IDENTIFYING KNOWLEDGE TRANSFER BARRIERS WITHIN A COMPLEX SUPPLY CHAIN ORGANIZATION.

Presented By

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Declaration

The research presented in this thesis constitute work carried out by the author unless otherwise stated. The thesis is less than 100,000 words in length, exclusive of Tables, Figures, bibliography and appendices, and complies with the stipulations set out for the degree of Doctor of Philosophy by the University of Glasgow.

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List of Contents.

List of Figures.

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List of Publications.

The following peer reviewed publications have been generated based on the findings presented within this thesis. Abstracts for the papers listed below can be found in Appendix H.

Publications arising from this thesis.

McLaughlin SA, Paton R, & Macbeth DK (2006). "Managing change within a complex supply chain: An IBM Case Study", *Decision Management.* 44(8), pp 1002-1019.

McLaughlin SA, Macbeth DK (2006). "Identifying knowledge transfer barriers within a complex supply chain organization", In Mendibil K & Shamsuddin A (Eds), *EurOMA: Moving up the value chain.* Glasgow: Strathclyde University Press.

Articles under review.

McLaughlin SA, Paton R, & Macbeth DK (2006). "Barrier impact on organizational learning within complex organizations", *Journal of Knowledge Management.*

McLaughlin SA, Paton R, & Macbeth DK (2006). "Knowledge strategy framework for process aligned organizations: an IBM case", *European Management Journal.*

List of Abbreviations.

Abbreviation	Meaning
B2B	Business to business
BU	Business unit
CIMOSA	Computer integrated manufacturing open system architecture
E2E	End to end
EMEA	Europe, Middle East, & Africa
IBM	International Business Machines
ICT	Information and communications technology
IDEF	Integrated definition methods
IM	Information management
IS	Information systems
ISC	Integrated supply chain
ISO	International organization for standardisation
IT	Information technology
KM	Knowledge management
KMS	Knowledge management strategy
KPI	Key performance indicator
LOM	Learning organizational model
NHS	National Health Service
OR	Order receipt
OE	Order entry
OD	Order drop
OS	Order ship
ODel	Order delivery
PC	Personal computer
SC	Supply chain
SME	Subject matter expert
SNA	Social Network analysis

Table 1. List of abbreviations. **Source: Developed for research**

Thesis Abstract.

This research is concerned with understanding how organizational performance can be improved through effective knowledge transfer. In particular, the researcher is interested in organizational performance as it relates to those organizations that rely on core horizontal business processes, such as those found within a supply chain. Many organizations develop knowledge strategies to try and utilise existing knowledge within their organizations. However, this process tends to be developed from a top-down perspective, and deployed on an organization-wide basis. It is the researcher's contention that this is not a suitable approach for developing an effective knowledge strategy for supply chain / complex organizations. It is the researcher's belief that in order to develop and define a suitable method for knowledge strategy development and implementation, how knowledge and information are created and shared along core business processes must first be understood. To do this it is important to identify the barriers that impact knowledge transfer across an organization, and more specifically, along core business processes.

By mapping a core IBM supply chain process, and identifying the employee work groups associated with the process (through social network analysis), the researcher was able to identify and assess knowledge transfer barriers, and how they impact along the IBM order flow process. Through a combination of qualitative and quantitative methods the researcher developed an emergent theory concerning how organizations should approach the identification and management of knowledge transfer barriers.

1. Introduction.

"Knowledge has become the key economic resource, the dominant and perhaps even the only source of competitive advantage"

Drucker (1999)

1.1 Introduction.

The importance that effective supply chain integration and management plays in underlining the competitive nature of today's business is becoming better understood by senior business leaders (Moberg *et al*, 2003). Organizations involved with global product and service offerings are now driving supply chain competency as a primary factor in defining their competitive strategy (Kulp *et al*, 2003). However, even though the need for better supply chain integration and management is understood, the implementation of a supply chain strategy often fails to fully realise its potential (Moberg *et al*, 2003).

Much research has been done into the importance of a supply chain focus. The practicalities of modern business introduce a higher level of complexity where organizations now find themselves responsible for all aspects of delivering the customer's required solution. However, after outsourcing many formerly core activities they are now without direct control over certain aspects of the supply chain process, such as manufacturing, order fulfilment, logistics, procurement and / or development. Organizations now need to take a more holistic approach to supply chain management. Implementation of a supply chain strategy now requires organizations to consider the supply chain not simply from a product throughput perspective, but also from process, relationship, technology, knowledge transfer, and cultural perspectives.

The effectiveness of the overall supply chain is dependant on the effectiveness of its core end to end processes (Lee, 1997; Rajiv, 2006). If these processes are broken or poorly designed, supply chain optimisation successes elsewhere along the process may be negated in their overall impact. In order to understand how these different complex factors impact end-to-end performance, organizations should look at how information and knowledge are transferred along core processes, and the factors, or specifically the barriers, which if removed or modified can enable and motivate employees to access, create, and share both information and knowledge. By identifying and understanding how these barriers impact along core processes, organizations should be able to better manage their processes in light of the different complex organizational impact factors.

1.2 Shaping the current Knowledge Environment.

Since the mid-Eighties a lot of work and research into how best to harness the strategic advantages the Information and Communication Technology (ICT) revolution has provided the business community. The advent of more reliable and cost effective networks, coupled with the proliferation of the Internet has seen a marked increase in the demand for integrated 'e-business' solutions that need to support and enhance business response within a dynamic business environment; dynamism enhanced by the very technology created to monitor and respond to it!

Through the 80's and 90's there has been, on a truly global level, a lot of resource and effort put into the development of ICT in order to enhance organizational performance. Organizations, irrespective of whether they are 'for profit' or not, have realised the importance of ICT in enabling the transfer of data instantaneously anywhere in the world. No longer do geographical distances and international time zones restrict the flow of information as before. This access to data has opened the door for a truly '24/7' information culture; an information culture whose characteristics are instant access, quick response, and worldwide access.

So, if organizations now have this never before known level of control over their data, why do so many ICT deployment projects fail to deliver as promised (Davenport 1994, Haeckel & Nolan 1993, Brown & Jones 1998)? Why do many organizations spend millions of pounds on projects that fail to meet the needs of the organization? Why also do so many organizations fail to identify the necessary data within their systems, and act on the data when they do get it right? In a Survey carried out in 2000 by Gartner Group it was estimated that 40% of ICT projects failed to produce their intended results. This report appeared in Journal of Accountancy (News Report, 2001) and highlighted a major contributor to the failures as being the lack of experienced staff working on the projects. This view is certainly supported in a survey of 785 companies by Moss Canter (2001) in which she cites the lack of experienced staff as being a key issue of the time. However, this is not the only reason for failures.

Following closely behind 'lack of experience' is a more 'active' reason for failure. That is the 'resistance to change' experienced by stakeholders in the project. Brown & Jones (1989) highlight ICT failures as being possibly attributable to deliberate actions of specific groups or individuals. Moss Canter (2001) also rates this as key contributor to failure.

What current research (Ragosti, 1998; Haeckel & Nolan, 1993; Moss Canter, 2001), tells us is that those organizations that do not identify and manage the soft issues will fail to tackle the overall complexity of the projects. Organizations need to be aware of the organizational climate, and organizational predisposition to any perceived changes (real or otherwise) that ICT deployments will bring. The speed of ICT deployments and hence the changes to how people work has highlighted the need for an understanding of Change Management techniques throughout the management strata of any organization. People count, and their 'buy in' to any ICT dependant change project is a vital ingredient to its success (Moss Canter, 2001; Davenport, 1994). If an ICT system does not match the user's needs and expectations it simply won't work. What, in fact, will invariably happen will be an increase in work load experienced by the key system users due to the need to use legacy processes to get the job done, and the push to use the new systems to justify the cost of development and deployment (Davenport, 1994).

Davenport (1994) also looked at the problems involved with the deployment of ICT solutions. In his article (Davenport, 1994) he also highlighted the need to address the soft issues, particularly in the form of stakeholder 'buy in'. What is interesting about Davenport's research (Davenport, 1994) is that he highlights what he believes are the information facts of life (highlighted below). This is relevant because most approaches to ICT up to this point had been viewed from a hardware perspective that looked at delivering data structures that meet business data format and reporting criteria. Little thought is actually given to how the data is sourced and then used by people.

Davenport (1994) puts forward 10 'Information Facts of Life' that try to tie the soft aspects of data management into ICT systems solutions. In particular, he (Davenport, 1994) puts forward the following points that are important as they have helped shape the researcher's initial concerns relating to knowledge management implementation.

1. *Most information in organizations and most of the information most people care about isn't on computers.*
2. *Managers prefer to get information from people rather than computers; people add value to raw information by interpreting it and adding context.*
3. *If information is power and money, people won't share it easily.*
4. *Since people are important sources and integrators of information, any maps or models of information should include people.*
5. *The willingness of individuals to use a specific information format is directly proportional to how much they have participated in defining it, or trust others who did.*

These are only a subset of Davenports 'Information Facts of Life'. However, they help redirect the focus on ICT systems from the 'technical' components of the solution to the 'people' component of the solution. Arguably, when these are considered along with the technical aspects this makes for a far more complex project. With this complexity also comes a better awareness of the demands and difficulties facing any organization in the development and successful deployment of any ICT system.

1.3 Pre-understanding of the Problem.

In order to start the research from a common point of understanding it is important to have some awareness of the background of the researcher. The researcher is currently employed within IBM's Integrated Supply Chain, which is located in Greenock, Scotland.

The researcher's current role looks at ISC Optimisation and Serviceability for the PC products (laptop, desktop, monitors, and peripherals) and X Series products (Intel based servers and their associated options). To support this role the researcher manages four separate support departments; Serviceability, Sales Reporting, Business Controls, and Optimisation. Throughout the departments there are 24 employees engaged in these activities.

Prior to this role the researcher worked as an IBM Fulfilment Operations Manager for EMEA Central and Nordics Regions, and before that IBM EMEA Technical Support Manager. In total the researcher has spent 8 years working in different parts of the IBM organization. However, a common theme throughout has been the management of product and services through different parts of the supply chain. This role has also necessitated the need to work with, and rely on different parts of the organization in order to achieve any level of success.

The problem the researcher has identified is in part based on his time in ICT technical, and business management roles. In 2001 IBM set up an internal organization specifically to look at improving cost and efficiency through supply chain management. This organization is called the Integrated Supply Chain (ISC). In effect the ISC will focus on Manufacturing, Procurement, Global logistics, and Customer Fulfilment as its four key areas for integration and improvement.

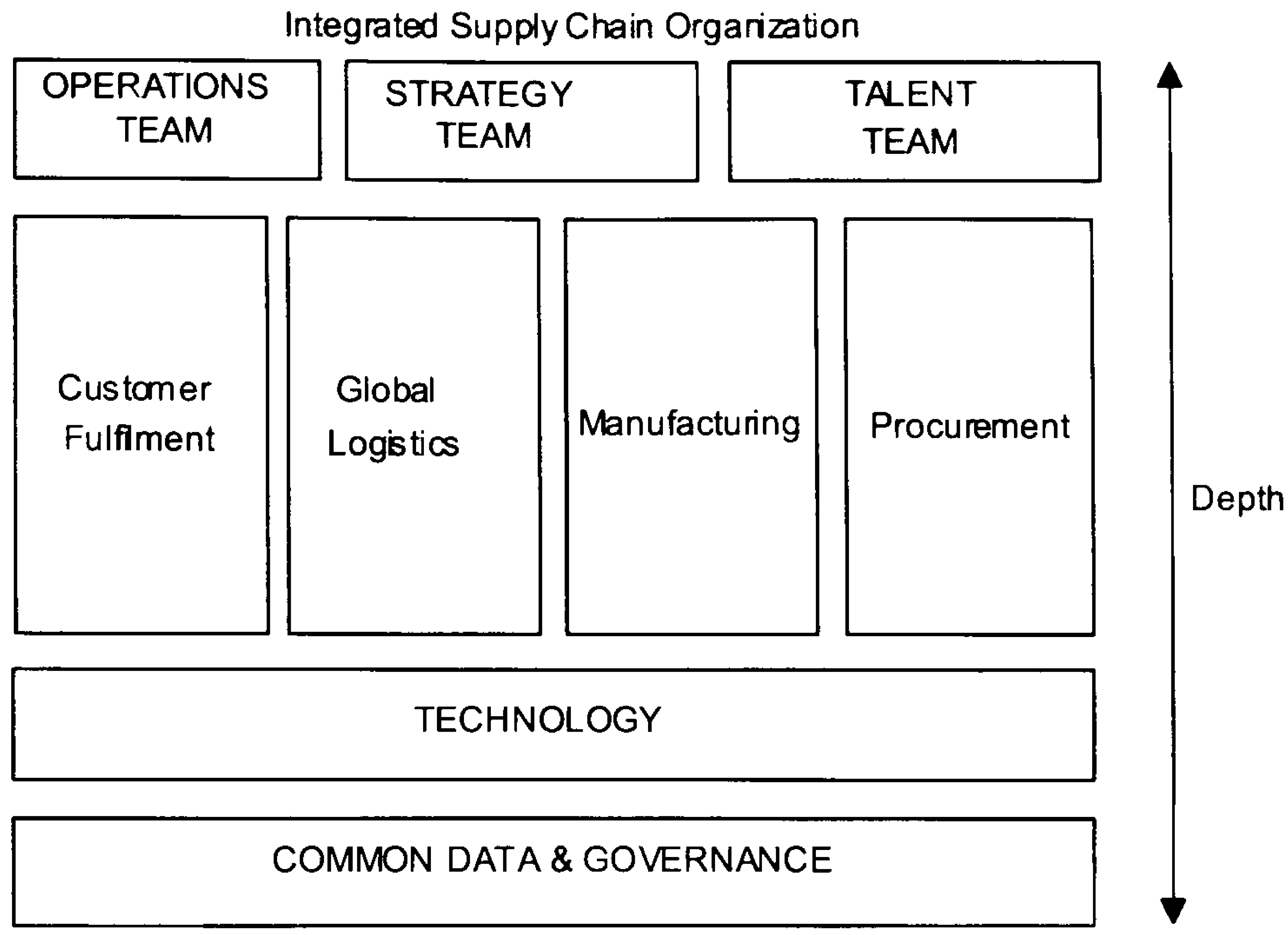

Figure 1.1 IBM ISC organizational structure. Source: IBM Corporation 2004.

The new ISC organization will pull the four key organizational components together under one umbrella organization. However, they are all mature, fully formed entities that up until the formation of the ISC operated as independent organizations.

The challenge of getting the ISC to operate as a single minded entity is compounded by the fact that Procurement, Manufacturing, Global Logistics, and Customer Fulfilment would continue to operate with their own independent management systems and structures. Although up to 2003 saw initial cost savings in excess of $7bn USDs the long-term benefits of the supply chain would surely be in its efficient and effective operation as a horizontally integrated organization (Lee 2003). With such a complex organization to support the speed at which information is made available, accessed, and acted upon would be a vital component to the success of the supply chain. But surely this isn't just about the performance of the ICT systems? What about the people?

The organization is in an almost continuous state of change; systems, reporting lines, product scope and deliverables. Within this environment how does the organization ensure the right information is being made available in the right time frame to the right people? These are issues the researcher feels do not just relate to the supply chain environment, but in fact any business which decides to concentrate its main resources on its competitive differentiators whilst outsourcing its non-competitive functions to service providers.

At a top level the researcher is keen to understand what the key points are any business in this position should identify and focus on. Whilst working for IBM the researcher's experience has indicated that when faced with change the emphasis has been more on what technology is needed to support the change, as opposed to how the people will actually use the technology in the new structure. As the business changes we demand more from our employees and in order to manage and support their efforts we need to understand not just how our ICT systems work, but also how people collate, use and share the information these systems carry. Couple this with the need to shift organizations from a vertical alignment to a horizontal alignment compounding further the complexity of issues of ownership, trust, and job security; the effects of which need to be taken into consideration. This is the area that most interests the researcher.

1.4 Motivation for Research.

Whilst working as a Project Manager with IBM the researcher was made aware of the problems incurred when the 'human' factor was not considered when designing and developing ICT solutions. In IBM's case the main failing was possibly not down to a lack of key technical skills (Brown & Jones 1998; Moss Canter 2001) but in fact down to a lack of understanding of the business processes the ICT systems were being designed to improve. Due to the size of the organization, technical, ICT professionals and business operations professionals worked, for the most part, independently of each other. Therefore, the main contact between the business problem owners and solution providers happened during initial requirements capture and product test prior to deployment. As one can imagine this situation has lead to many misunderstandings concerning the final solution deliverables.

This situation has improved with the introduction of a tier of Business/ICT managers who coordinate ICT solutions to business requirements. However, solutions still fail to hit the mark, be it due to over expectation of what ICT can deliver by the business process owners, or misunderstanding surrounding what the end customer actually wants from the ICT systems designers.

Even with better communications between the designers and end users / system owners ICT projects are still very much driven as technical projects (Murray 2001). Due to advances in the technology used in developing applications the gulf of understanding between the business process owner and the skills employed by the systems designers is widening. This makes it difficult for business process owners to participate in projects past the data gathering stage. This in turn can result in most of the design decisions being taken by the technical specialists. In general this may not always been seen as a bad thing. However, this can and does in some cases lead to misinterpretation of end user needs. A decision to opt for one technology over another may seem to the solution designer a simple choice based on the attributes of the technology, but in fact may have restrictive consequences on the final business solution in terms of scalability, transparency, and system inter-connectivity.

What interests the researcher about this dynamic between business process owners and solution designers is the impact the subtle shift away from Information Management (IM) to Knowledge Management (KM) will have on project delivery success. Many organizations, including Governments (UK Government, DTI 1998), are looking at the importance of managing knowledge within their organizations as a means of improving their competitive advantage. Up until the mid-1990's IM, and KM, for many people meant the same thing. IM was the control and management of data throughout the organization. The emphasis is placed on the speed of processing raw data, the presentation of that data into a useable format, and its subsequent delivery throughout the organization. In essence the focus is on the technology needed to move, store, manipulate, and display data within the boundaries of the ICT system. However, KM looks at this from a different perspective. With KM the focus is on how information flows and is actually used (productively) throughout an organization. Therefore, Knowledge Management is not bounded by any one ICT solution. Nor is it concerned just with data or information per se, but with the end product once it has been contextualised and 'value add' has been provided by human input.

Certainly the flow of information throughout an organization will be enhanced by ICT systems and, therefore, a successful KM initiative will also have a backbone ICT solution, or solutions to support it. In fact it could be argued that a successful KM initiative depends on a knowledge-centric ICT solution. Therefore, the drive towards KM solutions will introduce further complexity into the design and delivery of ICT solutions. In a lot of cases, certainly with large-scale ICT projects, organizations struggle to deliver. The added complexity of ensuring the ICT solution also drives knowledge development, capture, use, and growth within an organization is going to make the projects a whole lot more difficult. Business functions and ICT development teams need to be more in tune with each other's requirements and needs. The subtleties of successful KM can easily be overlooked and focus can drift back to the demanding issues of getting the technology working. From the researchers own experience within the work environment, complex technical issues tend to drive the overall focus of the project.

The concepts of KM are straightforward and will be dealt with in more detail later in this thesis.

