustment is shorter, that is, the current experience changes the long term frustration faster. On the otehr hand, When Current Frustration is lower than the longe term Frustration, then it takes longer to accommodate this present experience.

Frustration_Tranformation

= GRAPH(Effect_of_F_on_learning,-1,0.2,[0,0,0,0,0,0,0.2,0.4,0.6,0.8,1"Min:0;Max:1"])

This table function assures that only positive values for frustration have effects on learning. The preceding function has a zero for its minimum.

implementation_time

= (average_implementation_time*effect_of_budget_ratio_on_impl*
effect_of_MM_time_on_impl*effect_of_TM_visibility_of_impl)

This variable represents the actual implementation time as the average implementation time is moderated by the effects of available budget, middle management time allocated for implementation and by the contribution of top management visibility.

implementation_time_ratio

= 0+STEP(implementation_time/average_implementation_time,0)

This compares the actual implementation time to the normal or average implementation time.

Learning_by_doing

= GRAPHLINAS(NP_AR_ratio,0,0.1,
[0,0.02,0.04,0.08,0.13,0.19,0.26,0.34,0.43,0.49,0.52"Min:0;Max:1"])

This indicates the learning gained from the actual experience of proposing new projects. It is dependent on the quality of the projects submitted. Thus there is more learning as the NO AR ratio increases.

learning_from_facilitation

= GRAPHLINAS(Facilitation_time_ratio,0,0.1,
[0,0.009,0.046,0.083,0.16,0.241,0.338,0.425,0.471,0.489,0.5"Min:0;Max:0.5"])

This variable transforms the delayed facilitation ratio into learning.

Learning_from_training

= GRAPHLINAS(Training_Time_Ratio,0,0.1,
[0,0.004,0.013,0.031,0.077,0.17,0.307,0.408,0.467,0.493,0.5"Min:0;Max:0.5"])

This variable transforms the delayed training ratio variable into learning.

New_Projects

= No_of_Circles*indicated_projects_per_circle

This variable is exactly the same as the new suggestions rate.

NP_AR_ratio

= Acceptance_Rate/MAX(New_Projects,.0001)

This ratio provides for a measure of the quality of new projects that are submitted. The higher the ratio, the better is the quality of the new projects.

percent_rejection

= (STEP(.2,2)*Project_Rejection_Switch)+0

This variable is an exogenous reject rate.

time_to_develop_new_ideas
= Effect_of_ability_on_time_to_develop_new_ideas*normal_time_to_develop_new_ideas
This is the actual adjusted time to develop new ideas with influence from adequacy of ability to overcome difficulty.

Total_Current_Frustration_Experienced
= F_due_to_rejection+F_due_to_implementation+F_due_to_new_ideas
This is the total current frustration derived from delayed implementation, to rejection and difficulty in generating new ideas for discussion and solution.

Total_Current_Learning
= Frustration_Tranformation*(learning_from_facilitation+Learning_from_training+Learning_by_doing)
This the total current learning gained in the present as affected by Frustration

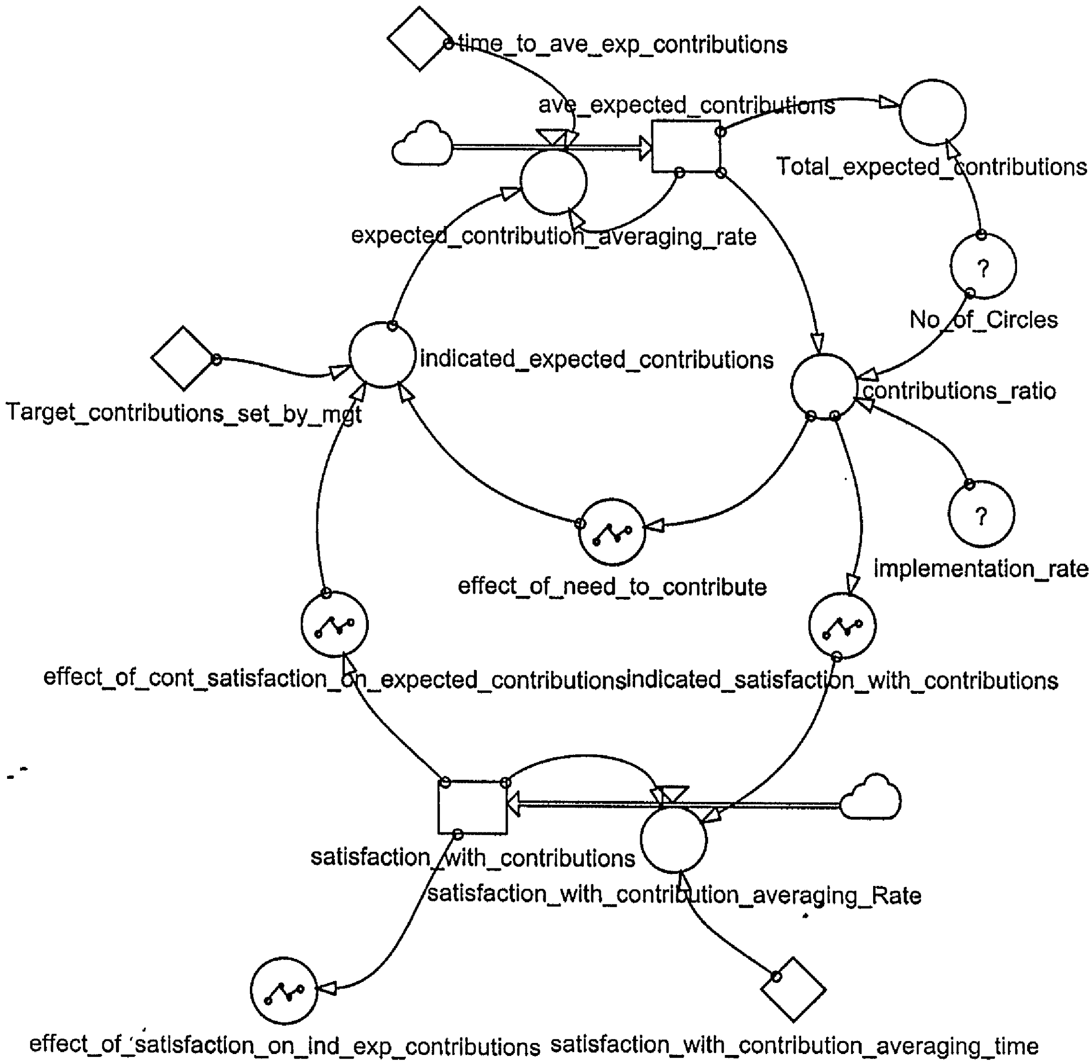
Training_Time_Ratio
= facilitator_training_time/Participant_training_needs
This variable compares the actual time allocated to training with the time required by participants/employees.

Ability_decay_time
= 120/12
This variable is the average time (in months) at which ability decays and become obsolete.

Learning_Time
= 6/12
This is the adjustment time in months for Ability to increase

normal_time_to_develop_new_ideas
= (2/12)*1.5
This the normal time for ideas to be developed either as a new improvement area or a solution to a problem.

VALENCE DUE TO CONTRIBUTIONS



ave_expected_contributions
INIT 1
+dt*expected_contribution_averaging_rate
This represents the long term average of expected contributions

satisfaction_with_contributions
INIT -1
+dt*satisfaction_with_contribution_averaging_Rate
This is a long term average of satisfaction with contributing to the organisation

expected_contribution_averaging_rate
= (indicated_expected_contributions-ave_expected_contributions)/
time_to_ave_exp_contributions
This indicates the rate of adjustment for the long term expected contributions

satisfaction_with_contribution_averaging_Rate
= (indicated_satisfaction_with_contributions-satisfaction_with_contributions)/
satisfaction_with_contribution_averaging_time

contributions_ratio
= implementation_rate/IF(ave_expected_contributions*No_of_Circles>
0,ave_expected_contributions*No_of_Circles,.001)
This variable compares the actual suggestions that have been implemented with the total expected contributions.

effect_of_cont_satisfaction_on_expected_contributions
= GRAPH(satisfaction_with_contributions,0,0.1,
[0,0.05,0.11,0.18,0.31,0.51,0.8,1.19,1.39,1.46,1.5"Min:0;Max:1.5"])
This is the infuence of satisfaction due to contribution on expected contributions.

effect_of_need_to_contribute
= GRAPH(contributions_ratio,0,0.1,[2,1.51,1.28,1.17,1.1,1.05,1.03,1.02,1.01,1,1"Min:1;
Max:2"])
This variable indicates the inverse effect of the need to contribute on expected contributions. Together with the effect of satisfaction from the contribution motive results in the factor that determines the strength of its effect on preference

effect_of_satisfaction_on_ind_exp_contributions
= GRAPH(satisfaction_with_contributions,0,0.1,
[0,0.02,0.05,0.1,0.18,0.36,0.59,1,1.25,1.39,1.5"Min:0;Max:1.5"])
This variable indicates the strength of the effect of satisfaction with the contribution motive on the preference, or valence, for participating in the TQM programme.

implementation_rate
= for_implementation/implementation_time
This rate variable represents the average number of suggestions taht have been implemented.

indicated_expected_contributions
= Target_contributions_set_by_mgt*
effect_of_cont_satisfaction_on_expected_contributions*
effect_of_need_to_contribute
This is the adjusted target contributions as it accommodates the impact of satisfaction with contributions and the need for more contributions

indicated_satisfaction_with_contributions
= GRAPH(contributions_ratio,0,0.1,[0,0.03,0.05,0.1,0.16,0.27,0.51,0.76,0.92,0.97,1"Min:
0;Max:1"])
This is the current experience of satisfaction with contributing to the company