1.5 Problem Outlined.

The changing global economic landscape now sees many organizations fighting to compete with organizations that can take advantage of a lower paid work force. Organizations are driving cost out of their businesses not just to be profitable, but also to survive. Western organizations need to remain competitive against their 'low-paid' competitors but how can they do this? There are many options open to businesses; outsourcing cost centres, automation of manual processes, tighter internal cost management... All these measures (and more) will help to remove cost from any business. However, organizations need to be more than just cost effective to win in the global market place; they must be innovative if they are going to stand out and become the market leaders (Carrillo & Gaimon 2000, Von Krogh, Ichijo & Nonaka 2000).

A lot of organizations now realise that in order to unleash the innovative spirit within an organization they must enable effective knowledge transfer within the organization. Unfortunately, due to strategic outsourcing initiatives and business unit specific cost drivers, organizations are becoming more complex in their structure and operation. An example of this being the supply chain organizations that can outsource components such as manufacturing, procurement, and possibly distribution to name a few. We now have different organizations providing support operations to a virtual supply chain. This introduces the following complexities in managing the supply chain, and more importantly managing the 'knowledge flows' through the supply chain.

- **Inter-organizational trust** - *How do we get people to share what they know across inter-organizational boundaries and to ensure quality of service is maintained?*

- **Intra-organizational trust** – *How do we get departments and functions to share knowledge across the organization? If we remember that knowledge is power when Departments / Functions are in direct competition with each other for funding this will impact the flow of knowledge.*

- **Common understanding of terms** – *Need to ensure everyone understands and agrees on the terms to be used throughout the 'virtual' organization.*

- **Commonly agreed priorities** – *Once a service is outsourced the new provider may not work to the same set of priorities as the original service provider. This can cause inconsistencies in the quality of the service being provided.*

Within a complex supply chain organization the aforementioned issues will impact the flow and use of knowledge. As ICT will provide the core backbone infrastructure to enabling the knowledge flow, one questions how organizations can ensure that Knowledge Management Systems (KMS) can be successfully implemented? When we consider the issues that effect the deployment of complex ICT projects, what additional issues do we need to identify as key barriers / enablers to the successful delivery of a KMS? Although different organizations will have different needs and different knowledge habits based on cultural behaviour, are there generic critical success factors that must always be considered prior to a deployment?

A large part of current research in the field of KM deals with how knowledge is developed and flows in organizations (Bhatt 2001), but fails to identify what makes a successful KMS implementation. However, there are many consultancies that will advocate certain methodologies over others, whilst offering little empirical data to support their claims. Largely the methodologies fall into one of two camps (Tiwana 2000; Hansen, 1999). The *Personalised* approach looks at basically developing a KMS around how people communicate with each other, whereas the *Codified* approach looks to build its KMS around data repositories and warehouses. As consultancies tend to favour one approach over the other it begs the following questions;

- *Is there a real value in using one methodology over the other?*
- *Are there aspects of each methodology that need to be matched to the specific project requirements?*

IBM's Integrated Supply Chain (ISC) organization is currently going through a lot of change, and like a lot of organizations is looking to improve its effectiveness through improved business operations within an outsourced environment. Over the next 12 -18 months the organization is looking to introduce system changes which will result in a better customer experience whilst also looking to reduce the length of the supply chain. The success of this system will in no small way rest on the organization's ability to communicate information and utilise knowledge that resides throughout the supply chain.

The development of the ICT systems to support the ISC processes will be built using industry standard applications such as, SAP, i2, DB2 etc., and will be developed using industry standard project management techniques such as PRINCE, SSADM etc., The research opportunity here is to look at the development and deployment from a KMS perspective. From this vantage point can it be determined what the key implementation considerations are for the development and deployment of a suitable knowledge strategy within a complex environment? Once identified and defined, can the barriers to implementing those drivers also be identified? If so, this could provide an overview of the generic success factors any organization embarking on a complex KM solution must be aware of, and the key barriers that may conspire to prevent them from succeeding.

As a senior manager within IBM's Integrated Supply Chain (ISC) organization the researcher is very keen to understand how KM solutions can be successfully deployed to improve organizational performance across the supply chain. Whilst conducting this research a clear understanding of what Knowledge is, as opposed to Information or Data, will need to be achieved. It is possible that most of the research will focus around this differentiation point. It is also the belief of the researcher that the failures of knowledge management initiatives can be largely attributed to an organization's failure to holistically manage knowledge from a codified (explicit) and personalised (tacit) perspective.

Also an understanding of the supply chain in relation to KM systems will need to be developed. This is important as the successful mapping of any solution is dependant on a clear understanding of what is driving the need, in terms of business processes and organizational structures.

Although this research will be carried out with IBM the findings will be tested by way of exploratory case study analysis (Yin, 2002) with other complex organizations. Therefore, it is believed the findings will have relevance for any complex organization working to develop its own knowledge strategy.

1.6 Research Aim, Objectives, and Research Questions.

Knowledge management is certainly believed to be an important part of driving value within any knowledge economy. However, the question is really how do you actually manage knowledge, or know if you are doing this effectively? IBM sells knowledge management consultancy services, and through the use of its intranet sites pushes the importance of knowledge and asset management to its internal business units. From an ISC perspective the importance of Knowledge Management is expressed at a high level. Executive management push the importance of the knowledge worker and the need to share what we know throughout the organization. ICT solutions have been developed to help aid the sharing and transfer of information. These include Lotus Notes, Sametime instant messaging, Team rooms, IBM Blue Pages, Collaborative Team rooms, Blogs etc; all of which are very systems centric.

However, the ISC is made up of individuals who are driven by other influencing factors to share knowledge, other then to simply use the ICT systems. At one level just about every employee will use these systems. Therefore, what needs to be considered is the degree to which these systems will be used.

1.6.1 From Business Problem to Research Problem.

It is the researchers considered opinion that organizations, whilst creating knowledge transfer systems, are not effectively concentrating on ensuring the systems fit with the practices of knowledge transfer used by employees, or take into consideration the 'softer' issues which affect an individual's readiness to share information, such as trust, job security, shared context, shared / conflicting business interests etc. The more tangible aspects of knowledge management are certainly easier to focus on. However, as organizations need to be more responsive to market forces (especially supply chain organizations) the softer aspects of knowledge management become more important as systems don't make decisions...people do; decisions whose quality is based in no small way on the quality and accessibility of information.

This leads on to the researcher making a *Critical Assumption*, which in turn will drive the research methodology and method.

Critical Assumption: ***Failure to identify Knowledge Management barriers to performance will lead to sub-optimisation of the supply chain process.***

1.6.2 Defining the Research Scope and Objectives.

Because the supply chain incorporates so many different business functions and looks for high levels of coordination and cooperation between them it can be considered complex in nature. The levels of complexity from an organizational alignment to process control will be varied and different dependant on the organization being researched. Therefore, it is not the intention of the researcher to study and analyse the entire supply chain, but to investigate one key core supply chain process that spans the organization and is critical to the overall success of the supply chains performance. This will allow for the testing of the critical assumption.

For the purposes for this thesis the research will focus on the core order management (order flow) process through the supply chain. The reason for choosing this process is because it touches multiple areas/groups across the supply chain. As the assumption is concerned with knowledge management's impact on performance the intent is to look at the key knowledge transfer points through the process with a view to identifying any key barriers.

As the ISC management team have a view on how effective knowledge transfer will be throughout their organization, the intent will be to conduct the research from a bottom-up perspective. The researcher is keen to get a clear understanding of the problems employees face with information transfer around key performance bottleneck points along the process.

1.6.3 Defining the Research Questions.

The research question (RQ) can now be expressed as follows:

RQ: ***How does a Supply Chain Organization ensure barriers to performance related knowledge transfer are identified and managed?***

The following assumptions are made:

- The research is *not* focusing on aspects of the supply chain particular only to IBM. The intent is to identify the *primary* core process for order flow / management, which although it may not be exactly replicated within other organizations, will have elements which match. Also, a key point for choosing this process is its complexity due to the many departments and business functions involved in the daily operation across the organization.
- The research will focus on the way knowledge transfer is inhibited at the key linkage points within the supply chain order process, and how an organization can identify these barriers and manage them.

- Once the barriers are identified and their impact on performance is assessed this information will be reviewed with other supply chain / complex organizations for concurrence.

In order to answer the Research Question the following sub-questions (SQ) will need to be addressed.

SQ1: Why the need for Knowledge Management (KM) within a supply chain (complex) organization?

- What does current research say about how KM impacts organizational performance, and in particular how KM impacts horizontally and vertically aligned organizational performance. (*Secondary Research*)

SQ2: What is the core process flow for order management through the supply chain?

- Need to identify and map the business process for order flow. (*Primary Research*)
- Need to identify the Key Performance Indicators (KPIs) performance points within the process flow. (*Primary Research*)
- Need to identify the 'map' points through the process where knowledge transfer needs to happen in order to support performance. (*Primary Research*)

SQ3: What are the key performance indicators in a supply chain?

- What are the KPIs for the supply chain, both from an IBM perspective, but also from a generic industry wide perspective? (*Primary & Secondary Research*)
- Investigate using primary research of company reports and serviceability documentation. Also use secondary research from journals / textbooks to identify generic KPIs. (*Primary & Secondary Research*).

SQ4: Where are the Knowledge Transfer points that supports the order flow process within the Supply Chain?

- Map the organizational ownership boundaries over the core order process to help identify the main cross boundary transfer points in the process. (*Primary Research*).
- Separate out the IBM specific transfer points if not relevant to generic KPI metric generation, or process flow. (*Primary Research*).

SQ5: What are the barriers to Knowledge Transfer?

- What does current research say about barriers within organizations to efficient knowledge transfer? (*Secondary Research*)
- How does this research relate to knowledge transfer within a horizontally aligned organization? (*Secondary Research*)
- The need to understand the difference between knowledge and value-add knowledge. (*Secondary Research*)
- What are the knowledge transfer barriers within the core order flow process? (*Primary Research*)
- How do these barriers relate to key performance points within the process? (*Primary Research*)

1.7 Scope of Thesis.

From a methodological perspective this thesis falls into two parts; theory building and theory testing. Theory building represents an important part of this research followed by the practical validation of the theory and as a result, the literature review is distributed throughout the thesis.

The scope of the thesis and literature review covers change management, organizational development and learning, complex systems theory, and operational supply chain theory. All of these key management fields have had significant research conducted within them over the past 25 years. However, from a knowledge transfer management perspective little research has been done to link pure theory to the practical application of knowledge management within a real-time environment (Bhatt *et al* 2001). In an attempt to answer the proposed research question it is important to accept the fact that knowledge management demands a holistic overview of how organizations operate. Therefore, an understanding of how change management, organizational learning and development etc., can act to influence the knowledge environment is needed.

In effect the research looks to identify and highlight the importance of looking at knowledge management from a holistic, bottom-up perspective. If an organization is to successfully develop methods of sustained and effective knowledge transfer it cannot develop knowledge management programmes separate to the normal operating practices. It is the researcher's belief that knowledge management needs to be inherent within how the organization operates. Therefore, in answering the research question the researcher hopes to be able to identify a generic approach that complex organizations can adopt to help identify key (generic) steps for ensuring knowledge management strategy and implementation is properly embedded within the organizations way of doing business.

1.8 Structure of Thesis.

In order to answer the proposed research question an understanding of certain ideas and basic concepts needs to be developed. The research question not only relates to knowledge, but also the relationship between knowledge, information and performance within a complex organizational environment. Therefore, before a suitable research methodology can be decided on, and conclusions drawn, these aspects of knowledge enablement must first be defined.

The thesis structure will look to define the key components and their interdependent relationships through the early chapters (1-4). Once the researcher has defined knowledge, information, knowledge management, performance and their relationships a clearer view of the most suitable research methodology will be reviewed through chapter 5 (Choosing the right research approach). Once this has been completed the process of gathering and analysing data will begin.

From chapter 6 (Understanding the process) onward the chapters are laid out in the order in which the key stages of data gathering and analysis occurred. Each chapter will contain a chapter conclusions section that will re-cap on all the salient points and findings highlighted throughout the respective chapters. Chapters 8 and 9 will look at developing and testing the researcher's findings. It is within these two chapters that the researcher will look to develop and test any emergent theory based on the research question.

The thesis will conclude with a conclusion chapter (chapter 10). The researcher will identify the top-level findings, and review how the thesis has addressed the research, and sub-research questions. The researcher will also use this opportunity to identify possible further areas for research that have been identified through the course of the PhD process. It is also important to remember that the PhD process is a learning one, and as such the researcher will include some of the main reflective points, and lessons learnt whilst conducting the research.

1.9 Chapter Conclusions.

Through practical experience the researcher has seen knowledge management initiatives fail. This failure to properly identify a suitable knowledge strategy can and does influence organizational performance issues. As organizations start to identify the need to develop a supply chain competency the level of complexity, from an information and knowledge perspective increases significantly. With this in mind the researcher is keen to understand how complex organizations can utilise knowledge transfer techniques effectively in order to drive up core supply chain performance. However, before knowledge management can be effectively implemented organizations need to understand what barriers within their complex operating environment impact information and knowledge creation and sharing practices. By understanding how information and knowledge are accessed, created, and shared along a core business process the researcher contends that the organization can then define the best strategy to help support and develop the information and knowledge habits as they relate to the core process. Once this is understood the researcher can address the fundamental research question, and develop a generic framework for other complex organizations that will guide them in understanding how barriers impact across their own complex organizations.

However, before an organization can determine how knowledge barriers impact across their organizations an understanding of what knowledge is, and how it differs from information must first be understood.

2. Defining Knowledge Management.

"A word means what I want it to mean, nothing more and nothing less"

Carroll (1928)

2.1 Introduction.

According to Sveiby (1997) employee competence is a key organizational intangible asset that needs to be understood. Therefore, in order to understand competence one needs to understand one of competence's key components; knowledge - hence the question '*What is knowledge?*' Philosophers have been asking this question since the time of Plato, and still there is no consensus on a definitive answer.

The term 'epistemology' refers to the theory of knowledge and comes from the Greek word 'episteme', which means absolute certain truth. However, the English word 'knowledge' is more flexible and is harder to define having many different meanings to different people. To some it means simply 'information', to others it can mean, awareness, knowing, cognition, experience, learning, wisdom, certainty, know-how, sapience, and so on. In effect, knowledge means different things to different people depending on the context in which they use the term. This is an significant point as the difficulty in defining a precise definition of knowledge is clear when considering the way in which people in business and ICT freely interchange the words 'knowledge' and 'information' when describing their processes and systems.

2.2 What is Knowledge?

In order to try and get an overall feel for how the different thinkers and practitioners view knowledge within the fields of knowledge management research and application, the following table (Table 2.1) has been compiled. The definitions vary, however, what the researcher is interested in understanding is if the definitions used relate to knowledge as a cognitive process, or a technology driven process. The table has a column attached (titled Focus) by the researcher that identifies each definition as being either function of a cognitive process, a technological process, or a combination of the two.

Source	Definition of knowledge	Focus
Plato (369 BC)	*Knowledge is justified true belief.*	Cognitive process
Davenport TH (1998)	*Knowledge is information combined with experience, context, interpretation, and reflection.*	Cognitive process
Davenport & Prusak (1998)	*Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information.*	Cognitive process
Tiwana (2000)	*Knowledge is simply actionable information. It is formed in and shared between individual and collective minds. It does NOT grow out of databases but evolves with experience, successes, failures, and learning over time.*	Cognitive process
Nonaka (1995)	*Knowledge is mutable and can take many faces in an organization...knowledge is justifiable belief.*	Cognitive and Codified processes
Durand *et al* (1996)	*The whole of the rules (know how, know what, know where and know when) and insights (know why) that can be extracted from, and help make sense of information.*	Cognitive process
Delong & Fahey (2000)	*Knowledge is a product of human reflection and experience.*	Cognitive process
Dretske (1981)	*...that knowledge flows from, and influences, the interpretation of information.*	Cognitive process
Sveiby (1997)	*Knowledge is made up of four characteristics: Knowledge is tacit, action orientated, supported by rules, constantly changing.*	Cognitive process
Polanyi (1958)	*Tacit knowledge achieves comprehension by indwelling, and...all knowledge consists of or is rooted in such acts of comprehension.*	Cognitive process
Malhotra (2000)	*...it embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings.*	Cognitive and Codified processes
Fuller (2001)	*Knowledge is the minds receptiveness to what lies outside it.*	Cognitive process
Von Hayek (1952)	*Knowledge is a property of individual minds that largely reflects their unique circumstances...*	Cognitive process

Table 2.1 Knowledge Definitions. **Source: Developed for research.**

As shown in Table 2.1 definitions of knowledge and knowledge management predominantly focus on the need for human interaction in order to generate knowledge, with the generation of knowledge being very much a human function. This is not an exhaustive list but a list of the key definitions currently being used in academic research and business literature. The definition proscribed very much depends on the source's viewpoint and own experiences. For example Sveiby (1997) states that even his definition depends on the context in which the term (knowledge) is used.

It is not the intention of this thesis to define an all-encompassing definition for knowledge, as that would constitute an entirely separate research question. What the researcher needs to do is select a definition that best suits the knowledge environment in which the research is based.

The list of definitions in Table 2.1 establishes knowledge as a human-centred concept. Knowledge creation and use is dependant on human interaction within an organization or process. Prusak and Davenport (1998) provide the most commonly accepted definition of knowledge within organizational and business research. Considering the number of peer references to this definition and its open and encompassing nature the researcher will use this definition.

"Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a frame work for evaluating and incorporating new experiences and information."

Davenport and Prusak (1998)

However, it is possible that the reason why Davenport and Prusak's definition is so widely cited is because of the broad, encompassing nature of their definition. Whilst the definition calls out the components of 'knowledge' it fails to show how they link or interact. According to Tsoukas (2005) what we're left with is a statement that does little to remove the existing ambiguity that surrounds knowledge.

From the list of definitions provided it is interesting that although knowledge is perceived to be very much dependant on human contextualisation of data, and the definitions very human-centric nature, the majority of current knowledge initiatives are based on technology (Pawar *et al*, 2002). This may create the perception that knowledge is dependant on information technology or, to some, knowledge management systems amount to the same thing as information systems. An interesting idea considering the concepts of knowledge creation and distribution pre-date the information technology boom of the 1980's and 90's.

From Polanyi (1958), Nonaka *et al* (2000). and Sveiby (1997) the concept that knowledge is made up of two key elements; tacit and explicit is introduced. This concept is important, as it has shaped how organizations view knowledge from a practical perspective, and subsequently try to harness and 'manage' knowledge.

2.2.1 Tacit and Explicit Knowledge.

Two key components to knowledge as generated and used within any organization are Explicit and Tacit (Polanyi, 1958; Nonaka *et al*, 2000; Smith 2001). Tacit is very much dependant on the individuals experiences and perspectives. This is difficult to capture from a systems perspective, with most knowledge management (KM) systems relying on explicit knowledge capture as the main focus. In fact some researchers make the point that in order to improve KM efficiency an organization must focus on ICT, and intelligent agents (Carneiro, 2001). According to Johannessen *et al* (2001) there is a real danger that because of the focus ICT solutions have on mainly explicit knowledge this may relegate tacit knowledge to the background and hence a knowledge mismatch. Therefore, in order for KM systems to maximise their potential they need to be able to address the question of how to capture and work with tacit knowledge, but not just through the use of ICT systems. From an organizational perspective this means understanding how knowledge becomes embedded in organizations, in what form this knowledge takes, and how individuals react to, and draw on it.

A lot of development work is going on to capture this knowledge using such techniques as Story telling, Collaboration, Social Network Analysis etc., However, these techniques provide methods of identifying and capturing knowledge – as yet it has to be shown that the technology is currently in place to automate and manage these processes (Marwick 2001).

Although the concept of tacit knowledge is clearly defined and understood from a psychologist's perspective (Shirley & Langan-Fox, 1996; Sternberg, 1997) the view of Nonaka (1995) is that measuring tacit knowledge is a 'risky proposition'. Nonaka's reasoning being that this form of knowledge is too abstract and elusive in nature, and therefore, exceedingly difficult to capture. Even though researchers such as Castillo

(2002) try to break down tacit knowledge into more manageable sub—groups; in this case *socio-cultural*, *semantic*, and *sagacious* tacit knowledge, the fundamental distinguishing characteristic does not change. It is this abstract and elusive characteristic that continues to make tacit knowledge difficult, if not impossible to capture. So, does this mean that of the two components of knowledge, explicit is merely information, and tacit is too abstract a concept to manage? If this is the case how can these two components be managed? If one considers the definition of knowledge it becomes clear that the focus should not be on the management of any one component. The point of interest is not how tacit or explicit knowledge function on their own, but how tacit and explicit knowledge interact, and possibly how information and knowledge is created or lost through this continuous process.

2.2.2 Nonaka's Model.

In 1995 Nonaka and Takeuchi produced their seminal work on the way organizations learn through tacit to explicit knowledge conversion. The work was largely influenced by Polanyi's (1956) work identifying tacit knowledge as a form of knowledge. In their work Nonaka *et al* (1995) proposed four modes of knowledge conversion that are shown in Figure 2.1.

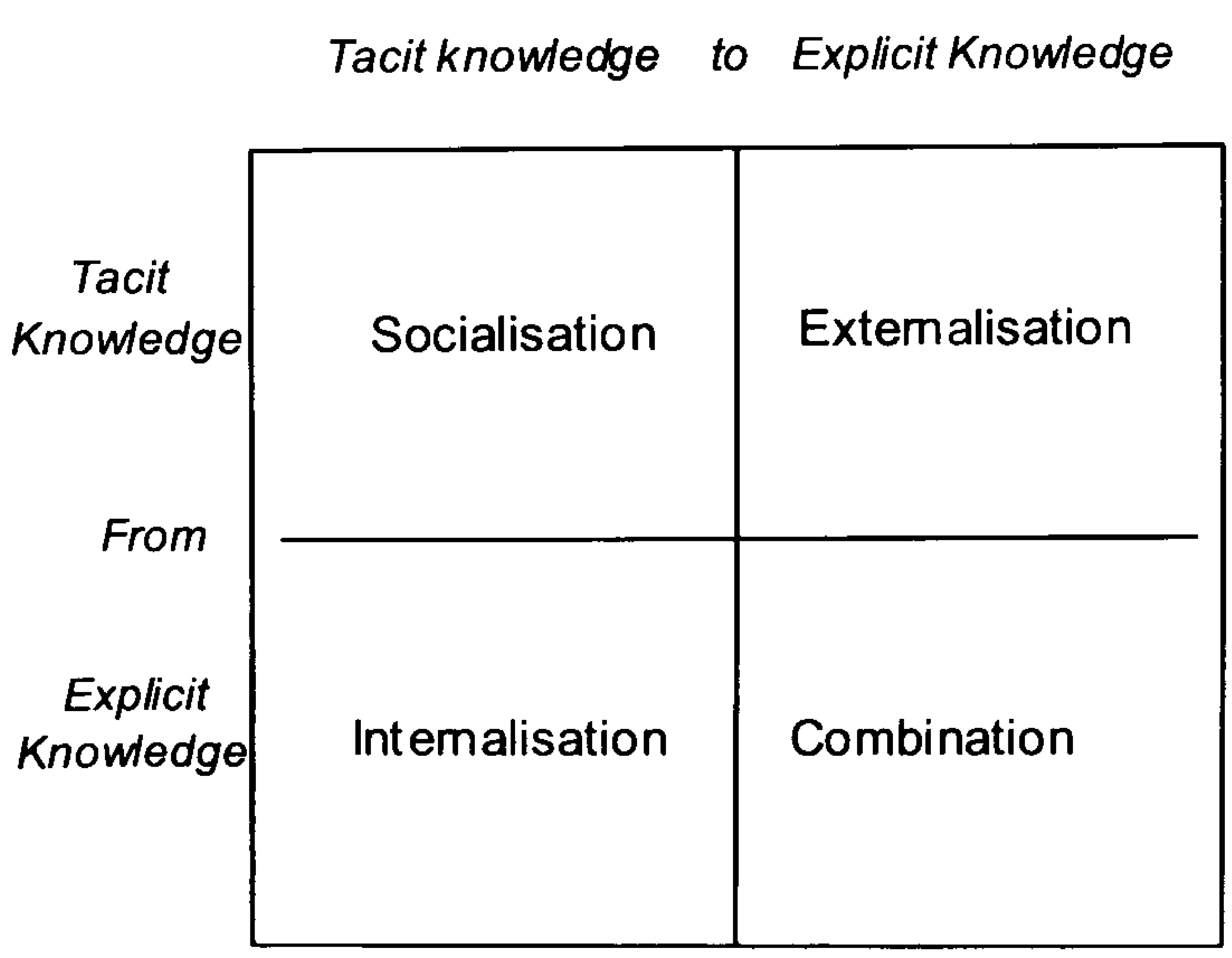

Figure 2.1 Modes of knowledge conversion. Source: Nonaka *et al* (1995)

The modes referred to how they perceived knowledge to form and transfer between tacit and explicit states through different stages. The four stages as identified by Nonaka *et al* (1995) are:

1. **Socialisation** – Tacit to Tacit. *Where individuals share personal knowledge with their peers through personal contact / interaction. An example of this is when individuals share common experiences in meetings, over coffee, at the water cooler.*

2. **Externalisation** – Tacit to Explicit. *When individuals codify their tacit knowledge. An example of this is when individuals load information onto ICT systems or write reports / documents.*

3. **Combination** – Explicit to Explicit. *When information in one codified format is transferred, or re-formatted into another codified format. An example of this is when ICT systems transfer data / information between each other.*

4. **Internalisation** – Explicit to Tacit. *When individuals try to take codified information and contextualise it in order to develop tacit knowledge. An example of this is when individuals pull information from ICT systems / reports / documents.*

It is important to point out at this junction that there is some concern over the way Nonaka *et al* (1995) describe the process of socialisation, or more specifically how tacit to tacit transfer can happen (Wilson, 2002). Assuming the absence of telepathy amongst employees, how can tacit knowledge be shared with out first being explicitly expressed through, say speech? If we accept the definition of tacit knowledge as already provided in this chapter, then we must accept that pure tacit to tacit transfer cannot happen without some explicit element. The researcher accepts this argument, but still accepts the process of socialisation as a valid stage in the learning organization model for the following reason. If one looks at the stages as relative knowledge transfer stages then the tacit to tacit can have an explicit component. What is important is that the type of knowledge transfer is happening between individuals on a face-to-face level. So, although speech maybe used to explicitly express the thoughts of an individual, gestures, facial expressions, situational context, practical example, and vocal inflections will all complement the verbal (or written) explicit knowledge being passed. Therefore, a significant difference between *socialisation* and the other three stages is the level of contextual, semiotic and personal information that is transferred with the explicit knowledge. Once again it is expected knowledge will be lost through the tacit to tacit transfer process.

Nonaka *et al* (1995) also identified a pattern of information and knowledge flow around this model. They proposed that knowledge would accrue and grow through the transfer process where tacit transformed to explicit, and back to tacit. Figure 2.2 show how Nonaka *et al* (1995) believed organizations developed internal knowledge as part of their learning process.

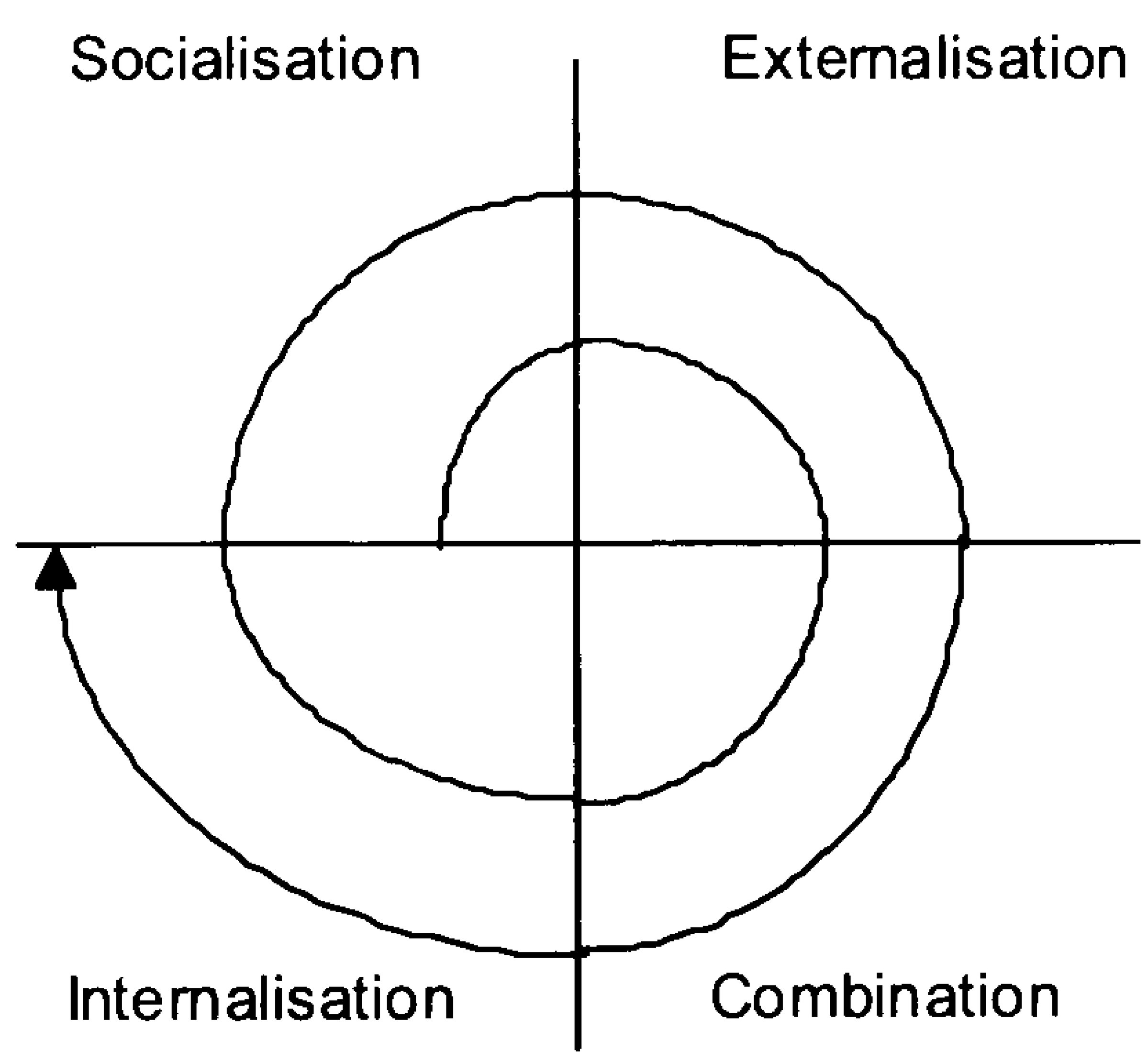

Figure 2.2 Knowledge flow in learning organization. Source: Nonaka & Takeuchi (1995)

The model shows an outward spiral representing increasing knowledge. This knowledge is growing as it passes through the four stages of tacit/explicit interaction. This theoretical model is widely cited as showing how knowledge, as a combination of tacit and explicit, behaves within an organization.

However, to accept this model is to accept the fact that there is no or negligible knowledge loss between tacit and explicit and back to tacit at any stage along the process. If we assume that people do not tell all they know, or write down all they know then one can assume there will be some knowledge loss through this process.

Herschel *et al* (2001) support this view that failure to focus on the tacit to explicit transfer points will impact the knowledge amplification process across the organization.

Can we identify what will cause this knowledge loss, and develop a framework for reducing the impact? It is the researcher's belief that in order to allow and encourage knowledge transfer the barriers that inhibit transfer must be first identified. This will be a key task in this research project if an understanding as to how organizations should define their knowledge strategy is to be developed.

2.3 What's the Difference between Information and Knowledge?

As discussed, knowledge is an abstract concept that can mean different things to different people when viewed in different contexts. The previous sub-chapters have identified a definition of knowledge (Davenport *et al*, 1998) that is being used to identify knowledge from a complex organizational perspective. Even this definition (Davenport *et al*, 1998) is open to interpretation. One of the questions asked of the researcher by many work colleagues, academics, and research participants is '*What's the difference, if any, between information and knowledge?*'

Fuller (2001) addresses this question by highlighting the fact that the terms are often used to mean the same thing. This is a view that is also supported by Tsoukas (2005). This in effect has reduced the significance of knowledge, often reducing it to merely information. The qualities of knowledge, as a classic philosophical concept are lost. In order to try and distinguish between information and knowledge Fuller (2001) looks at the original meaning of information. 'Information' was derived, during the Middle Ages, from a Latin word used to describe the process by which documents were transferred, or communicated, from one entity to another. As for 'knowledge', this was the mind's representation of this process, which in turn was usually understood in relatively passive terms. Knowledge, in effect, was the result of the minds receptiveness to what lies outside it.

Simons (1945) seminal work 'Administrative Behaviour' and March & Simons' (1958), 'Organizations' also tackled the question concerning the difference between information and knowledge. Simons (1945) developed and used the concept of

Bounded Rationality to build a computer model of the human thought process as a form of information processing. Simons found that according to his model humans act as information processing systems that extract 'meaning structures' from information inputs through sensory organs, and store these meaning structures as new knowledge. Although Simons views failed to capture the proactive nature of humans in problem solving and the subsequent generation of new knowledge, his view that information only becomes knowledge within the context of the human mind is supported by Davenport (1998), Prusak (1998), Fuller (2001) and Von Hayek (1952) and Polanyi (1962).

Pondering the differences between information and knowledge is not limited to thinkers within the academic world. As a sign as to how important the need to understand the fundamental differences between these two concepts are, KPMG (1998) has also invested time and resources into understanding the difference. From KPMG's perspective the difference between knowledge and information is the clear emphasis on the proactive involvement of users. Nonaka & Takeuchi (1995) also support this view by basing the difference between knowledge and information on three observations.

1. *Knowledge, unlike information, is about belief and commitment. Knowledge is a function of a particular stance, perspective, or intention.*

2. *Knowledge is about action. It is always knowledge to some end.*

3. *Knowledge, like information is about meaning. It is context specific and rational.*

In order to further understand the differences between information and knowledge, information, according to Shannon & Weaver (1949), should be viewed as *syntactic* and *semantic*. Syntactic refers to the volume of information, whilst semantic refers to the meaning of information (Shannon *et al*, 1949). The semantic aspect of information is more important for knowledge creation (Nonaka *et al*, 1995) as it focuses on conveyed meaning. If an organization limits its focus to syntactic information the real importance of information as part of the knowledge creating process will be unrealised. Focus will settle on the processing of information as opposed to the meaning and relevance of the information. So, even the term 'information' can be interpreted in one of two ways. This is an important point when one considers how organizations manage information. According to Nonaka *et al* (1995) and Shannon *et al* (1949) information systems which are developed to move information, with little or no concern for its meaning do not support knowledge creation. Therefore, for information to contribute to knowledge creation, the information must contain semantic and syntactic components.

Nonaka *et al* (1995) then conclude by providing a statement that helps clarify not so much the difference between information and knowledge, but the relationship between them.

'...Information is a flow of messages, while knowledge is created by that very flow of information, anchored in the beliefs and commitment of its holder'

Nonaka & Takeuchi (1995)

2.4 What does KM mean in today's Business Environment?

According to Prusak (2001) knowledge management is not just a consultant's invention but also a practitioner-based, substantive response to real social and economic trends such as globalisation, ubiquitous computing, and the knowledge-centric view of the company. Over the past 10 years many academics and organizations have developed techniques to help understand how information flows within an organization, and processes to try and manage the information so as to be useful and relevant. So why is KM still not a main component of every businesses strategic tool kit? Where are all the examples for KM success? Despite the fact that a number of researchers (Bhatt *et al* 2001) highlight the competitive advantages of 3M, Hewlett-Packard, Buckman laboratories, Scandia AFS, and Xerox as a result of KM projects, they do not clearly describe the principles and procedures of KM that have been used. In particular, how these companies managed to capture and effectively manage the flow of tacit knowledge – as opposed to explicit knowledge is not made clear. From the information the researcher has managed to acquire on these companies their KM successes have had the following themes running through them:

- *Successful knowledge transfer is mainly based on explicit knowledge transfer (Lotus Notes, email, workrooms etc), as tacit knowledge is difficult to capture* (Marwick 2001).

- *No clear indication of why the company believes it has a 'successful KM strategy'. How they are measuring their success is unclear - it is doubtful that they are using the same yardstick so in effect one company's success could be another's failure* (Kalling 2003).

- *What all these organizations have is an awareness of the importance of teams. Therefore, the team dynamic is seen as key to organizational success.*

- *Organizations that are strategically aware of the importance of KM implement their KM programmes using one of two approaches* (Hansen *et al* 1999).

  1. **Technology Driven** – (***Codified Systems***) The use of technology to support and manage explicit knowledge.

  2. **Team Driven** – (***Personalised Systems***) The development of teams and the flow of tacit knowledge via the team dynamic.

The concern that this raises for the researcher is that explicit and tacit knowledge do not always flow along the same paths. According to Nonaka *et al* (1995) the key to knowledge creation lies in the mobilisation and conversion of tacit knowledge to explicit knowledge. Therefore, how do these organizations manage to ensure the teams allow the flow of knowledge to continue unrestricted?

According the Wiig (1999) globalisation has placed businesses everywhere in new and different competitive situations where knowledgeable, effective behaviour is necessary to provide a competitive edge. Enterprises have turned to explicit and systematic knowledge management to develop the intellectual capital needed to succeed. Further developments are expected to provide considerable benefits resulting from changes in the workplace and in management and operational practices. Changes will partly come from information technology and artificial intelligence developments.

However, more important changes are expected in people-centric practices to build, apply, and deploy knowledge and understanding for support of innovative and effective knowledge-intensive work. Next generation KM methods will still be crude and our understanding of knowledge and how people use it to work still has a long way to go (Wiig, 1999; Marwick, 2001).

However, in today's business environment, organizations are constantly re-organising and re-inventing themselves. The 'knowledge-worker' (Drucker, 1993) is becoming more mobile which is resulting in a greater mobility in the work force at large. Gone are the days when a person joined a company and stayed for life. For workers to 'sell' themselves to organizations they need to show themselves to be 'knowledgeable' within their field of expertise. Knowledge is the 'new currency and organizations will pay highly for it' (Davenport & Prusak, 2000).