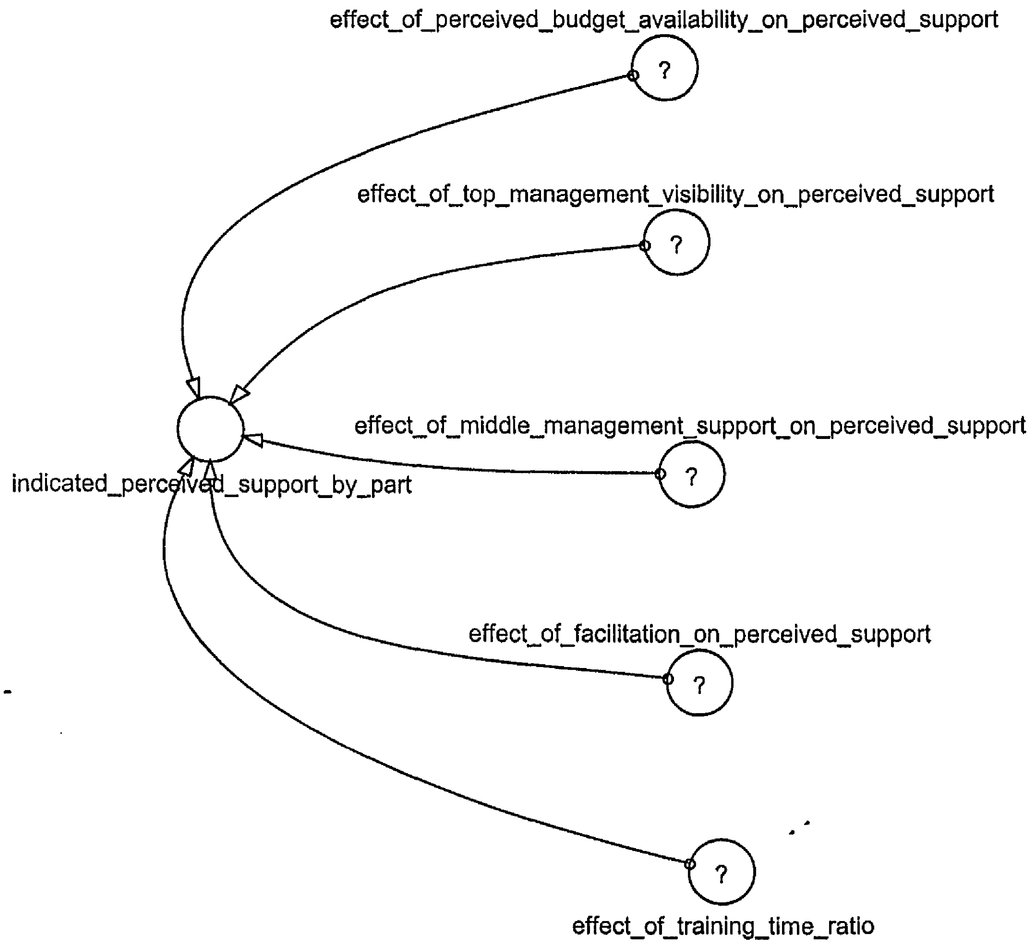
No_of_Circles
= Participants_1*population/Constant_49
This variable is the total number of quality circles in the company.

Total_expected_contributions
= ave_expected_contributions*No_of_Circles
This is the total number of contributions expected for the entire organisation.

satisfaction_with_contribution_averaging_time
= 24/12
Time to average satisfaction due to contributions

- Target_contributions_set_by_mgt
  - = 1
  - The contribution target set by the organisation
- time_to_ave_exp_contributions
  - = 6/12
  - This expected contributions averaging time in months

PERCEIVED SUPPORT DYNAMICS



effect_of_facilitation_on_perceived_support
= GRAPH(facilitation_time_ratio,0,0.1,
[0,0.026,0.046,0.062,0.074,0.082,0.087,0.093,0.097,0.099,0.1"Min:0;Max:0.1"])
This represents the effect of the availability of TQM staff facilitation for quality circle activities to total perceived organisational support

effect_of_middle_management_support_on_perceived_support
= GRAPH(middle_management_support_ratio,0,0.1,
[0,0.005,0.013,0.032,0.079,0.159,0.218,0.259,0.282,0.295,0.3"Min:0;Max:0.3"])
This variable represents the effect of perceived middle management support to total perceived organisational support

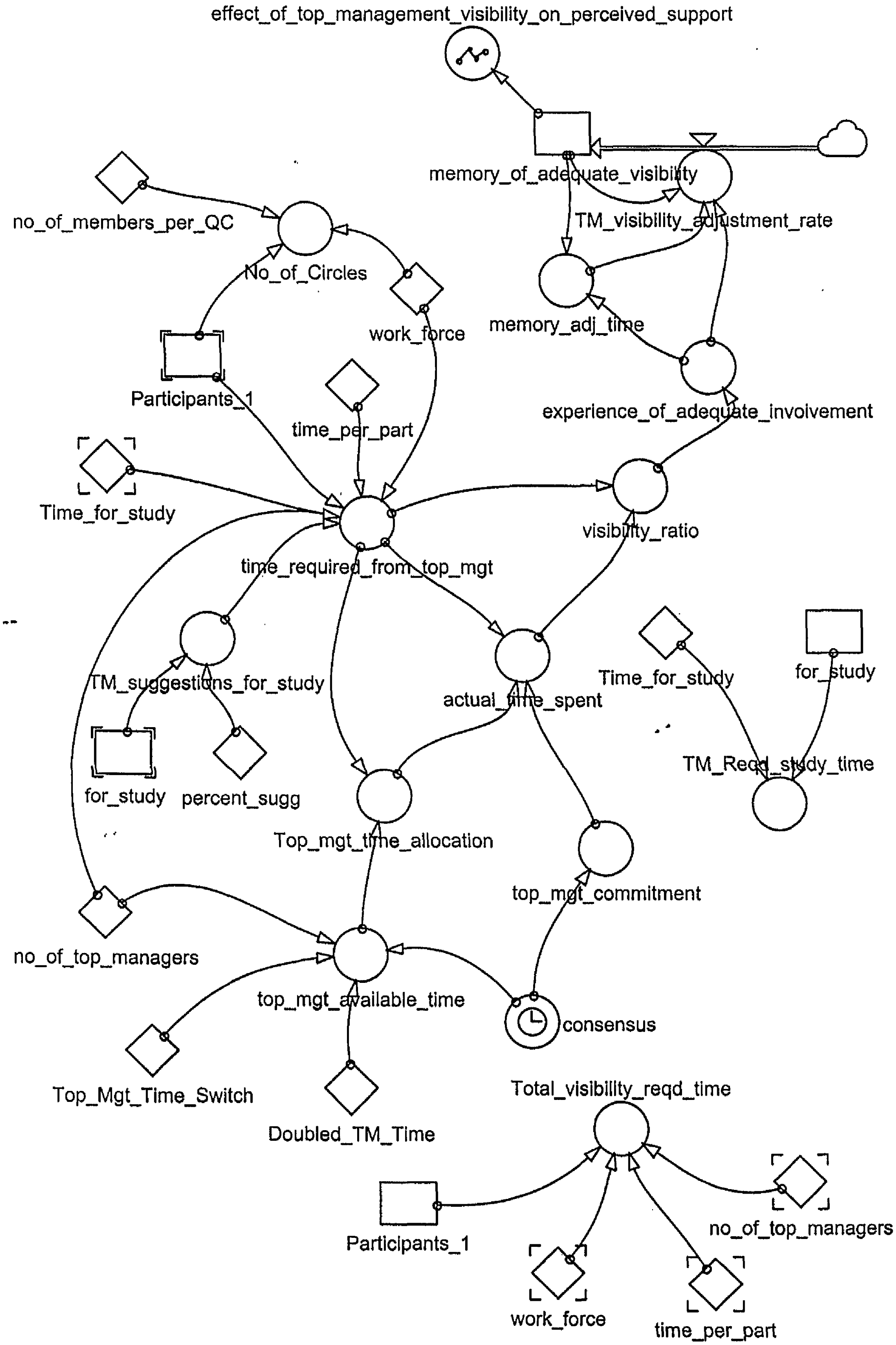
effect_of_perceived_budget_availability_on_perceived_support
= GRAPH(perceived_budget_ratio,0,0.1,
[0,0.0007,0.0018,0.006,0.021,0.061,0.119,0.168,0.19,0.196,0.2"Min:0;Max:0.2"])
This represents the influence of the perception of budget availability to total perceived organisational support

effect_of_top_management_visibility_on_perceived_support
= GRAPH(memory_of_adequate_visibility,0,0.1,
[0,0.002,0.007,0.02,0.036,0.089,0.211,0.261,0.286,0.295,0.3"Min:0;Max:0.3"])
This represents the influence of perception of top management visibility to total perceived organisational support

effect_of_training_time_ratio
= GRAPH(training_time_ratio,0,0.1,
[0,0.02,0.039,0.057,0.068,0.079,0.086,0.091,0.096,0.099,0.1"Min:0;Max:0.1"])
This variable indicates the contribution of training availability on total perceived organisational support.

indicated_perceived_support_by_part
= (effect_of_facilitation_on_perceived_support+effect_of_training_time_ratio)+
effect_of_middle_management_support_on_perceived_support+
effect_of_perceived_budget_availability_on_perceived_support+
effect_of_top_management_visibility_on_perceived_support
This variable indicates the short term or current perception of support by participants.

PERCEIVED FROM TOP MANAGEMENT VISIBILITY AND INVOLVEMENT



for_study
INIT 0
This level variable represents the number of suggestions that are awaiting decision of acceptance or rejection.

memory_of_adequate_visibility
INIT 0
+dt*TM_visibility_adjustment_rate
This variable represents the long term perceptions that management is visible and supportive.

Participants_1
INIT .2
This level variable represents the fraction of employees who are presently participating in the programme.

TM_visibility_adjustment_rate
= (experience_of_adequate_involvement-memory_of_adequate_visibility)/memory_adj_time
This is the rate at which the memory of adequaate visibility changes

actual_time_spent
= IF(top_mgt_commitment>0.7,time_required_from_top_mgt,Top_mgt_time_allocation)
This variable takes two values that is dependent on top management commitment: when commitment is high enough (>0.70), this variable takes the value of required time. Otherwise, it takes the value that top management was willing to spend.

consensus
= 1-STEP(.10,0)
This variable refects the possibility that members of top management agree or support the actions in accordance with their TQM involvement. Lower values reflect decreasing agreement or increasing politics.

effect_of_top_management_visibility_on_perceived_support
= GRAPH(memory_of_adequate_visibility,0,0.1,[0,0.002,0.007,0.02,0.036,0.089,0.211,0.261,0.286,0.295,0.3"Min:0;Max:0.3"])
This represents the influence of perception of top management visibility to total perceived organisational support

experience_of_adequate_involvement
= visibility_ratio
This variable indicate the inadequacy of top management visibility in the programme as reflected in daily observations.

memory_adj_time
= IF(memory_of_adequate_visibility>experience_of_adequate_involvement,12/12,120/12)
This is an assymetric adjustment time for the memory of top management visibility and support. The formulation assumes that bad experiences with top management are easier to remember than favourable experiences.

No_of_Circles
= Participants_1*work_force/no_of_members_per_QC
This variable is the total number of quality circles in the company.

time_required_from_top_mgt
= MAX(time_per_part*Participants_1*work_force*no_of_top_managers,time_per_part)+(Time_for_study*TM_suggestions_for_study)
This variable is the estimated total required time by all participants.

TM_Reqd_study_time
= for_study*Time_for_study
This is the actual time required by all projects to make the decision as to accept or reject the project

TM_suggestions_for_study
= for_study*percent_sugg
This variable represents the number of suggestions that middle management cannot decide on and thus need top management's decision and approval.

top_mgt_available_time

= Top_Mgt_Time_Switch*24*Doubled_TM_Time*no_of_top_managers*consensus

This variable represents the total number of hours that top management is willing to spend with the employees and for the participation programme.

top_mgt_commitment

= .5*consensus

This is the average level of commitment of all the members of top management

Top_mgt_time_allocation

= MIN(top_mgt_available_time,time_required_from_top_mgt)

This variable determines the amount of time that top management actually allocates to the programme as it compares its available time with required time.

Total_visibility_reqd_time

= Participants_1*work_force*no_of_top_managers*time_per_part

This is the total actual time needed by the programme from top managers

visibility_ratio

= actual_time_spent/time_required_from_top_mgt

This variable compares the actual time spent by top management indicating their visibility and involvement with the programme to the.requirements of the participants.

Doubled_TM_Time

= 1

This is a switch variable to switch a new policy that allocates more time to TQM activities

no_of_members_per_QC

= 10

no_of_top_managers

= 6

This is the number of top managers

percent_sugg

= .3

This variable represents the percentage of suggestions that are passed to top management for study. It may be noted that this percentage can reflect the autonomy given to middle managers to approve suggestions. The lower the value, the higher the autonomy.

Time_for_study

= 1

This is the time to study and evaluate proposed projects

time_per_part

= .004*12

This represent the estimated time required by participants from top management to show its commitment to the programme. It is computed from the assumed need for top manager to spend 1.0 hour per week to go around the plant that has 100 employees.

Top_Mgt_Time_Switch

= 0

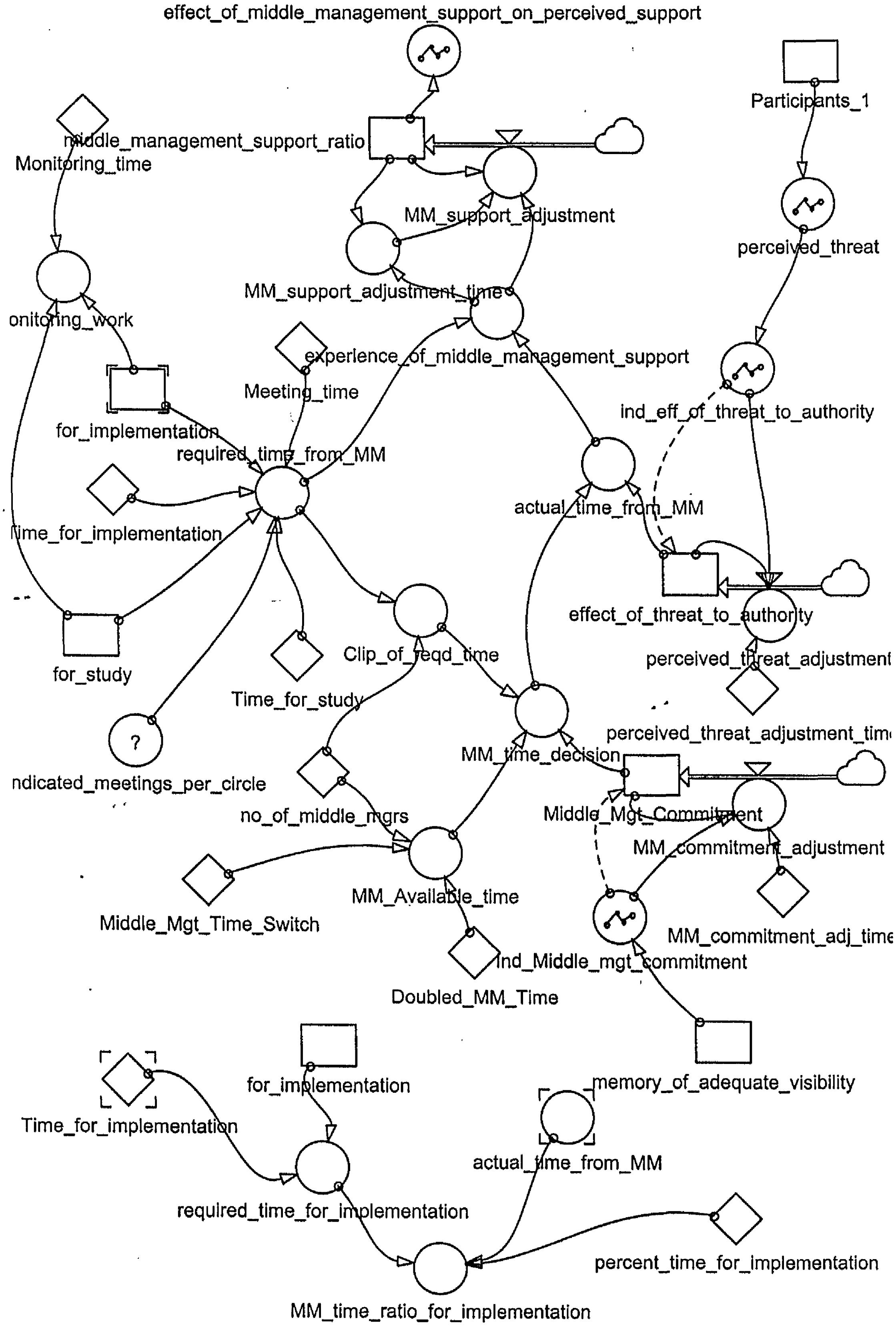
This is a switch variable that toggles between 0.0 (to indicate that top management did not allocate time for TQm activities and responsibilities) to 1.0 (to indicate the presence of this time allocation)

work_force

= 1000

This is the total number of people in the organisation

PERCEIVED SUPPORT FROM MIDDLE MGT TIME ALLOCATION DYNAMICS



effect_of_threat_to_authority
INIT ind_eff_of_threat_to_authority
+dt*perceived_threat_adjustment
This is a long term average of the effect of the perceived threat to middle management position

for_implementation
INIT 5
This level variable represents the number of suggestions that are waiting to be implemented.

for_study
INIT 0
This level variable represents the number of suggestions that are awaiting decision of acceptance or rejection.

memory_of_adequate_visibility
INIT 0
This variable represents the long term perceptions that management is visible and supportive.

middle_management_support_ratio
INIT 0
+dt*MM_support_adjustment
This is the long term perception of middle management support

Middle_Mgt_Commitment
INIT Ind_Middle_mgt_commitment
+dt*MM_commitment_adjustment
This is the average middle management commitment.

Participants_1
INIT .2
This level variable represents the fraction of employees who are presently participating in the programme.

MM_commitment_adjustment
= (Ind_Middle_mgt_commitment-Middle_Mgt_Commitment)/MM_commitment_adj_time
This is the rate at which middle management commitment changes

MM_support_adjustment
= (experience_of_middle_management_support-middle_management_support_ratio)/ MM_support_adjustment_time
This is the rate at which perceived middle management support changes

perceived_threat_adjustment
= (ind_eff_of_threat_to_authority-effect_of_threat_to_authority)/ perceived_threat_adjustment_time
This is the rate at which current experiences of threat to position changes the long term average

actual_time_from_MM
= MM_time_decision*effect_of_threat_to_authority
This variable represents the total actual time spent by middle management for the TQM programme.

Clip_of_reqd_time
= MIN(required_time_from_MM,20*no_of_middle_mgrs)
This variable represents the time required by the programme from middle managers. However the maximum of 20 hours/manager is set to indicate that managers also have other reponsibilities and cannot spend all their time for TQM activities.

effect_of_middle_management_support_on_perceived_support
= GRAPH(middle_management_support_ratio,0,0.1, [0,0.005,0.013,0.032,0.079,0.159,0.218,0.259,0.282,0.295,0.3"Min:0;Max:0.3"])
This variable represents the effect of perceived middle management support to total perceived support

experience_of_middle_management_support
= actual_time_from_MM/IF(required_time_from_MM>0,required_time_from_MM,.0005)
This variable compares the actual time middle management spent on the TQM programme with the estimated required time by employees from the middle management.

ind_eff_of_threat_to_authority
= GRAPH(perceived_threat,0,0.1,
[1,0.99,0.96,0.92,0.88,0.83,0.76,0.69,0.62,0.54,0.45"Min:0;Max:1"])
This represents the effect of the perceived threat to position of middle managers on the time they actually spend and allocate to the programme

Ind_Middle_mgt_commitment
= GRAPH(memory_of_adequate_visibility,0,0.1,
[0,0.01,0.03,0.08,0.16,0.35,0.54,0.74,0.9,0.97,1"Min:0;Max:1"])
This variable conceptualises middle management commitment as a function of perceived top management visibility (which is an indicator of top management commitment). As perceived visibility ratio increases so does middle management commitment.

indicated_meetings_per_circle
= EXPS*Auxiliary_105
This variable indicates the average number of meetings per circle

MM_Available_time
= ((48*Middle_Mgt_Time_Switch)+Doubled_MM_Time)*no_of_middle_mgrs
This variable represents the time that middle managers have agreed to allocate each month for the TQM programme.