This now raises an interesting problem. In order for organizations to maximise their competitive edge, (Wiig, 1999) they need to capture and utilise the tacit knowledge held by their employees. However, it's this very tacit knowledge that workers see as being the key reason for their employment. In order for workers to share this information there needs to be an environment of trust between the giver and receiver of any knowledge.

Now consider the emergence of the supply chain as a recognised strategic element of the core business activity (Van Weele, 2002; Lee, 2002; Moberg *et al*, 2003). The new organizational focus is forcing internal business units and functions to work closer and more openly. To work effectively this requires business units and functions to have more in-depth knowledge of the other functions within the supply chain. However, when an organization then out-sources supply chain activities such as manufacturing and distribution this introduces an additional level of complexity. For the purpose of this thesis the 'complex supply chain' can include any organization which includes such an out-source model.

With respect to such a complex supply chain, how does an organization now identify the knowledge components it needs to keep 'in-house' to effectively manage its overall company's competitiveness via the supply chain?

This is an interesting question that assumes the organization in question already has rolled out an effective knowledge management programme. This is not always the case. Therefore, in the complex supply chain how does the organization ensure focus is kept on the core activities and the work force are pro-actively driving knowledge flow throughout the supply chain? This question will be considered further through the course of this thesis.

2.4.1 Why is creating Knowledge important now?

Knowledge is a complex intangible asset within any organization, and for centuries business has been successful without having to explicitly focus on the capture and management of this asset. So why is it important now? In fact, up until the mid/late 1990's knowledge transfer has received little focus from mainstream economics and the social sciences. Certainly the work of Nonaka & Takeuchi (1995) helped push the capture and control of knowledge into the fore as an important area for academic study. However, the slow realisation that knowledge was a key component to the success of any organization was picked up on by Drucker (1993). As far back as the 1960's Drucker coined the term 'knowledge worker' as it became apparent that post-war industry was shifting away from production to services. This is a view that has been subsequently borne out by Quinn (1992) who observed that the US economy has been fundamentally restructured by the service industry, and up to 95% of manufacturing firm's employee's are engaged in service activities. According to Drucker (1993) we are entering 'the knowledge society' in which the basic economic resource is no longer capital, natural resources, or labour, but 'is and will be knowledge'. Within this new society 'knowledge workers' will play a central role.

Nonaka *et al* (1995) support this view by pointing out that society has undergone many changes and the manufacturing based industries of the post-WWII economies have not remained unaffected. According to leading management thinkers the manufacturing, services, and information sectors will be based on knowledge in the coming age, and business organizations will evolve into knowledge creators in many ways.

Drucker (1993) also suggests that the most important challenge for every organization in the knowledge society is to build systematic practices for managing self-transformation. In effect the organization has to be prepared to discard obsolete knowledge and learn to create new ideas, processes, and paradigms through the following:

1. *Continuing improvement of every activity.*
2. *Development of new applications from its own successes.*
3. *Continuous innovation as an organised process.*

Drucker's views are strong on the need for organizations to embrace the need to focus on knowledge creation and management. Through his views Drucker focuses on the need to invest in identification, creation and management of tacit knowledge.

2.5 Can Knowledge actually be Managed?

In order to answer this it is important to look at the two distinct types of knowledge separately. The two main components of knowledge, tacit and explicit knowledge, have different characteristics with tacit knowledge creation being seen as a uniquely human activity, whilst explicit knowledge creation having more to do with how knowledge once created is transferred. Therefore, in order to assess whether 'knowledge' can be managed it is important to make the assessment based on an understanding of the key aspects relating to each type of 'knowledge'.

2.5.1 Managing Tacit Knowledge.

Polanyi (1958) identified tacit knowledge as a key component of knowledge. The interesting point is that tacit means 'hidden' and developed through the individuals cognitive knowledge generating processes, which in turn are influenced by their beliefs, experiences, understanding of the context, values and expert insight (Davenport & Prusak, 1998). So, this raises the following concerns:

1. *Do individuals consciously control the way they generate knowledge?*

2. *Do all individuals generate tacit knowledge the same way?*

3. *Can the human process for generating tacit knowledge be managed or directed?*

To answer the first concern we need to go back to Polanyi (1958) whose concept of tacit knowledge is 'hidden knowledge'. By 'hidden', Polanyi means that the method of generating the knowledge is hidden from the consciousness of the individual. Polanyi underlined this point with the quote "*We know more than we can tell*". Although we understand the key components that can influence the individual's cognitive knowledge generating processes, the individual does not directly manipulate or control this process.

Looking at the second concern the term 'individual' is the key to answering this question. As individuals we each have different experiences, values, insights, and understanding to draw on, this in effect is what makes us different. Within collective groups such as family, culture, and work we will have certain shared experiences, values, beliefs and understandings. Within these groups these common components facilitate the individuals in drawing similar conclusions and generating knowledge (Stacey, 2001). What is interesting is that whether a group of individuals come to the same conclusions and generate the same tacit knowledge will depend on the degree to which they share the same beliefs, values, experiences, insights and context. Figure 2.3 helps visualise this concept more clearly.

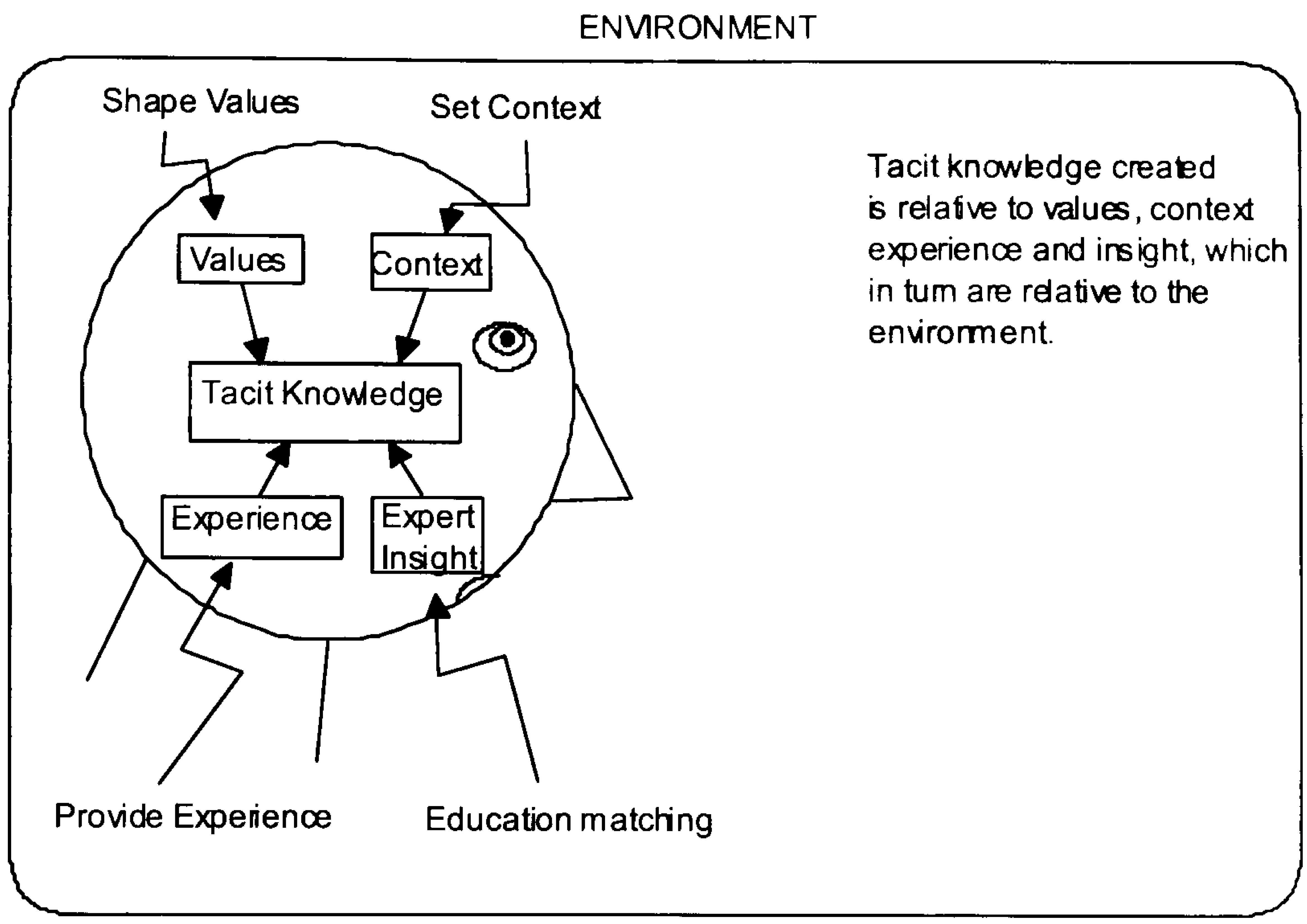

Figure 2.3 Tacit knowledge creation. **Source: Developed for research.**

The last concern leads the researcher to conclude that because the individual cannot consciously manage tacit knowledge, an external organizational body or structure cannot, therefore, manage tacit knowledge. In short how can an organization manage or direct the way people think, and, generate understanding and knowledge? Wilson (2002) also supports this view by asking how can anyone expect to capture, let alone manage hidden knowledge "*...which is inaccessible to the consciousness of the knower*". Organizations cannot do this unless they employ unethical means such as brainwashing.

However, if, as the researcher believes, individuals tend to share common cognitive reasoning skills when they share similar beliefs, insights, education, and contextual understanding then organizations can influence how individuals generate tacit knowledge. By managing certain environmental conditions individuals can be placed in groups of like-minded employees. Organizations must realise that they cannot expect to completely manipulate the cognitive reasoning and tacit knowledge generating processes for their employees, and should not try. However, by concentrating on certain aspects of the working environment, cognitive reasoning and tacit knowledge creation within certain business parameters can be largely standardised – the caveat to this being the individuals other experiences, values, beliefs and understandings may still have some influence in the final outcome.

2.5.2 Managing Explicit Knowledge.

What is 'explicit' knowledge? This term is used to cover anything that is not 'tacit', or hidden in nature. This is knowledge that is freely available, or can be accessed by the target audience. However, from the definitions of what we perceive knowledge to be, knowledge *per se* cannot be anything other then the result of a human cognitive process which is influenced by environmental parameters such as values, insight, experience and context (Polanyi, 1970). As we've seen from tacit knowledge it is not practical to assume that one can manage this process. So, what makes explicit knowledge any different?

If we believe, as the researcher does, that knowledge is the result of proactive human cognitive processing of information then the term 'explicit knowledge' is not an accurate descriptor. To be more precise and accurate would be to refer to 'explicit information' when talking about 'explicit knowledge'. The confusion between information and knowledge is at its worst when talking about explicit transfer. Many academic articles purporting to discuss explicit knowledge transfer concentrate on information system design through codified systems review, or the establishment of personalised networks. Both approaches concentrate fundamentally on links and data flows to allow quick and relevant information transfer.

So, in answer to the question, can we manage explicit knowledge? The purist answer is 'no' because explicit knowledge does not exist. However, if we look at Nonaka's learning diagram (Figure 2.1) Nonaka *et al* (1995) believes there is a need to capture and transfer information as it changes from tacit to explicit, explicit to explicit, and explicit back to tacit throughout the organization. The explicit knowledge may not actually be 'knowledge' in its pure sense but the contained information needs to be captured accurately and transferred in a manner that maintains its currency. This is a real and important challenge facing organizations, as the manner in which individuals and organizations access and use information can vary significantly.

As touched on previously there are two approaches organizations can take in managing how information may flow within the organization in a effort to best maximise an individuals ability to create new knowledge and share their experiences. These are personalised and codified systems (Hansen *et al*, 1999).

2.5.3 Codified and Personalised Systems.

Hansen *et al* (1999) and Gupta and Michailova (2004) have identified the main aspects that separate codified and personalised 'knowledge' systems. The important thing to remember with these two approaches is that they are designed to fit different business environments. Therefore, one is not necessarily always better then the other. The suitability of the approach will depend on the type of organization that is implementing the 'knowledge' strategy (Tiwana, 2000). The key aspects of both approaches are compared and outlined in Table 2.2. This is a comparison as defined by Tiwana (2000). However, the characteristics outlined are supported by Gupta & Michailova (2004) and are an expansion on the original comparison as put forward by Hansen *et al* (1999).

The tension between technology dominance and interpersonal dynamics in knowledge sharing is reflected in the distinction between codification and personalisation (Hansen *et al*, 1999; Tiwana, 2000). The key features of codification and personalisation are shown in Table 2.2. Codification emphasizes data capture, storage, and dissemination. This in turn is based on technologies, such as intranets, repositories, databases, etc. Personalisation emphasizes knowledge sharing among individuals, groups, and organizations through social networking and/or engaging in 'communities of practice' or 'epistemic communities' (Brown & Duguid, 2000; Hansen *et al* 1999; Wenger, 2000). Social and interpersonal aspects seem to override technology-based and procedural mechanisms in terms of 'meaningful knowledge management' (Hansen *et al*, 1999). McDermott (1999) concluded that the great trap in knowledge management is using information management tools and concepts to design knowledge management systems. Hansen (1999) maintained that strong network ties are important for the sharing of tacit knowledge while non-redundant weak ties play an important role for accessing explicit knowledge from elsewhere.

According to Gupta *et al* (2004) these distinctions are useful provided there is an unquestionable agreement regarding tacit and explicit knowledge, existing and new knowledge, and weak and strong ties: not in terms of what they mean in general, but rather what they mean where, when, and to whom.

Business Strategy Question	Codification	Personalisation.
What type of business is the organization in?	Provide high quality, reliable, fast and cost effective services and products.	Provide creative, rigorous, and highly customisable services and products.
How much data is reused to support new projects?	Reuses portions of old documents to create new ones. Know that there is no need to begin from scratch to deliver new product or service.	Every problem has a high chance of being a "one off" and unique problem. Highly creative solutions are called for.
What is the costing model used for organizations products or services?	Price based competition.	Expertise based pricing. High prices not detrimental to business. Price based competition barely (if at all) exists.
What are the organizations typical profit margins?	Very low profit margins; overall revenues need to be maximised to increase net profits.	Very high profit margins.
How best can the role IT plays be described?	IT is a primary enabler; the objective is to connect people distributed across the organization with codified 'knowledge' such as reports, documentation, code etc that is in some reusable form.	Storage and retrieval are not the primary applications of IT. IT is used to enable communication and better contact. Conversations, socialization, and exchange of tacit knowledge are considered to be the primary use of IT.
What is the organizations reward structure like?	Employees are rewarded for using and contributing to databases such as Notes discussion databases.	Employees are rewarded for directly sharing their knowledge with colleagues and for assisting colleagues in other locations/offices with their problems.
How is knowledge/information transferred?	Employees refer to a document or best practices database that stores, distributes, and collects codified knowledge.	Knowledge is transferred person to person; intra-organizational networking is encouraged to enable sharing of tacit knowledge, insight, experience and intuition.
Where do the organizations economies of scale lie?	Economies of scale lie in the effective reuse of existing knowledge and experience and applying them to solve new problems and complete new projects.	Economies rest in the sum total of expertise available within the organization; experts in various areas of specialisation are considered indispensable.

Business Strategy Question (Cont,)	Codification	Personalisation.
What are the typical team structure demographics?	Large teams; most members are junior-level employees; a few project managers lead them.	Junior employees make up a small proportion of team membership.
What type of services do the organization's services resemble?	Accenture Consulting, The Gartner group, Delphi Consulting, ZDNet, Delta Airlines, Oracle.	Boston Consulting Group, McKinsey and Company, Rand Corporation.
What type of products do the organization's products resemble?	Pizza Hut Dell Computers, Gateway, Microsoft, SAP, People Soft, Baan, America On-line (AOL), Bell South, Lotus, SAS Institute, IBM, Hewlett-Packard, Intranetics, 3Com	A custom car, or bicycle manufacturer, Boeing, a contract research firm, a private investigator.

Table 2.2 Codified and Personalised Systems. **Source: Tiwana (2000)**

Tiwana's (2000) comparison between codified and personalised knowledge systems provides a clear understanding of the different strategies organizations can take in developing a 'knowledge aware' environment. Interestingly, Tiwana (and Gupta & Michailova, 2004) seem to substitute the term 'knowledge' and 'information' freely. This is a habit they are not alone in, as the majority of academic papers demonstrate the same tendency (Wilson, 2002). An example of how easy and commonplace this happens is if the word 'knowledge' is replaced, in every instance in Table 2.2, with the word 'information' the Table's meaning and comparisons raised change little if any.

Putting aside the ease with which Tiwana (2000) interchanges 'knowledge' and 'information' the comparison between codified and personalised is still valid when one considers that Table 2.2 really refers to how organizations handle information currency and flow within their boundaries (explicit), whilst understanding the need to engage human cognitive problem solving and reasoning skills over data availability systems when operating within a unique problem solving environment (tacit). The differences outlined in Table 2.2 refer to two ends of a spectrum. No organization will (or should) use a totally codified or personalised strategy to the exclusion of the other.

From an IBM supply chain perspective the strategy and business pertaining to the order processing, manufacturing, and distribution of hardware systems is assessed in Table 2.3.

Business Strategy Question?	IBM ISC Position.	Personalised or Codified?
What type of business is the organization in?	Providing high quality, cost effective service.	Codified.
How much data is reused to support new projects?	Reuse contract templates and reporting metrics and formats.	Codified.
What is the costing model used for organizations products or services?	Price based competition. Cost efficiency – driving cost out of the business.	Codified.
What are the organizations typical profit margins?	Supply Chain seen as a way of taking cost out of the business...not seen as a revenue generator.	Codified.
How best can the role IT plays be described?	IT used to store and retrieve information. Also to automate generic / standard processes.	Codified.

What is the organization reward structure like?	Employees are rewarded for sharing knowledge directly with peers, and helping problem solve in other parts of the organization.	Personalised.
How is knowledge/information transferred?	Employees refer to documents of best practice, and use databases for storing common information. However, also encouraged to share person to person.	Codified & Personalised.
Where do the organizations economies of scale lie?	Economies lie in the effective reuse of information. However, information is supported by subject matter experts (SMEs') within key areas of the process.	Codified & Personalised.
What are the typical team structure demographics?	Matrix organization with varying sizes of teams. Organization invests in MBA's, Post-grad, and PhDs within supply chain specialisation.	Personalised.
What type of services do the organization's services resemble?	IBM services sections moving to a personalised services setup.	Personalised with strong IT support.
What type of products do the organization's products resemble?	Core supply chain process is process driven. However, supply chain used to support project type customer requirements.	Codified & Personalised.

Table 2.3 Best-fit strategy for knowledge enablement. Source: Developed for research

From the assessment in Table 2.3 it is not clear what IBM's strategy is for developing a knowledge aware organization. The main reason for this is that the organization manages a wide range of products and services, whilst trying to implement standard information solutions throughout. Where the focus over the last 24 months has shifted from a hardware provider to a solutions provider the organization has been required to make the paradigm shift whilst still using legacy information systems. The organization is undergoing continuous change in order to continue to compete in a dynamic market space. In effect this raises the pertinent point that organizations continually face change, and as such their strategy for creating, and sharing the fruits of knowledge will be constantly under pressure to readjust.

This raises the question, what should IBM's Integrated Supply Chain (ISC) organizations strategy be for developing a knowledge aware business? This is a question the researcher will look to answer through the course of this research project.

2.6 Knowledge Management: A Definition.

Although many authors seem to confuse knowledge and information, there still seems to be an understanding as to the importance of human interaction and our cognitive thought processes over IT solutions when it comes to solving new and unique problems. From an overall perspective the management of tacit knowledge is not practical. However, the environment in which the individuals work, collaborate, or interact can be engineered to maximise the probability that the individuals concerned will draw the same knowledge conclusions relating to shared information.

From an explicit perspective this relates to the management of information more then it does knowledge. This view is supported by current literature that refers to IT systems and network strategies when talking about explicit knowledge management. Therefore, the term 'knowledge management' is by no means accurate, and can be construed as being misleading in the very nature of what it proposes to do. Even Sveiby (2001), who wrote the first book on the subject in 1990, ('*Kunskapledning*'), believes the following:

"I don't believe knowledge can be managed. Knowledge Management is a poor term, but we are stuck with it, I suppose. "Knowledge Focus or Knowledge Creation (Nonaka) are better terms, because they describe a mindset, which sees knowledge as activity not an object...this is a human vision, not a technological one"

(Sveiby, 2001)

That said, the identification and management of an organization's intangible assets is important in maintaining a competitive edge within the global market place. The term knowledge management has been coined and is in popular use. The problem is that organizations are being misguided by the term. Knowledge management is not about managing tacit knowledge, as this cannot be done through the use of software or hardware solutions. Nor can explicit knowledge be managed because explicit knowledge is not knowledge, but relevant information. From a review of the current literature on knowledge management, and an understanding of what the actual concepts, involve the researcher has, for the purpose of this research, come up with a definition of knowledge management.

*"**Knowledge management means the effective management of communication and information flows, and environmental conditions which will facilitate shared contextual understanding, experiences, and beliefs within a motivated organization**"*.

Stephen McLaughlin (2005)

Therefore, as Sveiby (2001) and Wilson (2002) point out the term knowledge management is not ideally suited to the task in hand; the researcher will continue to use the term but will apply the definition as highlighted above in all cases to its meaning.

2.7 The Influence of Technology on Knowledge Management.

Wilson (2002) has highlighted the apparent view within existing academic literature that knowledge management is reliant on technology as its primary enabler. The majority of academic journal articles written about knowledge management still focus on ICT issues such as expert systems, artificial intelligence agents, collaborative software tools etc. For a lot of researchers, technology and knowledge are inextricably linked. Why is this? As stated already there is a widespread view that information and knowledge are the same thing; a view that is helped in no small way by a continuing failure to collectively agree on what knowledge is.

Within a complex business environment information is important in ensuring business decisions are made effectively and expediently. Businesses have invested heavily in their ICT programmes and have come to rely heavily on their ability to capture, store, and manipulate real time data. With the advent of knowledge management coupled with the confusion concerning the subtle difference in meaning between 'information' and 'knowledge' many organizations simply continued their 'Information Management' programmes under the new heading of 'Knowledge Management'. Within industry many organizations received accolades for being 'knowledge' organizations, when in fact they simply had best of class information storage and retrieval systems. However, the term 'knowledge management' started to lose its gleam as some organizations began to realise that the investment into ICT was not generating the rewards expected from the promised knowledge paradigm. Marwick (2001) looked at current technologies commonly used within knowledge management programmes and assessed them against Nonaka *et al's* (1995) model for organizational knowledge creation. Marwick concluded that automatic extraction of deep knowledge (tacit) from documentation (explicit) is still an elusive goal. Today the level of automatic extraction is still shallow – only a subset of the meaning can be captured. As yet there are also no systems that can reason in the sense of deducing something new from what is already known. Organizations were not getting what they though they needed from KM. For right or wrong KM was beginning to be thought of as faddish. The problem was that although many organizations spoke of knowledge management as the new management paradigm they never actually made the paradigm shift.

As discussed within this chapter, for any knowledge management initiative to succeed both key types of knowledge (tacit and explicit) must be considered. According to Johannessen *et al* (2001) there is a real danger that because of the focus ICT solutions mainly have on explicit knowledge this may relegate tacit knowledge to the background hence leading to a knowledge mismatch. Within a lot of organizations this can be seen to happen. However, the level of impact varies. This, the researcher believes is down to how the respective organization uses knowledge and information. If an innovative, empowered, organic culture is required, then organizations need to focus on tacit knowledge creation and transfer. If, however, a more mechanistic, controlling culture is required then tacit knowledge may not be as important as explicit knowledge. Hence, a successful KM implementation in one organization may not be considered a successful KM implementation in another.

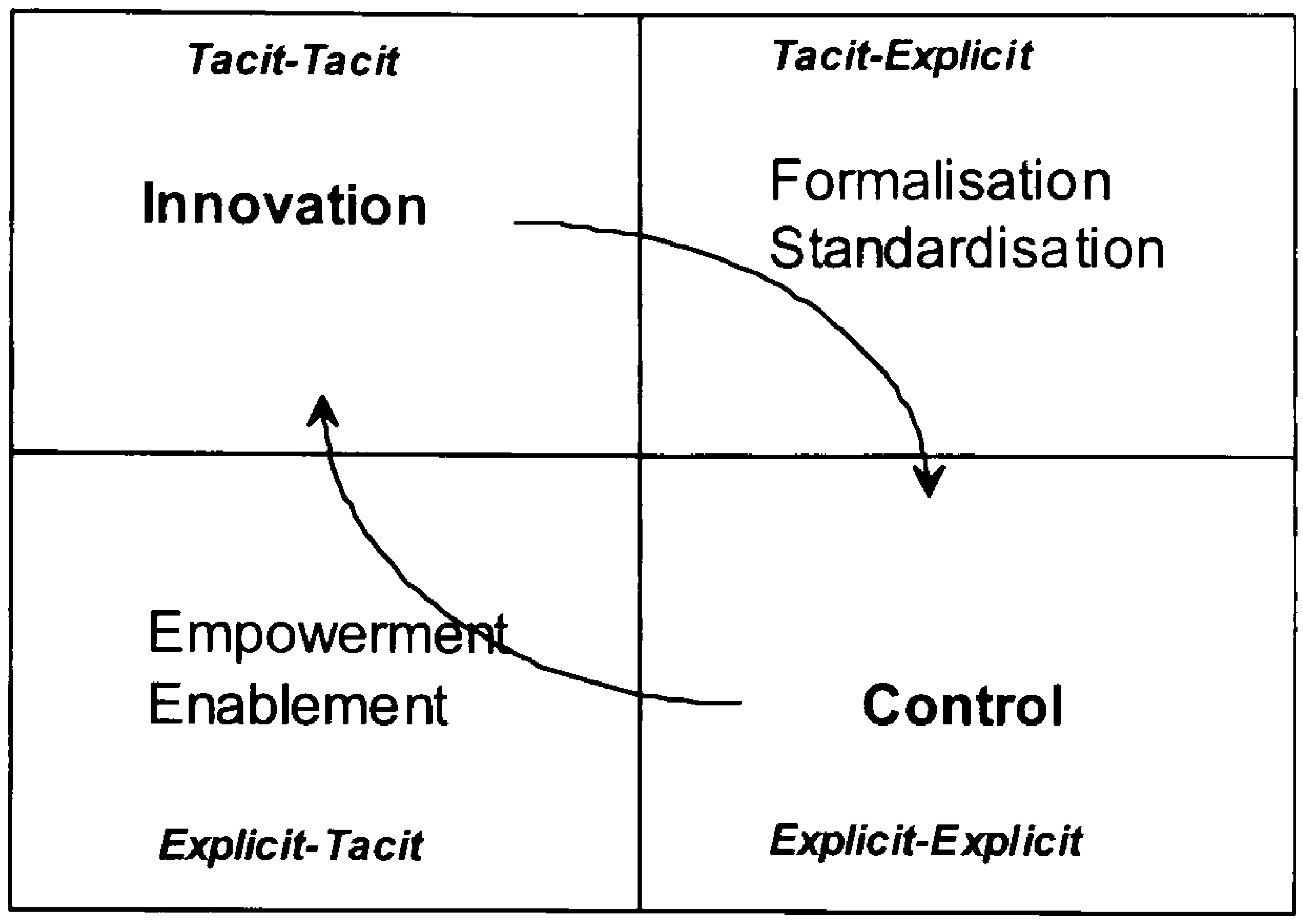

Figure 2.4 Impact of knowledge focus. Source: Developed for research.

Figure 2.4 is used to demonstrate this point. If an organization concentrates on explicit to explicit transfer then codified processes will be used to ensure information is captured, stored, and disseminated as and when required. The emphasis, if tacit knowledge is not considered, will be on information control. If however, the organization needs to be innovative it must focus on developing its individuals to create knowledge in the form of innovative ideas. Historically, most organizations have focused on the control aspect of knowledge management. This is quite suitable if this is what the business demands. However, if the business demands innovative thinking then a failure to focus on the development of tacit knowledge creation will leave the organization with an under performing knowledge implementation strategy. It is the researcher's belief that in order to get the most out of any knowledge management system the creation of new, innovative knowledge must be considered. This aspect is what really underlines the paradigm shift, as to focus on tacit knowledge creation one must look to people management techniques and not information management techniques as the key-enabling factor. Also now consider the fact that complex supply chain organizations will have different knowledge and information requirements across the organization. Development, marketing, and sales will require a higher degree of individual innovative knowledge creation then say distribution, or manufacturing. The point here is that the knowledge focus will not be uniform across the supply chain. Therefore, for an organization to get the most out of its knowledge strategy it must consider the separate and distinct needs of its knowledge stakeholders. The question now is how does the organization harness the individual knowledge needs for the benefit of the organization?

2.8 Individual Knowledge versus Organizational Knowledge.

As highlighted by Stacey (2001) the individual and organization, or 'social', are usually treated as two separate entities. As one of the goals of managing knowledge is to capture and utilise the knowledge within the organization, Stacey (2001) poses the question whether a team, group, or organization can be said to learn or whether it is just the individual members that do so. The mainstream thinking is that it is the individual who learns and creates knowledge, Therefore, the concern of the organization should be how to capture, share, and act on this knowledge.

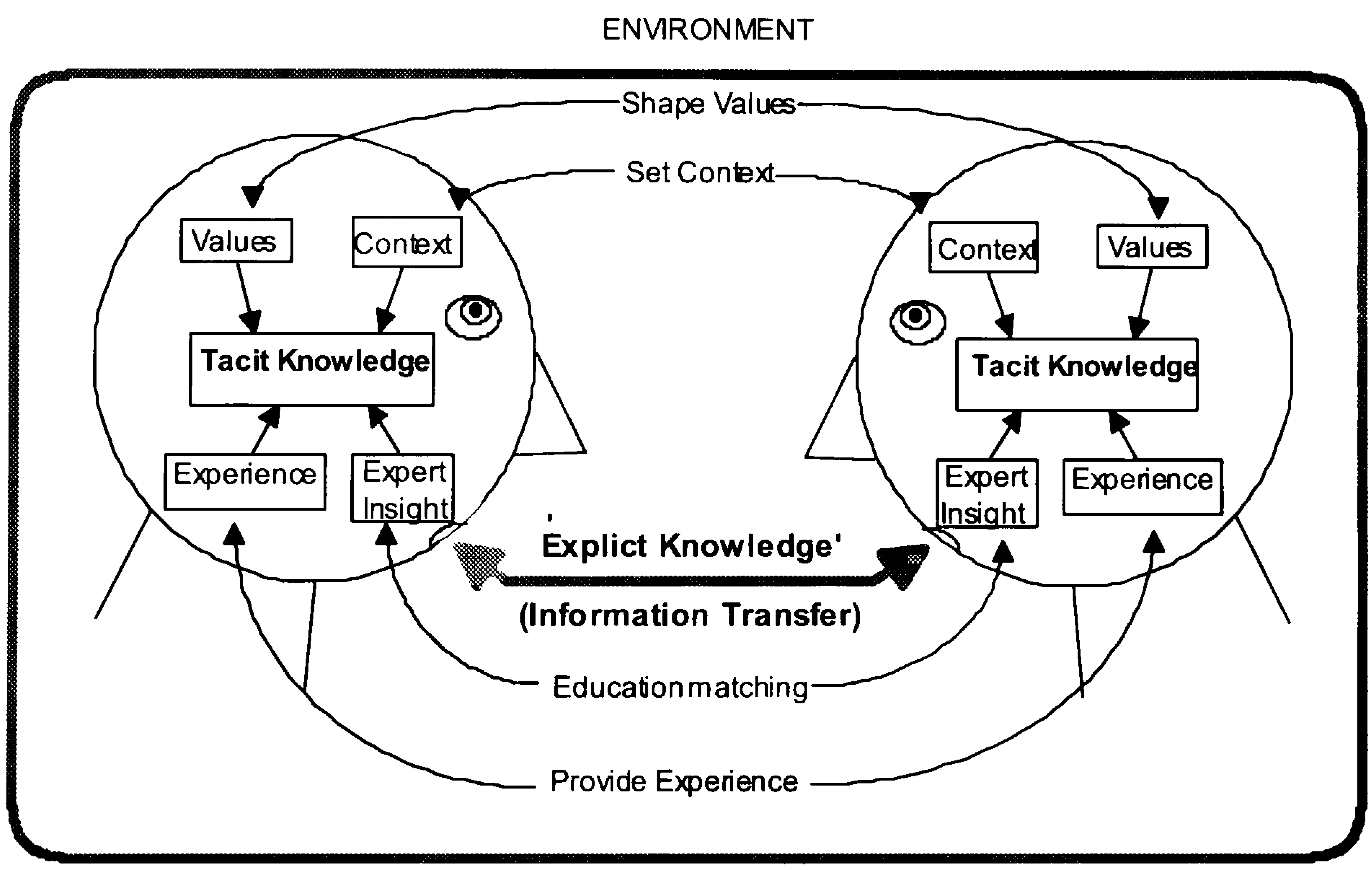

Figure 2.5 Knowledge sharing environment. **Source: Developed for research.**

Figure 2.5 illustrates how tacit and explicit knowledge exist at an individual level within the confines of the organization's learning environment.

Stacey (2001) puts forward the point that new or created knowledge comes from tapping tacit knowledge, and then expressing this knowledge in an explicit form. This is a belief held widely within academic circles; however, little focus has been given to defining what actually shapes the tacit knowledge in the first place. This maybe largely due to the abstract nature of tacit knowledge, and therefore, the difficulty in understanding the psychological processes involved in shaping that knowledge. It is not the intention of this research to identify the assumptions that shape an individual's ability to create knowledge. For that, see Stacey (2001: 29)

That said, from a holistic perspective effective learning and knowledge creation within an organization requires widespread sharing of values, beliefs, and shared context (Polanyi, 1970). This process of knowledge creation needs to be supported by openness, trust and affirmation (Stacey, 2001). However, in order to share the tacit knowledge inherent within the individual it must be explicitly expressed and codified for widespread dissemination. What is interesting is that Boisot (1998) points out the paradoxical nature of this process in that once knowledge is codified it loses value. From an organizational perspective this is important because if organizations focus predominantly on the task of codifying knowledge they will not benefit from the collective tacit knowledge as a whole. This view also points to the fact that knowledge loss between tacit to explicit to tacit may have a more significant impact across Nonaka *et al* (1995) learning model.

Hirschhorn (1990) and Gabriel (1999) identify the problem of knowledge loss through stressing the importance of unconscious group processes in restricting the knowledge creation (tacit to explicit) and learning (tacit to tacit and explicit to tacit) within the organization. From an organizational perspective this introduces the idea of knowledge loss, or failure to share information and knowledge based on group dynamics.

Therefore, when knowledge is looked at from an organizational perspective it becomes clear that although the role of tacit knowledge is clearly understood, the focus is on the capture and codification of explicit knowledge. Organizations fail to address tacit knowledge due to its individual and abstract nature. This results in the continued failure to drive knowledge creation, and transfer in line with Nonaka *et al* (1995) learning model. In effect, as the dominant approach to KM is a codified one, this restricts and focuses organizational knowledge efforts into the process of *combination*, or explicit to explicit transfer.

If one assumes Nonaka *et al* (995) are correct in the assumptions that have defined their learning organization model, and then accept that organizations in general fail to address the tacit to tacit, tacit to explicit, and explicit to tacit transfer mechanisms then knowledge creation within the organization through *socialisation*, *internalisation* and *externalisation* will be impacted. With tacit knowledge being so difficult to manage, how then does the organization effectively facilitate the knowledge creation?

The researcher supports the belief that knowledge cannot be managed in its purest sense. From this point the questions then become slightly different. What the researcher will attempt to answer is how the complex organization effectively builds a knowledge-sharing environment, which, in turn facilitates the creation and sharing of knowledge across the organization? This takes the emphasis off trying to directly identify tacit drivers at an individual level that can then be harnessed to support knowledge creation at a group or organization level. In effect the emphasis shifts from focusing on how tacit knowledge is generated, to how knowledge transfer between tacit to explicit to tacit is impacted by knowledge and information sharing barriers throughout the organization.

2.9 Chapter Conclusions.

The term 'knowledge' is often confused with 'information'. Through the continued misuse of these terms 'knowledge management' has for many organizations (and academics) simply become an extension of 'information management'. This has resulted in an over emphasis on technology as the main enabler of knowledge management. This technology-centric view has resulted in a lot of knowledge management initiatives developing as predominantly explicit knowledge, or more accurately, information management systems.

Knowledge can be broken down into two main components; tacit and explicit. Tacit refers to the 'hidden' knowledge we have in our heads, whereas, explicit refers to documented knowledge – which some refer to as information. The failure to consider the importance of tacit knowledge in the process of knowledge creation is aided in no small way by tacit knowledge's intangible abstract nature. If organizations are to improve their employees' ability to create new knowledge, and then explicitly communicate this knowledge, they need to consider both tacit and explicit forms of knowledge. The importance of tacit knowledge to any knowledge management initiative that looks to generate new innovative ideas is significant. However, the nature of tacit knowledge makes it practically impossible to manage. That said, organizations that ignore the importance of tacit knowledge do so at their peril.

Depending on how organizations use 'knowledge' and 'information' will impact on how they focus knowledge initiatives between tacit and explicit knowledge forms. Organizations which depend more on command and control may opt for a more 'explicit' focus to their knowledge initiatives, whereas, organizations that depend on continuous innovation will need to focus on tacit knowledge creation and sharing as the focus of their knowledge initiatives. The reality is that most organizations will have mix of innovation and control requirements. Considering the complex nature of supply chains, organizations will need to match their knowledge strategies to different parts of the supply chain as the shift between innovation and control will vary. If one accepts this view then the deployment of organization-wide knowledge and information strategies is not an effective approach to knowledge strategy implementation.

The Nonaka *et al* (1995) learning organization model provides a good starting point in understanding the relationship between tacit and explicit knowledge transfer. However, one needs to be aware that knowledge loss will happen across this process. If organizations concentrate on explicit to explicit transfer (*combination*) knowledge loss across the other three key stages could go unchecked. As the actual management of tacit knowledge is not believed to be practical, the researcher proposes that in order to try and reduce the amount of knowledge loss across the four stages the focus is not placed on how knowledge is created, but on identifying the actual barriers to knowledge transfer between *socialisation, internalisation, combination*, and *externalisation*. By identifying the barriers to knowledge transfer the organization can better understand the knowledge creation and sharing habits of its employees. Therefore, by managing the barriers to knowledge transfer the knowledge environment can be shaped to provide a more conducive atmosphere for the development of either tacit or explicit knowledge - depending on the organization's knowledge needs.