MM_support_adjustment_time
= IF(experience_of_middle_management_support<middle_management_support_ratio,3/12,36/12)
This is an assymteric adjustment time of perceived middle management support. Its formulation assumes that bad experiences with middle managers are remembered more strongly than favourable experiences

MM_time_decision
= IF(Middle_Mgt_Commitment>.7, Clip_of_reqd_time, MIN(MM_Available_time, Clip_of_reqd_time))
This variable determines the amount of time allocated as influenced by the middle management commitment. When it is high enough (>0.7), total required time by the activities is actually allocated. Otherwise, the minimum between this required time and the initially allocated time is taken.

MM_time_ratio_for_implementation
= (actual_time_from_MM*percent_time_for_implementation)/IF(required_time_for_implementation>.5,required_time_for_implementation,.5)
This variable compares the time actual time spent by middle management with the estimated required time to implement suggestions.

monitoring_work
= (for_implementation+for_study)*Monitoring_time
This variable represents the time spent by facilitators for monitoring the process through which the suggestions go through from receipt to implementation.

perceived_threat
= GRAPH(Participants_1,0,0.1,[0,0.01,0.02,0.04,0.14,0.39,0.67,0.85,0.92,0.97,1"Min:0;Max:1"])
This variable represents the threat to middle management authority as caused by increasing participation. It is assumed that there is a direct relationship between the two variables.

required_time_for_implementation
= MAX(for_implementation*Time_for_implementation,.0001)
This variable represents the time required from middle management to implement suggestions.

required_time_from_MM
= (for_study*Time_for_study)+(for_implementation*Time_for_implementation)+(indicated_meetings_per_circle*Meeting_time)
This variable computes the total time required by different activities (responding to new suggestions, studying and approving suggestions, and directing the implementation of accepted ssuggestions) from middle managers.

◇ Doubled_MM_Time
= 0
This is also a switch variable that doubles the time allocated by middle managers devote to TQM activities

◇ Meeting_time
= 4*12
This is the number of hours per month devoted to meetings

◇ Middle_Mgt_Time_Switch
= 0
This is a switch variable that toggles between 0.0 (indicating that middle managers did not allocate time for the programme) and 1.0 (indicating the allocation of time for the programme)

◇ MM_commitment_adj_time
= 36/12
This is the middle management commitment adjustment time

◇ Monitoring_time
= .1*12

◇ no_of_middle_mgrs
= 20
This variable represents the number of middle managers in the company.

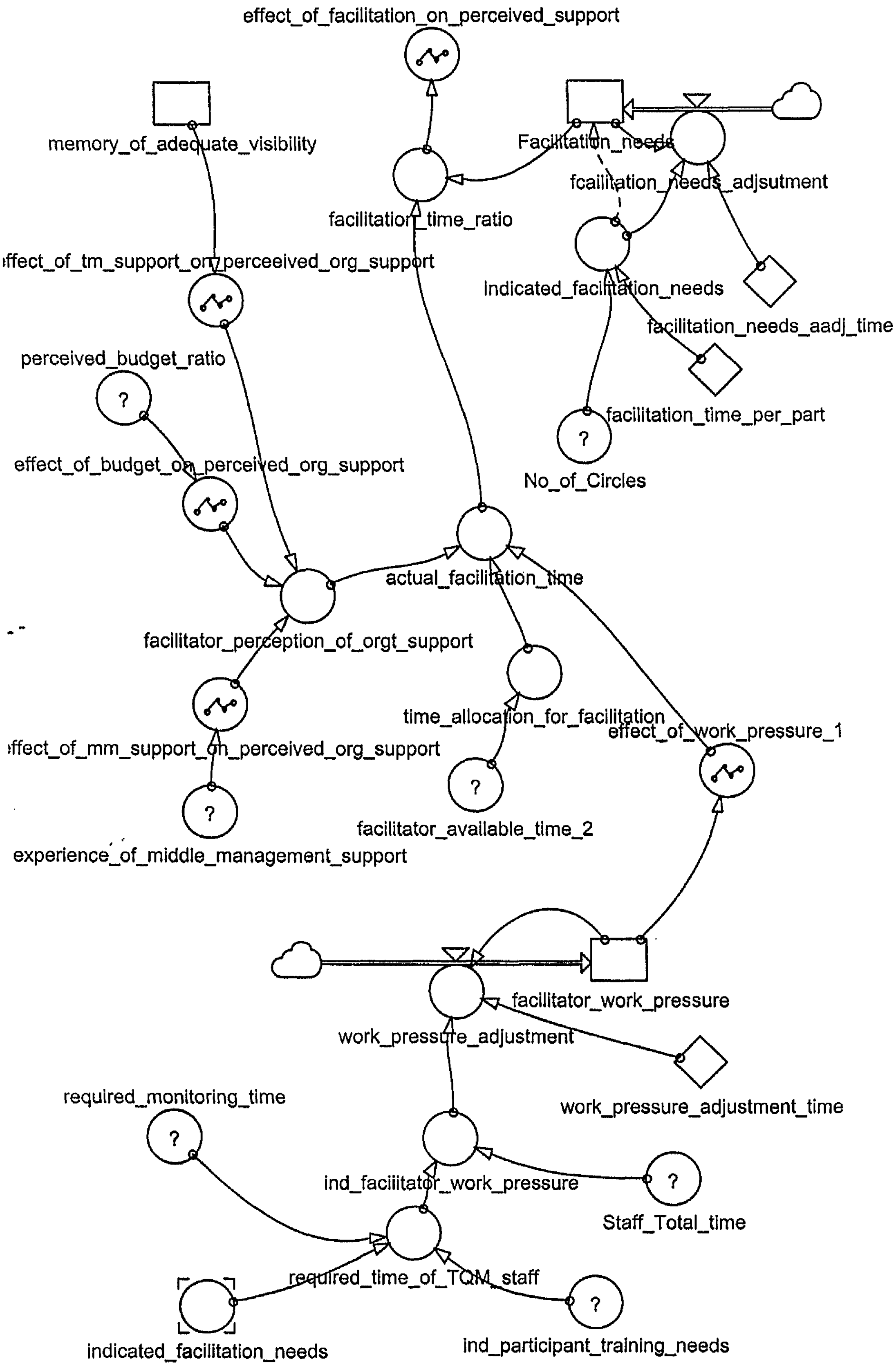
◇ perceived_threat_adjustment_time
= 12/12
This is the perceived threat adjustment time

◇ percent_time_for_implementation
= .33
This represents the fraction of the total middle management time that is allocated to implement suggestions.

◇ Time_for_implementation
= 2
This variable represents the average time required from middle management to implement each suggestion.

◇ Time_for_study
= 1
This is the time to study and evaluate proposed projects

FACILITATION ALLOCATION DYNAMICS



Facilitation_needs
INIT indicated_facilitation_needs
+dt*fcailitation_needs_adjsutment
This Is the acummulation of facilitation needs

facilitator_work_pressure
INIT 0
+dt*work_pressure_adjustment
This represents the accumulated pressure on the TQM staff

memory_of_adequate_visibility
INIT 0
This variable represents the long term perceptions that management is visible and supportive

fcailitation_needs_adjsutment
= (indicated_facilitation_needs-Facilitation_needs)/facilitation_needs_aadj_time
This is the rate at which facilitation needs change

work_pressure_adjustment
= (ind_facilitator_work_pressure-facilitator_work_pressure)/ work_pressure_adjustment_time
This is the rate at which work pressure changes

actual_facilitation_tlme
= time_allocation_for_facilitation*effect_of_work_pressure_1* facilitator_perception_of_orgt_support
This variable represents the effective actual time as affected by work pressure that is spent for facilitation.

effect_of_budget_on_perceived_org_support
= GRAPH(perceived_budget_ratio,0,0.1, [0,0.006,0.016,0.048,0.098,0.172,0.226,0.268,0.301,0.324,0.33"Min:0;Max:0.33"])
This represents the effect of perceived budget availability of the TQM satff on the perceptions of organisation support

effect_of_facilitation_on_perceived_support
= GRAPH(facilitation_time_ratio,0,0.1, [0,0.026,0.046,0.062,0.074,0.082,0.087,0.093,0.097,0.099,0.1"Min:0;Max:0.1"])

effect_of_mm_support_on_perceived_org_support
= GRAPH(experience_of_middle_management_support,0,0.1, [0,0.003,0.01,0.019,0.046,0.114,0.216,0.271,0.302,0.32,0.33"Min:0;Max:0.33"])
This represents the influence of perceived middle management support on the actual time devoted to facilitation

effect_of_tm_support_on_perceeived_org_support
= GRAPH(memory_of_adequate_visibility,0,0.1, [0,0.01,0.028,0.059,0.111,0.194,0.258,0.3,0.318,0.327,0.329"Min:0;Max:0.33"])
This represents the effect of top management visibility of TQM staff on the perceived organisational support

effect_of_work_pressure_1
= GRAPH(facilitator_work_pressure,0,0.2, [1,1,1,0.99,0.98,0.96,0.92,0.86,0.78,0.67,0.6"Min:0;Max:1"])
This variable reflects the decreasing efficiency and effectiveness of allocated time as work pressure builds up.

experience_of_middle_management_support
= actual_time_from_MM/IF(required_time_from_MM>0,required_time_from_MM,.0005)
This variable compares the actual time middle management spent on the TQM programme with the estimated required time by employees from the middle management.

facilitation_time_ratio
= actual_facilitation_time/Facilitation_needs
This variable compares the actual time spent for facilitation with the requirements of the task.

facilitator_available_time_2
= facilitator_available_time_1-time_allocation_for_monitoring
This variable computes the remaining time that is available for facilitating.

facilitator_perception_of_orgt_support
= effect_of_mm_support_on_perceived_org_support+
effect_of_tm_support_on_perceeived_org_support+
effect_of_budget_on_perceived_org_support

ind_facilitator_work_pressure
= required_time_of_TQM_staff/Staff_Total_time
This variable represents the pressure experienced by the facilitators and expressed as ratio of total available time and the total required time.

ind_participant_training_needs
= Regular_training+TQM_training
This represents the current needs for training

indicated_facilitation_needs
= MAX(No_of_Circles*facilitation_time_per_part,facilitation_time_per_part)
This variable determines the time required for facilitation, that is, personal contact between facilitators and employees.