In order to move the research forward, a view of knowledge barriers as they impact knowledge transfer across complex organizations would need to be developed for testing.

Finally, when considering a knowledge strategy the assessment for a suitable fit tends to look at the organization as a whole. Organizations embarking on a knowledge management programme will tend to deploy a codified (systems driven) or personalised (team driven) dominant strategy. The problem, as the researcher sees it, is that such approaches are usually deployed on an organization-wide level. Considering the complex knowledge creation and sharing needs along a supply chain a different approach is needed for developing an appropriate knowledge strategy. The researcher will address this issue through the 'theory building' stage of this research.

3. Barriers to Knowledge Creation and Sharing.

"In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge. Successful companies are those that consistently create new knowledge, disseminate it widely throughout the organization and quickly embody it in new technologies and products"

Nonaka (1997)

3.1 Introduction.

An organization's supply chain capability is now regarded as a key contributor to any organization striving to maximise competitive advantage (Toyer, 1995). No longer is the 'supply chain' simply the preserve of procurement, logistic, or manufacturing specialists (Porter & Miller, 1985). Organizations are waking up to the fact that the supply chain is not simply a support function for its business, but is in fact the key capability against which a competitive advantage can be developed (Kulp *et al,* 2003).

Organizations, in general, are now well aware of the components that make up their supply chain, indeed these components are often well established and embedded. However, many still struggle with the problem of effective component alignment (Day, 1994; Teece, 1998). Functionally aligned organizations may understand and individually manage their supply chain components, but performance can only be maximised once they achieve the transformation to process alignment. Process aligned organizational focus on core process performance as opposed to functional business unit performance. This is a fundamental and key change for most organizations and one that they must make in order to fully develop their supply chain capabilities (van Weele, 2002).

However, this shift in focus does not come easily to many organizations, as internal business unit boundaries can be difficult to remove (Argote, 2005). The problem is exacerbated within complex organizations where capabilities such as manufacturing, logistics, and procurement have been outsourced.

The alignment of these core components becomes all the more difficult as external business boundaries such as organizational, technological, and people barriers need to be negotiated and managed (Barson *et al*, 2000).

As the performance of core supply chain processes are vital to the overall success of the supply chain, and therefore, the overall success of the organization, how barriers impact knowledge transfer along core processes needs to be understood. It is no longer sufficient to know how barriers impact, in general terms, across the whole organization, or, indeed how particular functions may respond. Senior management needs to understand how barriers impact at different stages along core processes. The core business process, irrespective of where in the organization it operates, is in effect a core information/knowledge highway. Identified barriers will impact upon how information is accessed and shared, and also upon how knowledge is created and managed. If innovation and organizational learning are valued within the organization then consideration must be given to how barriers impact across an organization's 'arterial' business processes.

3.2 Delivering Knowledge throughout an Organization.

To ensure knowledge management initiatives stand any chance of success, an organization must develop within their employees a desire for knowledge (Quinn *et al*, 1996). According to Kluge *et al* (2001) if a knowledge program is to be embraced by the workforce, every individual within it needs to be thirsty for knowledge. The employee should see knowledge management, or to be precise the active application, distribution and cultivation of knowledge within the organization as a whole, as a fundamental part of their personal success and satisfaction.

Kluge *et al* (2001) go on to point out that a lot of knowledge management initiatives fail because they are implemented without taking cognisance of this point. Management use a 'knowledge push' approach to drive information to the right place at the right time in the hope of generating knowledge. This is a top-down strategy that leans heavily on infrastructure solutions. However, channelling information and knowledge in this manner is a one-way street. Research by Kluge *et al* (2001) showed that successful organizations approached this delivery mechanism from the other direction as well. In the more successful organizations Kluge *et al* (2001) researched they found the organizations in general using a balance of push and pull delivery systems. In the less successful organizations the tendency was to focus predominantly on push knowledge delivery systems. Instead of force-feeding their employees, the more successful organizations strive to create environments that encourage them to seek knowledge for themselves and pull it out from sources both within and beyond the confines of the organization. Developing such a knowledge pull is a key element of the right cultural context and should be included in any knowledge management strategy.

By far a pull delivery approach is more difficult to implement then the more commonly adopted push, or top-down approach. Managing the push approach fails to capture the full capability of everyone in an organization. Kluge *et al* (2001) put forward that the maximum potential of individuals can only be unleashed through an approach that gets to the heart of what motivates them.

The emphasis on the importance the individual plays in the creation and sharing of information and knowledge is a widely supported view (Krogh *et al*, 2000; Kluge *et al* 2001). What is also important is that because the nature of the pull delivery mechanism, is to focus heavily on the softer aspects of management, a lot of organizations fail to engage in successful pull or bottom-up knowledge delivery systems. In order to understand why organizations in a lot of cases still depend on push delivery systems one needs to understand the barriers which prevent a shift from top-down to bottom-up knowledge management.

3.3 Identifying Barriers to Knowledge Creation and Sharing.

Kluge *et al* (2001) identify two main barriers to developing a knowledge creating and sharing culture. Both are soft issues that Kluge *et al* (2001) believe are the main barriers that prevent an organization from enabling a pull capability. The barriers are:

- **Not invented here** - *The 'not invented here' syndrome describes the tendency to neglect, ignore or, worst still, disparage knowledge that is not* *created within an individual's department. This problem can arise from a genuine mistrust of outside knowledge.*

- **Knowledge is power** - *The 'knowledge is power' syndrome refers to a mindset that places the values of knowledge to the individual ahead of its value to the company.*

At its most basic, knowledge sharing starts by taking the time to help others. In a successful company there is always time pressure but the extra 10 minutes spent with a colleague explaining something will be repaid later. However, just as people distrust external knowledge, they also see their own knowledge as a part of their personal competitive advantage. McKinsey's 'corporate prisoner dilemma' (Kluge *et al,* 2001) illustrates this point very well, which is a modification of game theory's prisoner dilemma. Figure 3.1 demonstrates the corporate prisoner dilemma.

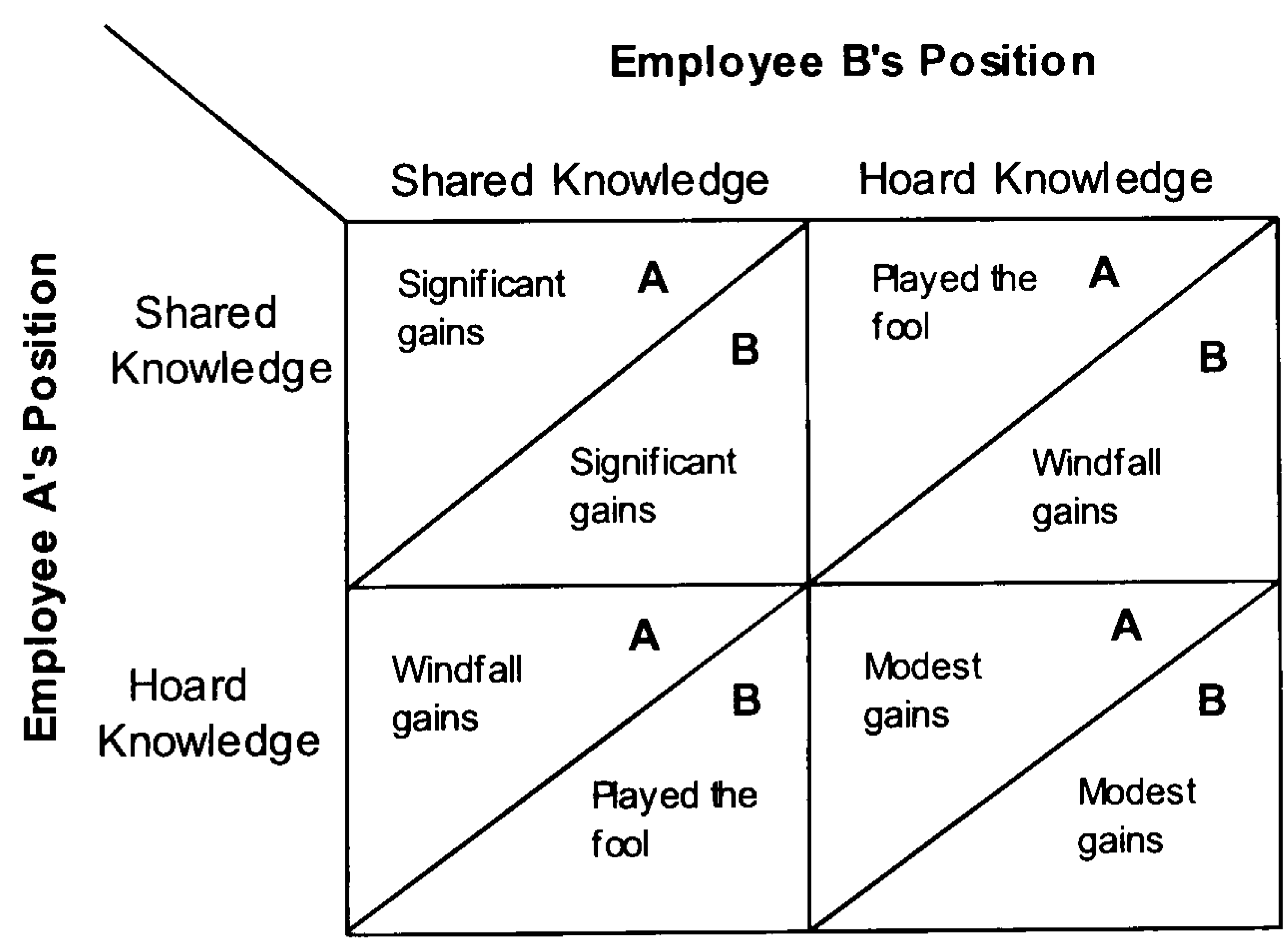

Figure 3.1 Corporate Prisoner Dilemma. **Source: McKinsey Co.,**

From Figure 3.1 we can see that the ideal solution is for employee A and B to share knowledge as this is where the most significant gains are expected. However, if one decides to hoard knowledge whilst the other shares knowledge then the power balance is shifted in favour of the employee who hoards. As no employee wishes to be taken advantage of, or if the culture is one where individual performance is rated above team performance, the expected behaviour will be one where both employees will hoard.

This will maintain a status quo where employees are keen to ensure their personal competitive advantage is not eroded. However, the overall effect within the organization is one where knowledge is selectively shared resulting in modest gains in performance for the organization. If this is the norm within the organization the hoarding process will be counter productive. This is one of the critical changes that should be targeted by any knowledge management program, and one that should have positive repercussions beyond purely the exchange of knowledge. If, as Kluge *et al* (2001) believe, these barriers impact knowledge creation and sharing then it is important to understand how they can be overcome. Table 3.1 outlines the barriers as Kluge *et al* (2001) see them and what actions are recommended to reduce their impact.

Barrier to Knowledge creation and sharing.	**Symptoms.**	**Actions to overcome.**
Not invented here.	• Someone else's knowledge cannot always be evaluated for quality and relevance. • External knowledge usually needs to be adapted for internal use. This takes time and effort that could be used to develop the knowledge internally. • People may feel that to use external knowledge may undermine the relevance of their input and increase the risk of their redundancy. • May be quicker for employees to re-invent the wheel rather then trawl through mountains of existing information.	• Set ambitious targets that cannot be achieved single-handedly. • Set clear goals rather then identifying methods to follow. • Provide an incentive to employees for re-cycling knowledge. Demands a qualitative input from management to assess level of reuse - such as 'who did you contact to get the input?' and 'How many other opinions where involved in finding a solution?' Such perspectives could help employees to start accepting external knowledge more rapidly.
Knowledge is power.	• Individuals see knowledge as part of their own personal competitive advantage. • Workers too busy to help, offer only generic information under the guise of being helpful. • Referring questions onward rather then handling it themselves.	• Set ambitious targets that cannot be achieved single-handedly. • Set clear goals rather then identifying methods to follow. • Provide an incentive to employees for re-cycling knowledge. • Bring individuals goals in line with organizations goals.

Table 3.1 McKinsey's barriers to knowledge. **Source: McKinsey & Co**

The most powerful weapon against the 'knowledge is power' and the 'not invented here' syndromes is a culture of cooperation. This is not a new concept and its implementation is not as easy as the solution sounds. As can be seen from the corporate prisoner's dilemma (Figure 3.1) the highest reward goes to the individual who benefits from other's shared knowledge but still hoards his/her own personal knowledge. Kluge *et al* (2001) believe that the most practical way of resolving this problem is by bringing the individual's goals in to line with the organization's goals. To achieve this they propose 4 primary levers.

1. *Setting high, world-class targets to encourage the acceptance of external knowledge.*
2. *Mitigating the prisoner's dilemma by increasing the likelihood of repeated interaction (team working).*
3. *Increasing the gains from cooperation with special incentives.*
4. *Fostering personal engagement and responsibility for own ideas.*

Obviously, the emphasis is firmly on the softer aspects of organizational change management if an organization is to develop a 'pull' knowledge delivery system. Whilst Kluge *et al* (2001) acknowledge the importance of technology in delivering information to the right time and place, the deciding factor as to whether an organization will benefit is down to how the employees pull and share the information and knowledge which may result. In essence their research shows that successful organizations use a combination of both push and pull. Push systems, being top-down in design, are dependent on technology for knowledge/information to flow. Pull systems, being bottom-up in design, are more dependent on an individual's innate desire for knowledge. It is this desire coupled with a culture of cooperation throughout the organization that determines how successful the pull delivery mechanism will be.

Szulanski (1996) also supports the view that relationships between employees contribute to knowledge transfer failures. However, he points out that prior research suggests that four sets of factors are likely to influence the difficulty of knowledge transfer. These are as follows:

1. *Characteristics of the knowledge transferred.*
2. *Characteristics of the source of the knowledge.*
3. *Characteristics of the recipient of the knowledge / information.*
4. *The context in which the knowledge / information is transferred.*

Some researchers place an almost exclusive emphasis on the attributes of the knowledge transferred (Zander & Kogut, 1995, Winters, 1987). Others stress the characteristics of the situation in which the transfer occurs (Arrow, 1969). However, all four sets of factors can be used together in a model that allows their relative influence to be measured.

Szulanski (1996) states that contrary to conventional wisdom placing primary blame on motivational factors, the major barriers to internal knowledge transfer are shown to be knowledge related factors such as the recipient's lack of absorptive capacity, causal ambiguity, and an arduous relationship between the source and the recipient. This is interesting as Kalling (2003a) identified recipient motivation as a key to driving knowledge transfer, and places it higher then cognitive factors such as tacitness, causal ambiguity and absorptive capacity. Although this is in direct contradiction to Szulanski (1969) both accept recipient motivation as a potential barrier to knowledge transfer. Kalling's (2003a) view is that irrespective of how knowledge is created and the mechanism of transferred; if an individual is not motivated to create or share then transfer will not happen.

Even though Szulanski's research was carried out using manufacturing sites it cannot be assumed his findings will describe how knowledge transferred within the ISC order flow process will happen. That said there is no reason to believe that the barriers described will not impact knowledge transfer to a greater or lesser degree.

Gupta & Michailova (2004) found that knowledge sharing among departments within the same organization is in reality not as natural as it may appear. In fact knowledge sharing hostility is a phenomenon that widely dominates organizational reality (Husted & Michailova, 2002). Gupta & Michailova (2004) identified three difficulties with the process of sharing knowledge.

1. **Knowledge is developed at a local level.** – *By definition knowledge is embedded in a certain cognitive and behavioural context. Without understanding the context one cannot inquire into the reasoning and the assumptions behind the particular piece of knowledge.*

2. **Knowledge is asymmetrically distributed.** – *Often those who possess the knowledge are not inclined to invest time and effort to share it without expecting reciprocity, as resources are finite and scarce* (Davenport & Prusak, 1998, O'Dell & Grayson 1998).

3. **Knowledge sharing is voluntary.** – *Efficient knowledge sharing depends on the willingness of individuals to identify the knowledge they possess and to share the knowledge when required* (Nonaka, 1994).

Moreover, Gupta & Michailova (2004) believe that an individual's ability to appreciate new knowledge is a function of their absorptive capacity (Cohen & Levinthal, 1990; Szulanski, 1996).

What is interesting about Gupta & Michailova's (2004) research is that it does not look at the organization as a single entity but as a collection of departments working together, and the different demands they place on knowledge creation. Through their research they identified three aspects of the complex organization that can hinder knowledge creation and sharing.

1. **The nature of the different businesses means different knowledge management requirements** – *Some departments or business units will operate within different environments; with some environments being more stable then others. Therefore, KM systems may need to be modified by department in order to support the internal knowledge creation process.*

2. **The different nature of the different business activities** – *The nature of the different businesses predispose different requirements to the type of knowledge sought as well as different preferences to how the needed knowledge is obtained.*

3. **The way codified and personalised systems are used within each department or business unit** – *Although the common practice is to assess organizations for codified or personalised knowledge systems, at a department level, depending on the mission and expected deliverables of the department the best fit from a codified or personalised strategy may not fit with the overall organization's assessment.*

This is an important view as the reality of today's organization, especially a complex supply chain organization, is that roles and expected deliverables will vary between departments or business units. Therefore, when defining a knowledge strategy, an understanding of how departments or business units that make up the organization use information and create knowledge needs to be taken into consideration.

What is also interesting from the literature reviewed is the strong view that technology as the primary focus in knowledge delivery systems has time and time again failed to deliver (Barson *et al,* 2000; Gupta *et al*, 2004; Pawar *et al*, 2002). The assumption that knowledge management relies heavily upon social patterns, practices, and processes goes far beyond computer-based technologies and infrastructures (Davenport & Prusak, 1998; Coleman, 1999; Liebowitz, 1999). Empirical evidence on barriers to knowledge sharing stresses the importance of behavioural and cultural factors rather than to outline reasons associated with technology (Skyrme & Amidon, 1997; De Long & Fahey, 2000). The emphasis on the role of technology, specifically knowledge codification, has also been questioned by Spender (1996) and Tsoukas (1996).

Pawar *et al* (2002) also question the effectiveness of a purely codified approach to knowledge management. It is their belief that modern management practice has only tended to focus on centralising, controlling, and standardising knowledge. Such codification allows the marginal cost of knowledge acquisition to be reduced by economies of scale (assuming the codified knowledge is relevant and useful). This underlying philosophy in the business environment has motivated an immense interest over the last decade in knowledge management as a business field. Pawar *et al* (2002), at the same time realise the place technology has within the effective coordination of knowledge. However, they feel that humans play more of a central role in the identification, acquisition, generation, storage, structuring, distribution, and assessment of knowledge (Table 3.2).

	Methods	**Tools**
Identification of Knowledge	Occupational aptitudes, Yellow pages, knowledge broker, knowledge map, handbook.	Intranet, expert systems, internet, databases, portals, collaboration, computers.
Generation of Knowledge	Training, simulation, role-plays, business games.	
Acquisition of Knowledge	Handbook, improvement program, communications forums.	Intranet
Structuring of Knowledge	Improvement program, micro articles, check lists	Intranet, internet, organizational memory, databases, portals, structuring.
Storage of Knowledge	Scenario techniques, business games, creativity techniques, space management, think tank, learning journey, communications forum.	Structuring, expert systems, intranet, organizational memory, intranet, internet, databases, portals.
Distribution of Knowledge	Handbook, training, mentoring, micro-world, role-playing, knowledge broker.	Internet, skills identification, knowledge discovery, organizational memory, databases.
Assessment of Knowledge	Handbook, balanced scorecard.	