No_of_Circles
= Participants_1*population/Constant_49
This variable is the total number of employees in the company.

perceived_budget_ratio
= budget_ratio*effect_of_perceived_inadequacy_of_budget

required_monitoring_time
= MAX(No_of_Circles*.1,0.1)+monitoring_work
This variable represents the total time required for monitoring participants activities and monitoring submitted suggestions.

required_time_of_TQM_staff
= indicated_facilitation_needs+ind_participant_training_needs+required_monitoring_time
This variable indicates the total time required for doing all three taks of training, facilitation and monitoring.

Staff_Total_time
= TQM_Staff_Switch*time_per_month
This variable represents the total amount of available time from all facilitators each month.

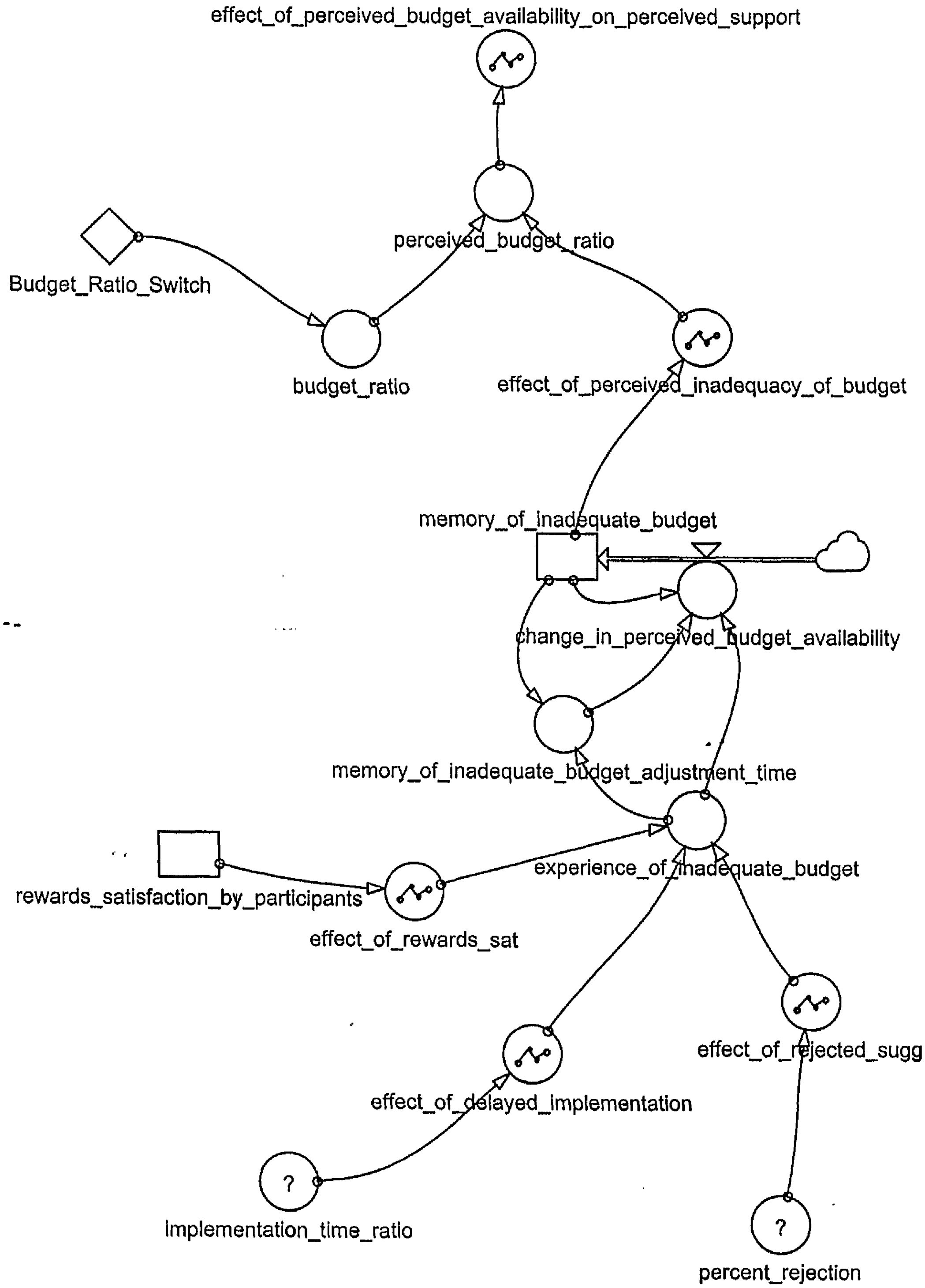
time_allocation_for_facilitation
= IF(facilitator_available_time_2>0,facilitator_available_time_2,0)
This clip functions acertains that there is no negative time allocation for facilitation.

facilitation_needs_aadj_time
= 3/12
This is the facilitation adjustment time

facilitation_time_per_part
= 2*12

work_pressure_adjustment_time
= 3/12
This is the adjustment time of work pressure

PERCEIVED SUPPORT FROM BUDGET DYNAMICS



memory_of_inadequate_budget
INIT 1
+dt*change_in_perceived_budget_availability
This variable represents a long term average of past experiences and subjective observations of inadequacy of the budget.

rewards_satisfaction_by_participants
INIT -1
This is the level of accumulated satisfaction from rewards.

change_in_perceived_budget_availability
= (experience_of_inadequate_budget-memory_of_inadequate_budget)/ memory_of_inadequate_budget_adjustment_time
This is the rate at which the memory of budget availability changes depending on the current experience or perceptions of its adequacy.

budget_ratio
= 1*Budget_Ratio_Switch
This variable represents the actual ratio of available budget to actual uses of the these financial resources.

effect_of_delayed_implementation
= GRAPH(implementation_time_ratio,0,0.1, [0,0.004,0.013,0.039,0.083,0.161,0.225,0.264,0.288,0.296,0.3"Min:0;Max:0.3"])
This variable reflects the relationship of delayed implementation to perceived inadequacy of the budget. As accepted suggestions are delayed in their implementation, the perception of the inadequacy of the budget increases.

effect_of_perceived_budget_availability_on_perceived_support
= GRAPH(perceived_budget_ratio,0,0.1, [0,0.0007,0.0018,0.006,0.021,0.061,0.119,0.168,0.19,0.196,0.2"Min:0;Max:0.2"])
This is the influence of the perceived budget ratio on total perceived organisational support.

effect_of_perceived_inadequacy_of_budget
= GRAPH(memory_of_inadequate_budget,0,0.1, [1,1,0.98,0.95,0.92,0.87,0.79,0.69,0.57,0.39,0"Min:0;Max:1"])
This variable represents the influence of the experience or perceived experience of the inadequacy of the amount of money available for the programme.

effect_of_rejected_sugg
= GRAPH(percent_rejection,0,0.1, [0,0.001,0.012,0.029,0.067,0.167,0.251,0.282,0.295,0.299,0.3"Min:0;Max:0.3"])
This variable represents the increasing influence of higher rejection rates on the experience of inadequate budget. It is suggested that employees tend to see rejection of suggestion as related to the lack of financial resources to implement such suggestions.

effect_of_rewards_sat
= GRAPH(rewards_satisfaction_by_participants,0,0.1, [0.4,0.396,0.386,0.363,0.33,0.272,0.184,0.082,0.026,0.007,0"Min:0;Max:0.4"])
This variable reflects the satisfaction of employees with the financial rewards. As dissatisfaction with the rewards increases, the perception of available financial resources is seen as inadequate.

experience_of_inadequate_budget
= effect_of_delayed_implementation+effect_of_rejected_sugg+effect_of_rewards_sat
This represents a numerical value that evaluates the adequacy of financial resources based on observations of events. These observations may or may not be accurate representations of reality as they are simply perceived, without justifiable support from finacial records.

implementation_time_ratio
= 0+STEP(implementation_time/average_implementation_time,0)
This compares the actual implementation time to the normal or average implementation time.

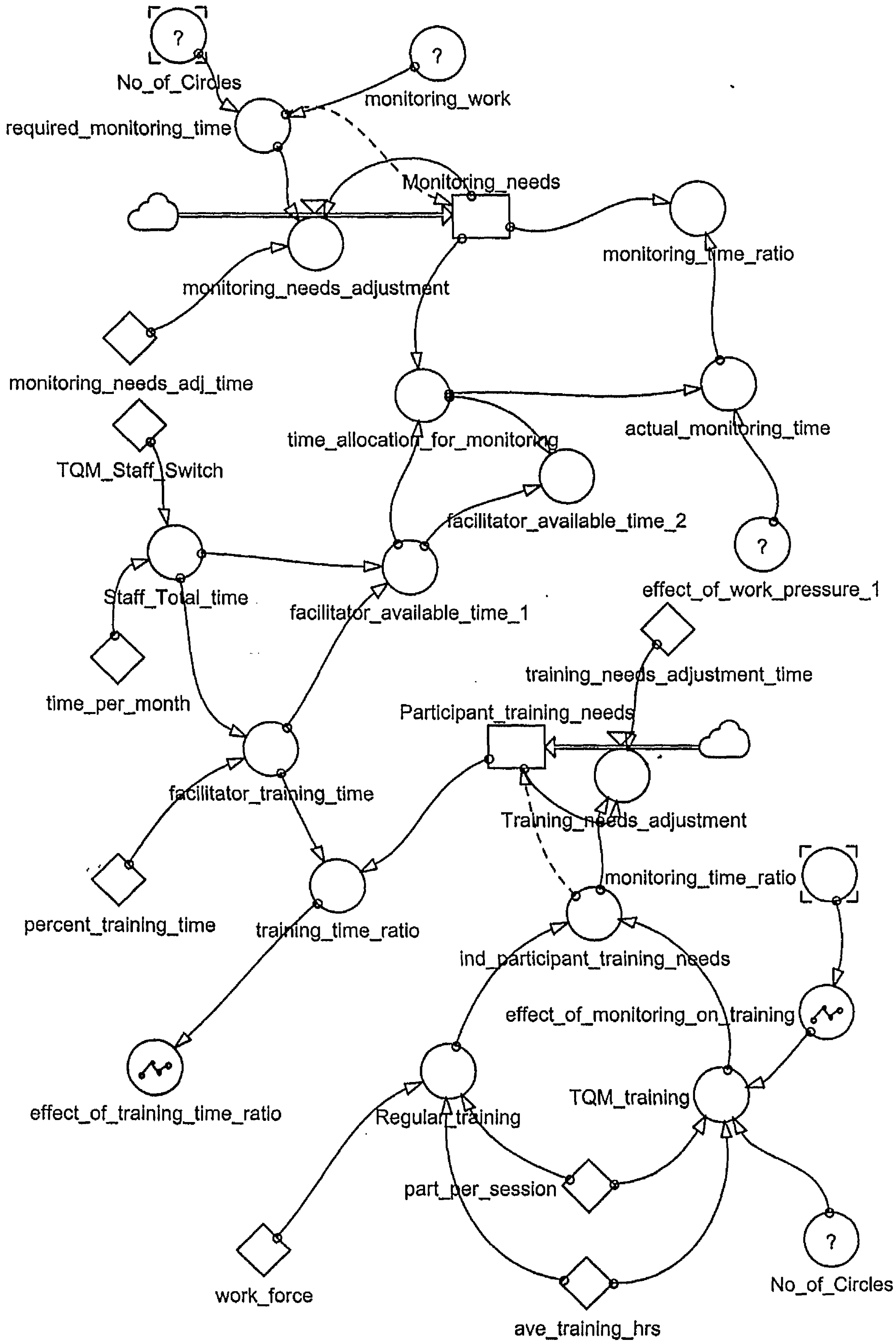
memory_of_inadequate_budget_adjustment_time
= IF(memory_of_inadequate_budget<experience_of_inadequate_budget,1/12,12/12)
This is an aauxiliary function that indicates the adjustment time of the memory of adequate availability. It is an assymetric function because it assumes that when current perceptions of budget availaability are more unfavourable that past experiences, this adjsutment time is shorter. In other words bad experiences are remembered easily while good experiences do not have an immediate and strong effects on the past perceptions.

perceived_budget_ratio
= budget_ratio*effect_of_perceived_inadequacy_of_budget
This variable is the organisation's subjective perception of the available budget allocated for the programme.

percent_rejection
= (STEP(.2,2)*Project_Rejection_Switch)+0
This variable is an exogenous reject rate.

Budget_Ratio_Switch
= 0
This is switch variable that toggles between 0.0 (no budget is allocated for the programme) and 1.0 (all the proposed budget for the programme is made available)

TRAINING AND MONITORING ALLOCATION DYNAMICS



Monitoring_needs
INIT required_monitoring_time
+dt*monitoring_needs_adjustment
This represents the accumulation of all monitoring tasks in hours

Participant_training_needs
INIT ind_participant_training_needs
+dt*Training_needs_adjustment
This variable indicates the needs of participants in hours.

monitoring_needs_adjustment
= (required_monitoring_time-Monitoring_needs)/monitoring_needs_adj_time
Thsi is the rate at which monitoring tasks change

Training_needs_adjustment
= (ind_participant_training_needs-Participant_training_needs)/ training_needs_adjustment_time
This is the rate at which training needs change

actual_monitoring_time
= effect_of_work_pressure_1*time_allocation_for_monitoring
This variable indicates the actual effective time for monitoring as affected by work pressure.

effect_of_monitoring_on_training
= GRAPH(monitoring_time_ratio,0,0.1, [1,1.03,1.06,1.09,1.14,1.19,1.26,1.34,1.43,1.53,1.66"Min:0;Max:2"])
This represents the influence of monitoring on training needs, as more monitoring is conceived as contributing to identification of more training needs.

effect_of_training_time_ratio
= GRAPH(training_time_ratio,0,0.1, [0,0.02,0.039,0.057,0.068,0.079,0.086,0.091,0.096,0.099,0.1"Min:0;Max:0.1"])
This variable indicates the contribution of training availability on perceived organisational support.

effect_of_work_pressure_1
= GRAPH(facilitator_work_pressure,0,0.2, [1,1,1,0.99,0.98,0.96,0.92,0.86,0.78,0.67,0.6"Min:0;Max:1"])
This variable reflects the decreasing efficiency and effectiveness of allocated time as work pressure builds up.

facilitator_available_time_1
= Staff_Total_time-facilitator_training_time
This variable indicates the difference between total time and aallocated training time. It represents the time available for allocation to the other two activities: monitoring and facilitating.

facilitator_available_time_2
= facilitator_available_time_1-time_allocation_for_monitoring
This variable computes the remaining time that is available for facilitating.

facilitator_training_time
= Staff_Total_time*percent_training_time
This variable indicates the time required for training activities. This not only include the

ind_participant_training_needs
= Regular_training+TQM_training
This represents the current needs for training

monitoring_time_ratio
= actual_monitoring_time/Monitoring_needs
This variable compares the actual effective time spent for monitoring with the requirements of the task.

monitoring_work
= (for_implementation+for_study)*Monitoring_time
This variable represents the time spent by facilitators for monitoring the process through which the suggestions go through from receipt to implementation.

No_of_Circles
= Participants_1*population/Constant_49
This variable is the total number of employees in the company.

Regular_training
= (ave_training_hrs*work_force)/(part_per_session*12)
This represents regular training courses for all employees.

required_monitoring_time
= MAX(No_of_Circles*.1,0.1)+monitoring_work
This variable represents the total time required for monitoring participants activities and monitoring submitted suggestions.

Staff_Total_time
= TQM_Staff_Switch*time_per_month
This variable represents the total amount of available time from all facilitators each month.

time_allocation_for_monitoring
= MIN(facilitator_available_time_1,Monitoring_needs)
This variable represents the number of hours that is allocated to monitoring activities. It chooses between the smaller value of required monitoring time and available time.

TQM_training
= (No_of_Circles*10*effect_of_monitoring_on_training*1.5*ave_training_hrs)/ part_per_session
This represents the required time spent for training participants. An allowance of 50% is made for preparing of the training materials and sessions.

training_time_ratio
= facilitator_training_time/Participant_training_needs
This variable compares the actual time allocated to training with the time required by participants/employees.

ave_training_hrs
= 16*12
This variable represents the number of hours per training session.

monitoring_needs_adj_time
= 3/12
This is the aadjustment time for monitoring needs

part_per_session
= 25
This variable represent the number of persons for each training session.

percent_training_time
= .80
This variable represents the estimated fraction of the total time of facilitators allocated to training.

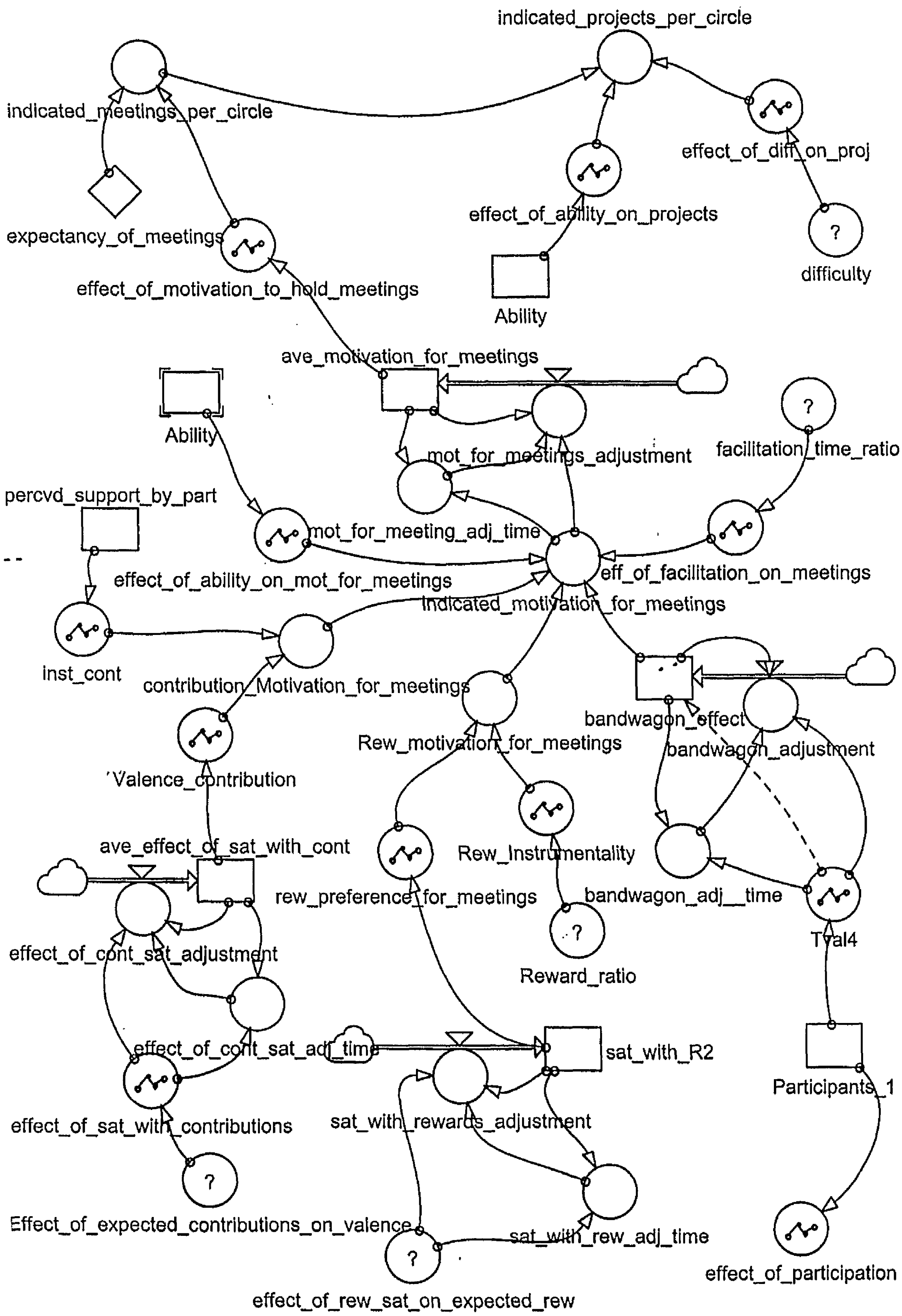
time_per_month
= 192*12
This variable represents the available number of hours for each facilitator.