Table 3.2 Methods and Tools for KM. **Source: Pawar *et al* (2002)**

It's interesting that the views of Pawar *et al* (2002), although taking the softer aspects of knowledge management in to consideration, do not really look at how organizations get their employees to pull knowledge. Although it is important to understand the different stages knowledge should pass through once it has been decided to push knowledge out to the wider community once the individual as created it. What still needs to be considered is what motivates the individual to create, share and more importantly seek out, or pull knowledge (Kalling, 2003a).

Malhotra (2001) also believes in line with Kluge *et al* (2001) that there is an overarching need for the building of a knowledge 'push-pull' culture within an organization, and the responsibility for developing this culture does not rest with the information technology specialists. In order to achieve this Malhotra (2001) believes organizations should focus on rewarding employees for what they contribute, and ensuring organizations track intellectual assets to show staff that knowledge is regarded as a valuable commodity; views which are supported by Kluge *et al's* (2001).

The literature on human issues in the vast area of knowledge management is somewhat sparse in comparison, but a study carried out by KPMG (1998) has highlighted that there is not only a lack of understanding about KM and its benefits but that there is a lack of skills within people of specific KM techniques. The point concerning knowledge understanding is a widely supported belief (Wilson, 2002). However, the point concerning a general lack of skills pertaining to KM techniques is worth considering at this stage. KPMG's review, like so many KM assessments, centred on the management of explicit codified knowledge. So, in the assessment that there is a skills shortage the reference really relates to a lack of technical ICT skills such as IT architecture, expert systems design, database design and management. These are high-level technical skills that continue to be scarce, even within large organizations like IBM. However, KPMG's assessment of KM related skills fails to specifically call out the 'softer' skills required to address knowledge management issues. It is the researcher's belief that in order to identify what 'soft' skills are required, one must first understand how knowledge creation and sharing practices are being impacted.

Barson *et al* (2000) looks at barriers to successful knowledge transfer using the TOP (Technological, Organizational, People) socio-technical systems classification as put forward by Brandt and Hartmann (1999). Barson *et al's* (2000) categorisation of the barriers is outlined in Table 3.3.

Technology	Organization	People
Existing resource	Existing resource	Existing resource
Available technology	Need for rewards	Need for rewards
Legacy systems	Culture	Culture
	Targeting	Internal resistance
	Costs	Self-interest
	Propriety knowledge	Trust
	Distance	Risk
		Fear of exploitation
		Fear of contamination

Table 3.3 Barriers to knowledge sharing and management. Source: Barson *et al* (2000)

This is an interesting perspective, because as many organizations fail to maximise on knowledge management performance due to failure to tackle the softer issues, it can be equally detrimental to performance if technical and indeed organizational issues are also neglected. A common theme that has emerged is that knowledge management must be viewed from a holistic perspective. Failure to do so will result in an organization's failure to realise the potential it has to create and share knowledge. Although the literature reviewed in this section looks at the barriers to knowledge creation and sharing from slightly different angles, there is a lot of commonality in their published findings. The barriers outlined by Barson *et al* (2000) encompass those already outlined in the literature review. A more detailed description of these barriers is given below.

3.3.1 Cross-category Barriers.

Existing Resource – Simply put, if an organization is to operate knowledge creation and sharing, then there must be the required resource available. The organizations must also have employees who can implement and develop the knowledge that has been accrued. This is implying a pull knowledge culture.

Need for rewards – This barrier concerns both organization and people. Rajan *et al* (1998) cited by Scarborough *et al* (1999) states that "*it is essential that employees can see that sharing means immediate gains such as less hassle, or easier tasks, reducing working hours or earlier closing.*" The need for rewards is a people issue whereas the mechanism for conferring rewards is an organizational issue.

Culture – The Lotus Corporation (and indeed Kluge *et al* (2001)) point out that a company's culture may not support sharing and re-use of knowledge. Although Lotus recommends overcoming this barrier through technology the general view is that this should happen through a combination of codified and personalised methods. It is important also to look at culture from a 'push' or 'pull' perspective as this determines largely how employees will access and use the information available. If the culture is predominantly either 'push' or 'pull' this maybe seen as a barrier as either the soft aspects of KM are being overlooked or the ICT systems are not in place to support information routing and sharing.

3.3.2 Technological Barriers.

Available Technology – Schwartz (1999) and Marwick (2001) suggest that technology still is unable to provide a single knowledge solution, and that an organization's codified solutions are usually a combination of applications cobbled together.

Legacy Systems – Swartz (1999) identifies legacy systems as a significant barrier to knowledge management. Connecting the systems of multiple departments, especially when there is no common standard approach to ICT deployment makes it difficult to solution an efficient knowledge transfer system.

3.3.3 Organizational Barriers.

Poor targeting of knowledge – Scarborough *et al* (1999) point out that 'information needs to be targeted if it is to serve knowledge'. Therefore, if a knowledge management system is to be effective it must be clear about what information it needs and what it expects to generate by way of knowledge.

Cost management of knowledge transfer – Farr & Fisher (1992) point out that a barrier to inter-organizational knowledge transfer is the cost of managing collaboration.

Protection of proprietary knowledge – Sharing of proprietary information with collaborators leaves an organization open to the risk that the information will be revealed. The consequences of this belief are the resistance within an organization to sharing proprietary information with suppliers.

Distance – According to Nonaka (1991) the most efficient means of transferring knowledge is through face-to-face communications. However, the distributed nature of today's organization may make this difficult to do. Different cultural, legal, and linguistic environments can also impact this.

3.3.4 People Barriers.

Internal resistance – This is where knowledge is hidden or its flow restricted in order to protect the interests of the organization.

Self interest – This is when customers may not be willing to supply information with a supplier for fear that the information will filter through to competitors.

Lack of trust - Trust impacts the way we perceive received information and the value we place on it, and also the manner in which we share information. If an individual does not trust the recipient of the information to use it wisely, and in the best interest of the organization, it will affect how much information is passed between the individuals.

Risk – Risk is related to both trust and proprietary knowledge barriers. Inter-organizational knowledge-sharing inherently involves an element of risk, particularly when proprietary knowledge in being shared.

Fear of exploitation – According to Lucas (2000) a fear of exploitation starts with the premise that "I will only share my knowledge with you if I think you can give me something in return". Although Barson *et al* (2000) see this as a 'people' barrier the solution to resolving this problem is very much an organizational one.

Fear of contamination – This barrier refers to when organizations with up-market brand issues are nervous about getting together with people they perceive as more down-market (Lucas, 2000).

3.4 Defining a list of Barriers for the purpose of this Research.

Although Barson *et al* (2000) provide a comprehensive list of issues that support the findings of previous research they do not provide any empirical evidence as to how the barriers impact knowledge creation and sharing within a complex organization such as IBM's ISC.

There are also aspects of Pawar *et al* (2000), Kluge *et al* (2001), and Szulanski's (1996) research that are not taken into account. Of particular interest is the impact an imbalanced push-pull knowledge strategy can have on information flow and knowledge creation. Also Szulanski's work on identifying barriers which effect knowledge 'stickiness' within an organization need to be considered when assessing barriers in any large complex organization.

Therefore, the findings from the different research papers covered in the literature review have been collated together and assessed by the researcher for over-lap. The barriers identified where categorised under the TOP headings used by Barson *et al* (2000) and are shown in Table 3.4.

Source	Technology Barriers	Description
Barson et al	Existing Resources (Money, time, technology, skills, data transfer).	Impact lack of money, time, technology, skills, and effective data transfer has on knowledge transfer. - For developing codified systems.
Barson et al	Available Technology (Does IT support knowledge requirement).	Does existing technology support organizations knowledge strategy?
Barson et al	Legacy Systems (Are Legacy systems impacting knowledge transfer).	Do existing legacy systems between dept/BU's impact knowledge creation, sharing, and distribution?
	Organizational Barriers	
Barson et al	Existing Resources (Money, time, technology, skills, data transfer).	Impact lack of money, time, technology, skills, and effective data transfer has on knowledge transfer. - For creating a knowledge delivery system (codified/personalised)
Barson et al/Kluge et al	Rewards (individuals rewarded for sharing/creating knowledge).	How are individuals motivated to share and create knowledge within the organization.
Barson et al/Kluge et al	Culture (Knowledge Strategy).	Does the organization have a balance knowledge creation and deployment strategy? (push v pull).
Gupta & Michailova	Knowledge Strategy Implementation.	Does the Strategy fit with how knowledge is created and shared within the Dept or BU?
Szulanski	Causal Ambiguity.	Depth of knowledge / does the individual or group know what the information /knowledge is supposed to be used for?
Barson et al	Poor Targeting of Knowledge.	Does the organization utilise its knowledge sources effectively?
Barson et al	Knowledge Cost.	Does the cost of managing collaboration impact knowledge transfer in the organization?
Barson et al/Pawar et al	Proprietary Knowledge.	Does the organization share its proprietary knowledge with suppliers / outsourced partners?
Barson et al/Pawar et al	Distance (Geo, Culture, language, legal).	Does geographical distance/language differences/cultural differences impact knowledge sharing?
Szulanski	Arduous Relationship.	Does a lack of communication and intimacy of the relationship with co-workers impact knowledge sharing?
Szulanski	Unproven (Is knowledge rated as being of value).	Degree to which knowledge is seen as useful based on previous experience of knowledge source.
Szulanski	Organizational Context.	Degree to which the organization context supports the development of knowledge transfers

Szulanski	Information Not Perceived as Reliable.	Degree to which the donor of the best practice is perceived as reliable.
Szulanski/Kluge et al	Lack or Motivation (Knowledge as power Syndrome).	Motivation of source to support knowledge transfer.
	People Barriers	
Barson et al	Existing Resources (Money, time, technology, skills, data transfer).	Impact lack of money, time, technology, skills, and effective data transfer has on knowledge transfer. - For allowing the individual to access/create/share knowledge.
Barson et al	Rewards.	How are individuals motivated to share and create knowledge within the organization.
Barson et al/Kluge et al	Internal Resistance (Protect interests of Org/BU).	How the desire to protect the interests of the dept/BU/ organization effects an individuals desire to share information / knowledge.
Barson et al	Self Interest (expose knowledge to competition).	Holding back on knowledge sharing with co-partners due to a belief that the knowledge will filter to competitors
Barson et al	Trust (Trust for Individuals sharing knowledge with).	Does the individual trust the source or recipient of the knowledge to use it correctly?
Barson et al	Risk (inc fear of penalty, losing profit).	Are there any risks that will affect Knowledge-sharing such as penalty clauses, profit risks?
Barson et al/Pawar et al	Fear of Exploitation.	Fear of sharing knowledge because knowledge is perceived to only flow one way.
Barson et al	Arduous Relationship.	Ease of communication and intimacy of the relationship
Szulanski	Lack of Motivation (Not invented here syndrome).	Motivation of recipient to support knowledge transfer.
Szulanski/Kluge et al	Fear of Undermining Position.	If the knowledge is shared will it undermine the individual's worth to the organization?
Kluge et al	Fear of Contamination.	Failure to work together because of perceived differences in professional capability.
Barson et al	Lack of Retentive Capacity.	Ability of recipient to routinise the use of new knowledge.
Szulanski	Lack of Absorptive Capacity.	Ability of recipient to identify value and apply new knowledge.
Gupta & Michailova	Knowledge System Modification.	How much flexibility individuals have in modifying systems to provide the necessary information or knowledge.

Table 3.4 Barriers to Knowledge creation and sharing. **Source: Developed for research.**

For the purposes of this research, this list will be used in assessing the main barriers to knowledge creation and transfer within the ISC's supply chain. What the research will endeavour to show is the degree to which these barriers impact knowledge creation and transfer, and where within the process they impact the most. However, before the impact across the organization can be assessed, the identified barriers need to be translated into questions that will then be used to poll the employees working within the order flow process. From the list of barriers outlined in Table 3.4 some barriers appear more than once. In order to help develop a concise questionnaire for the intended target audience the researcher has re-structured the barrier list to remove any duplication. The revised list now contains 25 barriers as outlined in Table 3.5.

Source	**Cross category Barriers**
Barson et al	Existing Resources (Money, time, technology, skills, data transfer).
Barson et al/Kluge et al	Rewards (individuals rewarded for sharing/creating knowledge).
Szulanski	Arduous Relationship.
Barson et al/Kluge et al	Culture (Knowledge Strategy).
	Technology Barriers
Barson et al	Available Technology (does IT support knowledge requirement).
Barson et al	Legacy Systems (are legacy systems impacting knowledge transfer).
	Organizational Barriers
Gupta & Michailova	Knowledge Strategy Implementation.
Szulanski	Causal Ambiguity.
Barson et al	Poor Targeting of Knowledge.
Barson et al	Knowledge Cost.
Barson et al/Pawar et al	Proprietary Knowledge.
Barson et al/Pawar et al	Distance (Geo, Culture, language, legal).
Szulanski	Unprovenness (Is knowledge rated as being of value).
Szulanski	Organizational Context.
Szulanski	Info not Perceived as Reliable.
Szulanski/Kluge et al	Lack or Motivation ('Knowledge is power' syndrome).
	People Barriers
Barson et al/Kluge et al	Internal Resistance (Protect interests of dept/BU/organization).
Barson et al	Self Interest (expose Knowledge to competition).
Barson et al	Trust (Trust for individuals sharing Knowledge with).
Barson et al	Risk (Fear of penalty, losing profit).
Barson et al/Pawar et al	Fear of Exploitation.
Szulanski	Lack of Motivation ('Not invented here' syndrome).
Kluge et al	Fear of Contamination.
Szulanski/Gupta & Michailova	Lack of Retentive Capacity.
Szulanski	Lack of Absorptive Capacity.

Table 3.5 Concise list of barriers. **Source: Developed for research**

The barriers identified in Table 3.5 have been used to develop a questionnaire, which in turn, will be used to assess barrier existence and impact within a complex organization. The development, testing and implementation of the questionnaire will be covered in more detail later in this thesis. A copy of the questionnaire can be found in Appendix B.

3.5 Barriers and the Learning Organization.

What is significant is how the barriers, identified in section 3.4, impact Nonaka *et al's* (1995) organizational learning model. The researcher looked at each barrier and assessed if it would, or could, impact any of the different transfer mechanisms; tacit to tacit, tacit to explicit, explicit to explicit, explicit to tacit. If the barrier had the ability to impact the aforementioned mechanism, it was listed in the respective quadrant. Figure 3.2 below shows Nonaka's organizational learning model with the 25 barriers mapped to the quadrant that they influence.

It is important to note that whilst the barriers are unevenly distributed across the organization-learning model it does not mean that the barriers will always be present in these areas; it simply means that these barriers may impact to a greater or lesser degree in these quadrants. Also, although the barriers are numbered this should not be taken to refer to a weighting; the numbers simply relate to their respective questions in the questionnaire included in Appendix B. The identified barriers may or may not appear depending on the organization, or even the part of the organization being assessed.

Nonaka's Learning Organization Model

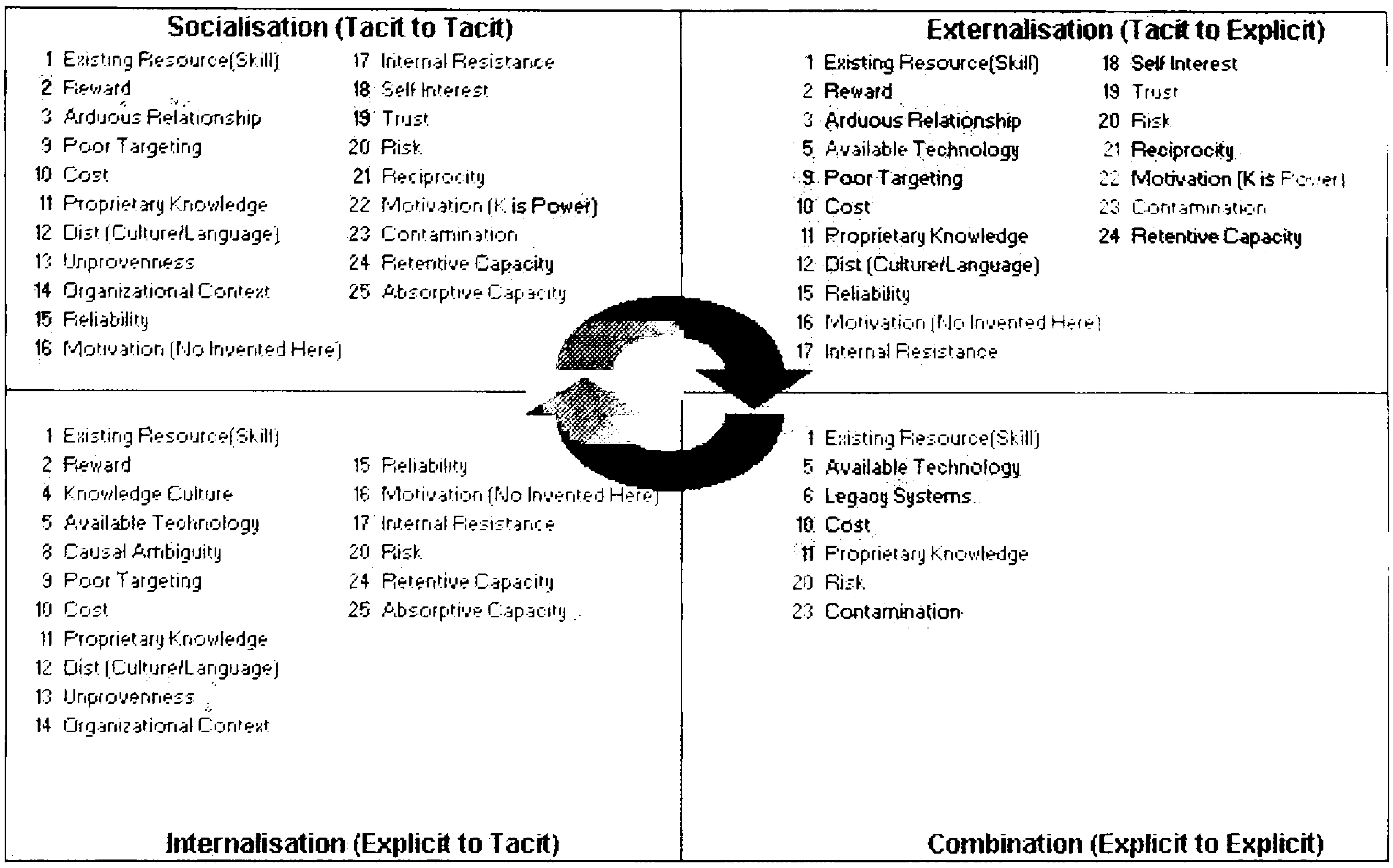

Figure 3.2 Learning Organization Model with barriers. Source: Developed for research.