TQM_Staff_Switch
= 0
This is a switch variable that toggles between values to indicate the number of TQM staff that will be inputted

training_needs_adjustment_time
= 3/12
This is the training needs adjustment time

work_force
= 1000
This represents the number of employees in the company.

SUGGESTION MOTIVATION



Ability
INIT .01
This variable represents the available units of knowledge to formulate new suggestions.

ave_effect_of_sat_with_cont
INIT -1
+dt*effect_of_cont_sat_adjustment
This level variable represents the long term average of the effect of satisfaction frm contribution.

ave_motivation_for_meetings
INIT -1
+dt*mot_for_meetings_adjustment
This level variable represents the long term average of motivation to make new suggestions.

bandwagon_effect
INIT Tval4
+dt*bandwagon_adjustment
This level variable represents the long term average of imitation effect that contributes to the motivation to contribute new suggestions.

Participants_1
INIT .2
This level variable represents the fraction of employees who are presently participating in the programme.

percvd_support_by_part
INIT 0
This level variable represents the long term average of perceived support by PARTICIPANTS.

sat_with_R2
INIT -1
+dt*sat_with_rewards_adjustment
This is a level variable that averages the satisfaction derievd from rewards.

bandwagon_adjustment
= (Tval4-bandwagon_effect)/bandwagon_adj__time
This is the rate at which the bandwagon effect changes

effect_of_cont_sat_adjustment
= (effect_of_sat_with_contributions-ave_effect_of_sat_with_cont)/ effect_of_cont_sat_adj_time
This represents the rate at which the effect of satisfaction from contribution changes

mot_for_meetings_adjustment
= (indicated_motivation_for_meetings-ave_motivation_for_meetings)/ mot_for_meeting_adj_time
This is the rate at which the long term motivation for meetings changes

sat_with_rewards_adjustment
= (effect_of_rew_sat_on_expected_rew-sat_with_R2)/sat_with_rew_adj_time
This is the rate at which satisfaction with rewards change

bandwagon_adj__time
= IF(Tval4<bandwagon_effect,6/12,6/12)
This is an assymetric adjustment time variable so that the bandwagon effect level adjusts slowly towards higher values (reflecting a cautious attitude) but adjusts faster to lower levels.

contribution_Motivation_for_meetings
= Valence_contribution*inst_cont
This variable represents the strength of motivation due to contributions and conceived as a product of valence or preference for contributing and instrumentality or the belief that contribution leads to the preferred outcome.

difficulty
= GRAPHLINAS(cumulative_acceptance_rate,0,5, [0.7,0.72,0.76,0.84,0.95,1.08,1.28,1.5,1.75,2,2.32"Min:0;Max:3"])
This variable represents the units of knowledge required to formulate new suggestions.

eff_of_facilitation_on_meetings
= GRAPH(facilitation_time_ratio,0,0.1,
[0,0.04,0.068,0.087,0.105,0.119,0.129,0.137,0.143,0.147,0.15"Min:0;Max:0.15"])
This is the effect of current facilitation efforts on the current motivation to meet

effect_of_ability_on_mot_for_meetings
= MIN(GRAPHLINAS(Ability,0,0.5,
[0.001,0.005,0.024,0.068,0.121,0.174,0.216,0.242,0.253,0.255,0.256"Min:0;Max:
0.3"]),0.3)
This non linear transformation function represents the effect of abilityu on the motivation to hold meetings

effect_of_ability_on_projects
= GRAPHLINAS(Ability,0.7,0.4,
[0.82,0.83,0.89,0.97,1.15,1.37,1.63,1.86,2.01,2.15,2.26"Min:0;Max:3.5"])
This is a non linear transformation function that represents the influence of ability on the generation of new projects

effect_of_cont_sat_adj_time
= IF(ave_effect_of_sat_with_cont<effect_of_sat_with_contributions,12/12,3/12)
This is an assymetric trime adjustment variable.

effect_of_diff_on_proj
= GRAPH(difficulty,0,0.5,[2,1.43,0.92,0.69,0.6,0.54,0.49,0.46,0.43,0.41,0.4"Min:0;Max:2"]
)
This is a non-linear transformation function that represents the influence of difficulty on the generation of new projects

Effect_of_expected_contributions_on_valence
= effect_of_need_to_contribute*effect_of_satisfaction_on_ind_exp_contributions
This variable converts the product of effects of the need to contribute and satisfaction fro contributing into the valence for participating.

effect_of_motivation_to_hold_meetings
= GRAPH(ave_motivation_for_meetings,0,0.1,
[0,0.01,0.03,0.06,0.14,0.29,0.53,0.81,0.94,0.98,1"Min:0;Max:1"])
This is a non linear transformation function that indicates the effect of motivation to hold meetings

effect_of_participation
= GRAPH(Participants_1,0,0.1,[0,0.01,0.04,0.14,0.28,0.51,0.73,0.88,0.95,0.98,1"Min:0;
Max:1"])
This non linear function represents the imitation tendencies by non participants.

effect_of_rew_sat_on_expected_rew
= GRAPH(rewards_satisfaction_by_participants,0,0.1,
[0.001,0.23,0.42,0.58,0.71,0.8,0.86,0.91,0.96,0.99,1"Min:0;Max:1"])
This variable is a non linear function based on satisfaction from rewards that contributes to the total valence for participation.

effect_of_sat_with_contributions
= GRAPH(Effect_of_expected_contributions_on_valence,0,0.1,
[0,0.075,0.121,0.159,0.182,0.2,0.214,0.226,0.236,0.245,0.25"Min:0;Max:0.25"])
This is a non linear transformation function that indicates the effect of expected contributions on satisfaction with contributions

facilitation_time_ratio
= actual_facilitation_time/Facilitation_needs
This variable compares the actual time spent for facilitation with the requirements of the task.

indicated_meetings_per_circle
= expectancy_of_meetings*effect_of_motivation_to_hold_meetings
This represents the average number of meetings that each quality circle is motivated to hold

indicated_motivation_for_meetings

= (effect_of_ability_on_mot_for_meetings+bandwagon_effect+ contribution_Motivation_for_meetings+Rew_motivation_for_meetings+ eff_of_facilitation_on_meetings)

This varaible represents the current total motivation to make suggestions per person. It may be noted that there are alternative ways of specifying the operations but the present formulation allows three independent sources of motivation to be influenced by facilitation activities.

indicated_projects_per_circle

= indicated_meetings_per_circle*effect_of_diff_on_proj*effect_of_ability_on_projects

This is the average number of projects that each quality circle is motivated and able to propose

inst_cont

= GRAPH(percvd_support_by_part,0,0.1, [0,0.01,0.04,0.15,0.39,0.72,0.88,0.93,0.97,0.99,1"Min:0;Max:1"])

This represents the instrumentality of contribution as suggested by the long term perceived organisational support

mot_for_meeting_adj_time

= IF(indicated_motivation_for_meetings<ave_motivation_for_meetings,1/12,3/12)

This variable is an assymetric adjustment time variable so that average motivation increases slowly but decreases very fast.

Rew_Instrumentality

= GRAPH(Reward_ratio,0,0.1,[0,0.09,0.21,0.35,0.5,0.64,0.74,0.84,0.93,0.98,1"Min:0;Max :1"])

This variable converte the reward ratio into a value between 0.0 and 1.0 as instrumentality is defined in this interval.

Rew_motivation_for_meetings

= rew_preference_for_meetings*Rew_Instrumentality

This variable represents the force of motivation to make suggestions based on the rewards.

rew_preference_for_meetings

= GRAPH(sat_with_R2,0,0.1, [0,0.005,0.01,0.023,0.037,0.066,0.122,0.184,0.219,0.238,0.25"Min:0;Max:0.25"])

This represents a non linear transformation function that idnicates the effect of satisfaction with rewards on the preference for meetings

Reward_ratio

= actual_rewards_1/ave_expected_rewards

This variable compares the available actual rewards with the expected rewards.

sat_with_rew_adj_time

= IF(effect_of_rew_sat_on_expected_rew<sat_with_R2,36/12,36/12)

This is an assymetric adjustment time variable.

Tval4

= GRAPH(Participants_1,0,0.1, [0,0.0009,0.0024,0.0053,0.0127,0.0279,0.0384,0.0445,0.048,0.0493,0.0498"Min:0; Max:0.05"])

This is a non linear transformation function that indicates the effect of the level of participation on bandwagon participation

Valence_contribution

= GRAPH(ave_effect_of_sat_with_cont,0,0.1, [0,0.04,0.1,0.19,0.32,0.48,0.67,0.82,0.91,0.97,1"Min:0;Max:1"])

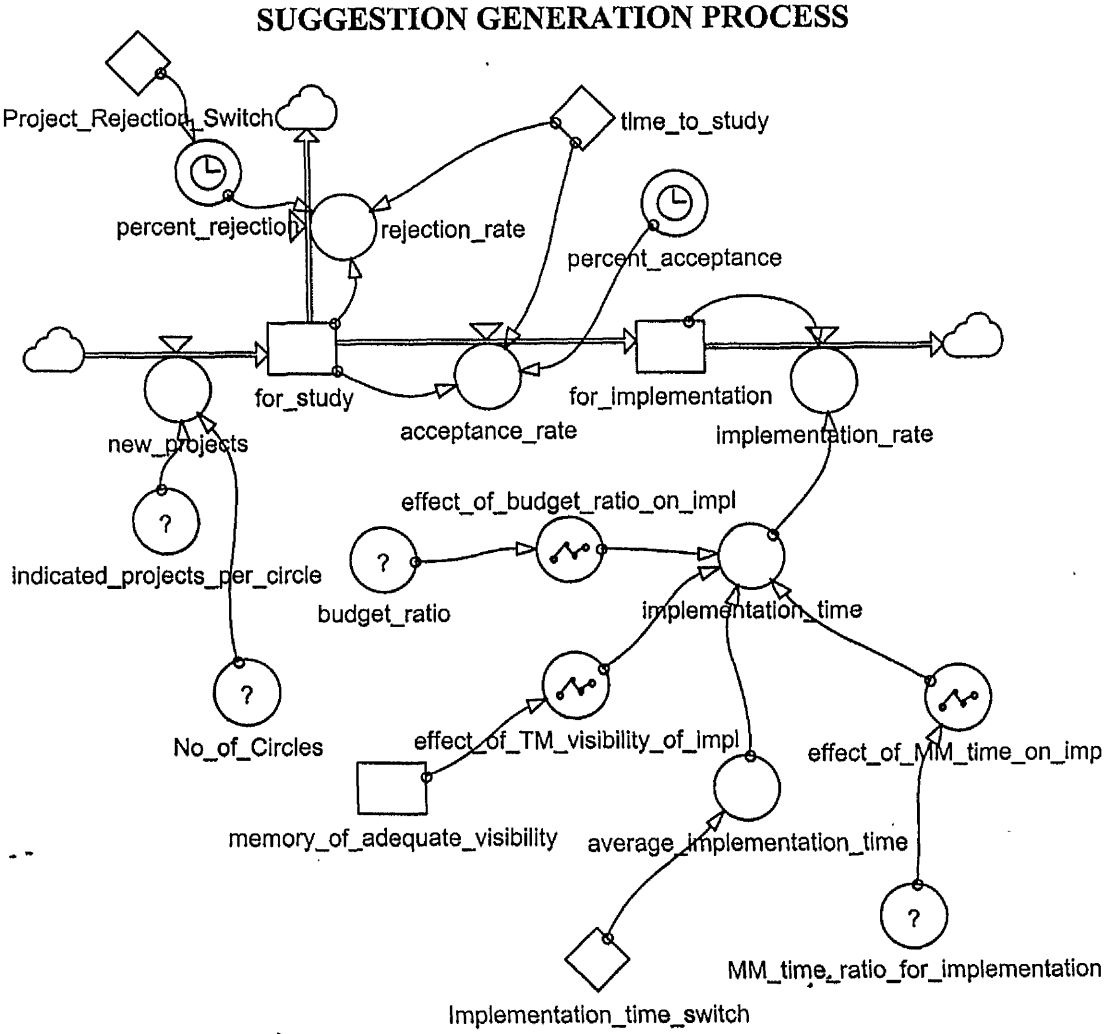
This represents the preference or valence derived from satisfaction with expected contributions

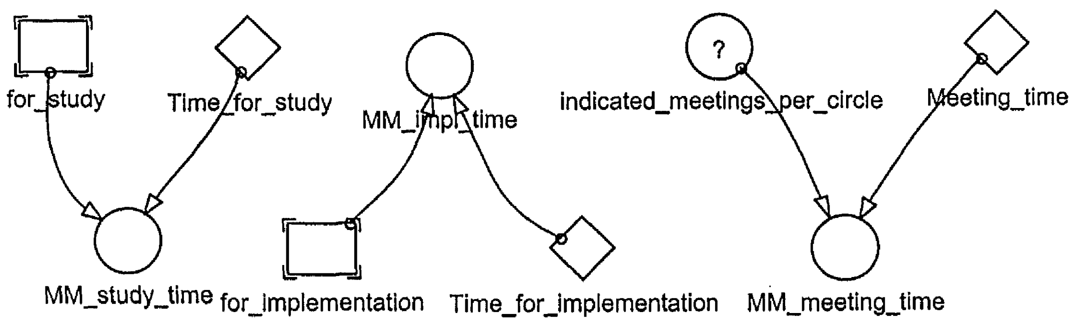
expectancy_of_meetings

= 1

This represents the expectancy of holding meetings. It is assumed to be equal to the maximum 1.0 because management support these meetings and would allow them to be held either during work hours or after work hours.

SUGGESTION GENERATION PROCESS





for_implementation
INIT 5
+dt*acceptance_rate
-dt*implementation_rate
This level variable represents the number of suggestions that are waiting to be implemented.

for_study
INIT 0
+dt*new_projects
-dt*acceptance_rate
-dt*rejection_rate
This level variable represents the number of suggestions that are awaiting decision of acceptance or rejection.

memory_of_adequate_visibility
INIT 0
This variable represents the long term perceptions that management is visible and supportive

acceptance_rate
= percent_acceptance*for_study/time_to_study
This rate variable represents the average number of suggestions that are accepted.

implementation_rate
= for_implementation/implementation_time
This rate variable represents the average number of suggestions taht have been implemented.

new_projects
= No_of_Circles*Indicated_projects_per_circle
This variable is exactly the same as the new suggestions rate.

rejection_rate
= percent_rejection*for_study/time_to_study
This rate variable represents the average number of suggestions that have been rejected.

average_implementation_time
= ((5*Implementation_time_switch)+(1000*(1-Implementation_time_switch)))/12
This is a long term average of implementation time. It includes switches to indicate the implementation of programme

budget_ratio
= 1*Budget_Ratio_Switch
This variable represents the actual ratio of available budgt to actual uses of the these financial resources.

effect_of_budget_ratio_on_impl
= GRAPH(budget_ratio,0,0.2,[3,2.46,1.97,1.55,1.2,1,0.89,0.84,0.82,0.79,0.8"Min:0;Max:3"])
This non linear function determines the effect of the budget ratio at its different values. As the budget ratio increases, that is, there is more available budget, the implementation effect decreases to lower the actual implementation time.

effect_of_MM_time_on_impl
= GRAPH(MM_time_ratio_for_implementation,0,0.2,[5,2.72,1.75,1.34,1.12,1,0.92,0.86,0.83,0.79,0.8"Min:0;Max:5"])
Middle management is conceived to be important in the implementation of suggestions and thus require a certain amount of their time for this purpose. As more time is allocated, the implementation becomes faster.

effect_of_TM_visibility_of_impl
= GRAPH(memory_of_adequate_visibility,0,0.2,[2,1.56,1.29,1.15,1.07,1,0.96,0.94,0.92,0.9,0.9"Min:0;Max:2"])
Perceived visibility is conceived as contributing to the faster implementation as it indicates top managements interest and sincerity with the quality efforts.

implementation_time
= (average_implementation_time*effect_of_budget_ratio_on_impl*
effect_of_MM_time_on_impl*effect_of_TM_visibility_of_impl)
This variable represents the actual implementation time as the average implementation time is moderated by the effects of available budget, middle management time allocated for implementation and by the contribution of top management visibility.

indicated_meetings_per_circle
= EXPS*Auxiliary_105
This represents the average number of meetings that each quality circle is motivated to hold

indicated_projects_per_circle
= indicated_meetings_per_circle*Auxiliary_123*Constant_44*Auxiliary_124
This is the average number of projects that each quality circle is motivated and able to propose

MM_impl_time
= for_implementation*Time_for_implementation
This is the total time required by all projects for implementation from middle managers

MM_meeting_time
= indicated_meetings_per_circle*Meeting_time
This is the total number of hours that all quality circles meet

MM_study_time
= for_study*Time_for_study
This is the total time required by all projects that are needed to be studied by middle managers

MM_time_ratio_for_implementation
= (actual_time_from_MM*percent_time_for_implementation)/IF
(required_time_for_implementation>.5,required_time_for_implementation,.5)
This variable compares the time actual time spent by middle management with the estimated required time to implement suggestions.

No_of_Circles
= Participants_1*population/Constant_49
This variable is the total number ofquality circles in the company.

percent_acceptance
= .7+STEP(0,10)
This represents the average percentage of projects that are accepted by management

percent_rejection
= (STEP(.2,2)*Project_Rejection_Switch)+0
This variable is an exogenous reject rate.

Implementation_time_switch
= 0
This is a switch variable that triggers the average implementation time to change from 1000 months (no participation programme) to 5 months when the programme is implemented.

Meeting_time
= 4*12
This is the total number of hours that each quality circle meets for the entire year. It is assumed that they hold one-hour meetings every week.

Project_Rejection_Switch
= 1
This is a switch variable that removes the rejection rate

Time_for_implementation
= 2
This variable represents the average time required from middle management to implement each suggestion.

Time_for_study
= 1
This is the time to study and evaluate proposed projects

◇ time_to_study

= 2.5

This variable represents the time necessary to study and decide the merits of a suggestion.