What can be inferred from Figure3.2 is that barriers will impact the learning organization's ability to identify, create, and share information and knowledge. Therefore, a more accurate view of the learning spiral is shown in Figure 3.3. This will be important later on in the research as improvements to a core complex supply chain process will be assessed against the barriers and how they relate to the learning organization model. In particular, the research will explore how knowledge related performance would be seen to improve when identified barriers are targeted through a process improvement programme.

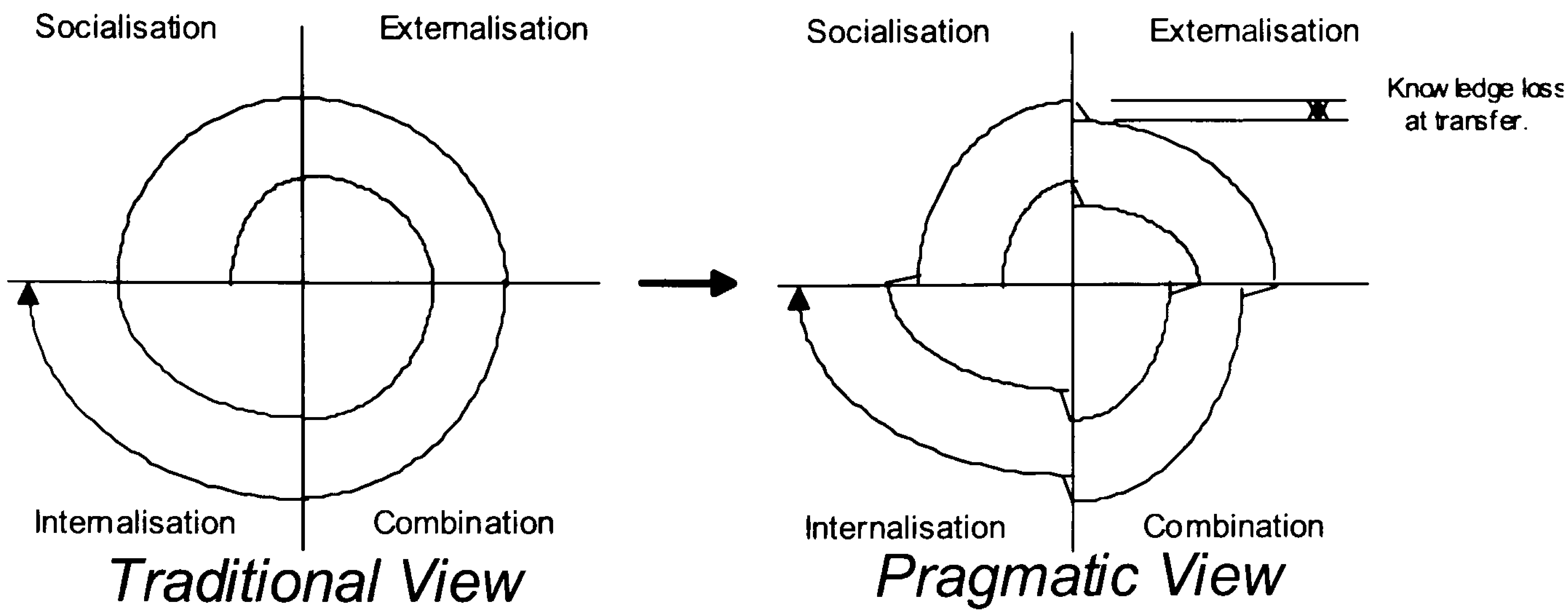

Figure 3.3 Knowledge loss across the LOM. Source: Developed for research

Figure 3.3 shows the traditional view as proposed by Nonaka *et al* (1995) juxtaposed with the more pragmatic researcher's view showing the effect the quadrant-related barriers might have on the learning process. The researcher hypothesises that the impact of the barriers (*knowledge loss at transfer*) will depend on whether the barriers exist, and to what level they are managed within the organization. Taking the pragmatic view a step further, if the barriers within the organization are allowed to impact knowledge creation and transfer without being identified and managed, the learning spiral may conceivably collapse as shown in Figure 3.4.

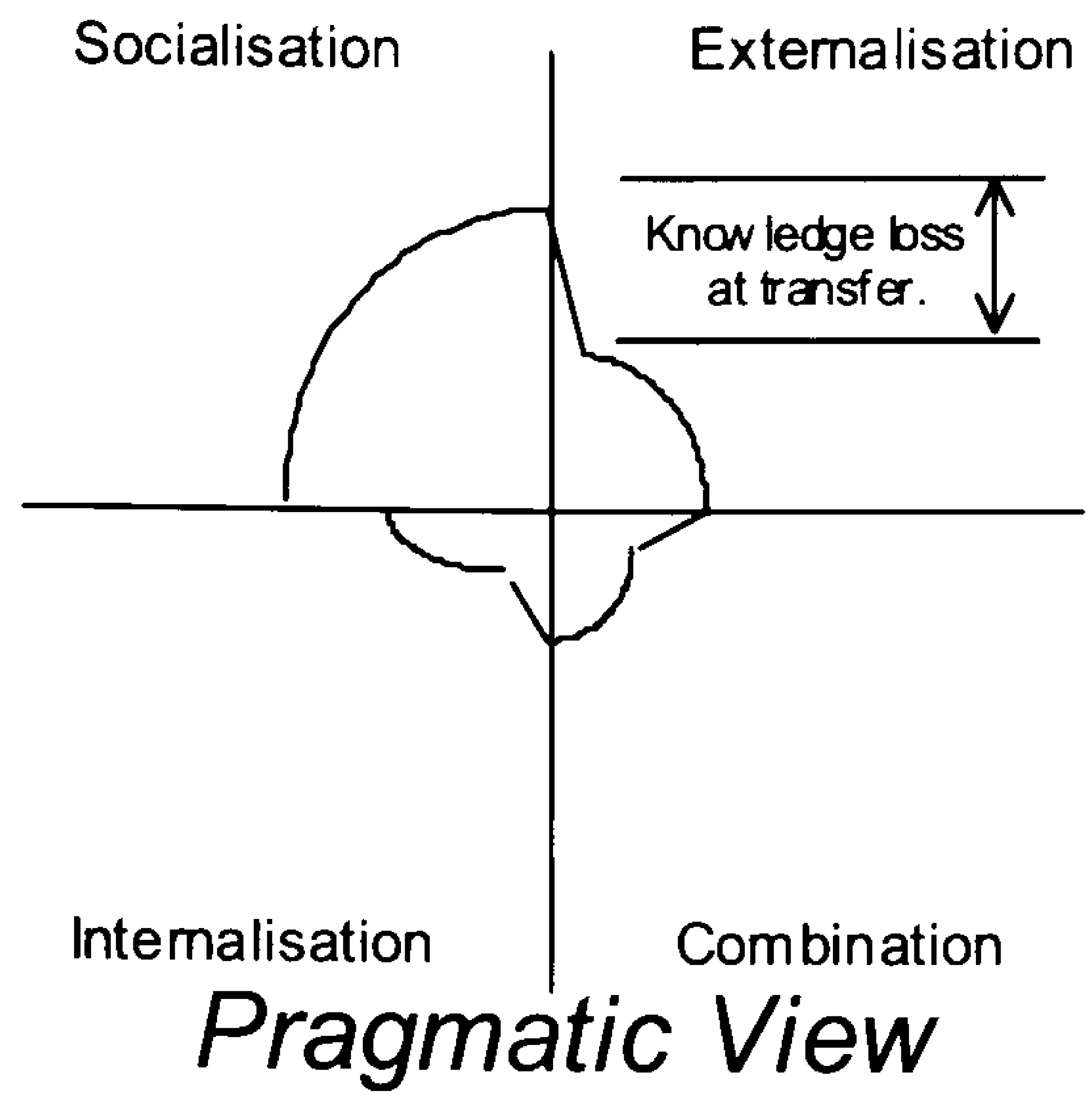

Figure 3.4 Extreme knowledge losses across the LOM. Source: Developed for research.

Figure 3.4 shows how the organization fails to maximise on its 'tacit to explicit to tacit' transfer mechanisms due to the actions of unchecked barriers within the organization. Barriers can and will impact to different degrees across the organization so the knowledge loss at transfer as shown in Figure 3.4 will vary through the different quadrants.

Therefore, organizations that simply see knowledge management as the implementation of bigger and better IT systems are possibly only addressing barriers within the *combination* section of the learning model. If organizations are to stand a better chance of achieving their knowledge management requirements they will need to identify and understand how the different barriers exist within their organization, and how they impact the learning process across the four quadrants.

3.6 Barriers and Knowledge Strategy.

As discussed in Chapter 2, organizations wishing to implement a knowledge strategy usually follow either a personalised or codified approach (Tiwana, 2001; Hansen *et al*, 1999). However, after reviewing the criteria for these approaches (Tiwana, 2001) it becomes clear that what is provided is a description of an organization's knowledge strategy. It does not take into consideration any of the barriers that might exist, which in turn will need to be addressed by the organization in order to effectively improve information and knowledge sharing. Tiwana (2001) looks at the organization from a top level when considering the type of strategic fit. This perspective fails to further consider the structure of the organization. This, the researcher believes, becomes more of an issue when considering suitable knowledge strategies for complex organizations such as supply chains.

Having identified the 25 barriers to knowledge and information sharing it will be important to see how the barriers impact upon a real organization. If one considers, as the researcher does, that core complex business processes can be viewed as information and knowledge highways, the existence of barriers and how they impact employees along the core business processes is of relevance. For the purpose of this research the core IBM process chosen against which the barriers would be tested is the order flow process. This process follows customer orders for computer hardware from initial receipt into IBM through the fulfilment, scheduling, manufacturing, and distribution components of the supply chain.

If the barriers did not appear uniformly across the organization this would in turn indicate differences in knowledge and information access/creation/sharing practices amongst employees involved in operating a core process. If this was the case, then the deployment of a 'blanket' knowledge management strategy could fail to address key aspects of how employees work together. By looking at how barriers impact along core processes, and then developing a knowledge strategy in order to manage these barriers, there is a shift in emphasis from a top-down to a bottom-up knowledge strategy.

3.7 Chapter Conclusions.

From existing research a list of 25 key barriers to knowledge creation and transfer has been identified. However, this in itself is not the central point of importance concerning this research. It is not the existence of barriers that interested the researcher, but the relationship those barriers have to knowledge creation and transfer across, specifically, complex organizations. In particular, the researcher is interested in how the barriers vary in impact along core complex processes, which in turn are critical to overall organizational performance.

It is also important to note that how barriers exist and impact along core complex processes would be expected to vary from organization to organization. How organizations create and share information and knowledge is vitally important if an innovative, responsive business is to be developed. As core complex processes are the mechanisms by which business performance is driven, information and knowledge creation and sharing along these arteries must become a key focus point for business success. Therefore, barriers that impact along these processes must be understood and where possible managed. However, identifying and then showing how barriers can vary in impact across a process, and also in the type of knowledge transfer mechanism the barriers impact, can force practitioners to revisit the way knowledge strategy is defined.

Another consideration this raises for organizations with complex business processes is that different barriers will need different solutions. How barriers impact the 'tacit-explicit-tacit' transfer mechanism along a process will determine the type of solution needed at that part of the process. Therefore, the deployment of a generic ICT or business solution across the organization cannot now be expected to fully support the operational needs of employees along a complex process. For organizations to effectively manage their supply chains they must consider the operation of their core supply chain processes. From this point they should then look to understand how employees create and share information and knowledge along this process and which barriers are seen to impact. Only when this has been achieved can the organization effectively fine-tune the performance of the process through the removal or management of the core process barriers.

From this chapter some important follow-on questions and research opportunities can be considered. Firstly, if an organization is to look to its processes and understand how barriers impact at different stages along them, how will this affect the choice of supporting information and knowledge management systems? The barriers identified can be driven by internal, external or a combination of both internal and external organizational influences. As such, the best approach to managing the barriers once identified can be either codified or personalised. However, only through identifying and understanding the influencing parameters of each barrier will the organization know the best way of reducing or managing the barrier's impact. Therefore, if the dominant barriers change between codified and personalised in nature along the process, how does this affect the development of an organization's ICT strategy? The development of a knowledge strategy must therefore, be flexible and continually monitoring or sensing the 'knowledge creating / transferring' environment.

Secondly, from a barrier perspective, the identification of barriers might be a lot easier than the practical management of them. However, if there was a relational link between barriers that could identify those with the most influence on other barriers, then an organization could focus on those barriers with the most impact. Therefore, how do these barriers interact and affect one another? Once again this question will be revisited later in the thesis.

The above questions are embedded within this research project being conducted by the researcher. Both questions will be revisited through the course of this research project.

4. Knowledge enhanced Performance in Complex Organizations.

"In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge. Successful companies are those that consistently create new knowledge, disseminate it widely throughout the organization and quickly embody it in new technologies and products"

Nonaka (1997)

4.1 Introduction.

The need for organizations to focus on the creation and transfer of knowledge as a competitive resource is widely accepted in both business and academic circles, and a lot of organizations now purport to be leaders in managing their knowledge assets. However, how are these companies and organizations assessing their success? What benchmark do they use to determine how good they are at deriving value from knowledge creation and reuse? Most importantly, how are they determining if their knowledge management initiatives are actually providing 'value-add' to the overall performance of the organization without driving up internal costs? Despite a growing body of theory on knowledge management there is still very little published research focusing on the links between knowledge and performance. Therefore, are we to assume that there is a causal link between knowledge and value?

4.2 The Problem linking Knowledge to Performance.

In particular two aspects of knowledge-enhanced performance interest the researcher. The first is how an organization can ensure its knowledge is used productively. Are its knowledge initiatives focused on performance improvement, or just generating knowledge in the belief that all knowledge will impact performance? A lot of organizations develop 'communities of practice'[1] (CoP) and intranet portals in the hope of generating and distributing explicit knowledge. Lesser & Stork (2004)

[1] Community of practice (CoP) – when practitioners with a common interest come together in order to share information, and experiences relating to the commonly expressed interest.

certainly believe that CoPs enhance organizational performance, but they fail to draw any causal links between the types of knowledge created in CoPs and how it can be shown to benefit the organization. Is there a more effective way of ensuring that explicit knowledge created and distributed is of real value in improving operational performance?

Fontaine (2004) also supports the view that CoPs have a role to play in driving performance. However, Fontaine (2004) points to the fact that the impact on performance is affected, in no small way, by the way CoPs are allowed or encouraged to develop. Top-down CoPs that develop around formal network structures are quick to set-up but can fail to provide the expected level of interaction due to the participant's lack of engagement. People need to trust and feel motivated to share information (Lee *et al*, 2003a; Kluge *et al* 2001) and knowledge. When practitioners are directed to come together in a contrived knowledge forum, they may feel reticent about fully committing to the sharing process. Bottom-up CoPs usually develop through contacts established through informal networks. The impetus to trust and share maybe present from the start, but the direction and type of knowledge being shared may not be related to organizational performance. Bottom-up developed CoPs also take a relatively longer time to move from the forming stage to the performing stage, and the majority of these CoPs fail due to lack of organizational support; especially in the area of ICT (Fontaine, 2004).

So what is the best approach? Possibly a combination of both types of CoP; a CoP that has been developed across informal networks (bottom-up), but is 'adopted' or 'sponsored' by the organization. This way trust and motivation exists from an early stage, but the organization is able to engage the CoP on performance related issues.

The organization looks to encourage the formation of CoPs from a bottom-up perspective, but then supports and engages the CoPs to identify and resolve operational / organizational problems. This gets the organization closer to linking its knowledge management initiatives (CoPs) to performance. In effect the organization is getting its subject matter experts (SME) within the CoPs to directly identify issues and possible solutions. Therefore, any solution can then be directly related to a performance metric.

The second aspect of knowledge enhanced performance is how to ensure performance related knowledge is viewed and effectively managed across a complex organization, and what is the best approach in utilising limited resources in ensuring that this happens. Organizations are becoming increasingly complex; especially supply chain organizations. Therefore, how should such organizations look to match their resources to the task of generating value-add knowledge? Desouza *et al* (2004) argue the point that only a small portion of what is considered to be organizational knowledge is used to support and sustain an organizations competitive advantage. It is these concerns that the researcher will look to address through the course of this chapter.

4.3 Increased Supply Chain Complexity and Knowledge Focus.

We accept that knowledge is important in developing and sustaining an organizations competitive position within its respective market place. So why is the supply chain organization being identified for special focus by the researcher. Organizations can be viewed as a generic business environment, which may operate within the confines of their own boundaries. The supply chain requires a more complex business-operating model, and as such the knowledge management requirements also become more complex. Lesser (2002) identifies five key changes to the business environment that supply chain organizations must address if they are to develop knowledge aware supply chains.

1. **Globalisation** – *The need for organizations to tap into the wealth of expertise located around the world.*

2. **Growth of strategic alliances and joint ventures** – *Cooperation and open knowledge sharing become vital to the overall success of the supply chain.*

3. **Migration from product to services** – *Organizations now need to lever tacit knowledge for the creation of new and innovative products. Once again this will mean improved inter-organizational cooperation.*

4. **Product complexity** – *This drives supply chain complexity. The partners within the supply chain need better awareness of the product / service, especially from a customer perspective.*

5. **Changing nature of the workforce** – *How do organizations ensure that the knowledge and experience of an ageing work force is not lost?*

These challenges, although not limited to supply chain organizations, introduce a level of complexity in the way modern organizations must now conduct their business. The need to develop and encourage the creative aspects of knowledge within the organization has underlined the need to re-focus on employee knowledge creation and sharing habits. Technology, or more specifically codified systems, can feed the flames of knowledge creation, but they do not provide the vital spark with which the process is started.

4.3.1 KM and the Supply Chain.

The importance of the core supply chain process is deemed a vital component to the success of the overall supply chain operation (Lee, 1997; Rajiv, 2006). In complex organizations the effective management of the core process can be negatively impacted due to conflicting interests of the different functional business users and owners of key process segments (Argote, 2005). Organizations are increasingly aligning their supply chain activities around processes, which are more relevant to their customers, rather than business functions (Hammer *et al*, 1993; van Weele, 2002). Hammer *et al* (1993) further expand this view by highlighting the need to consider the complete end-to-end process irrespective of organizational boundaries. When an organization adopts this approach to 'total' supply chain management, work practices have to change. Employees start to get things done through the formation of cross-functional teams or cross-departmental project teams, or even joint customer-supplier teams (van Weele, 2002). In order for employees to work effectively in such complex environments, innovation and peer-to-peer collaboration become a necessary part of driving overall performance (Simons, 2005). Within an environment where innovation and peer-to-peer collaboration become vital to the success of the organization (Hammer *et al*, 1993) the manner in which information and knowledge is accessed, created and shared within the organization becomes a fundamental component ensuring effective collaboration and innovation (Nonaka *et al*, 1995; Krogh *et al*, 2001).

Collaboration and innovation must be encouraged within the complex environment where organizational process alignment is adopted over functional alignment (van Weele, 2002, Hammer *et al*, 1993). Now also consider the importance of information and knowledge flows to organizational performance. What this points to, with respect to complex supply chains, is the importance of effective information and knowledge flow along core supply chain processes (Yuva, 2002; Lee *et al*, 2000). Many knowledge and information management initiatives focus on organization wide, business function specific, or technology implementation (Kluge *et al*, 2001). However, for optimal supply chain operation the focus needs to be on the actual processes. As the processes can cross multiple organizational boundaries, reliance on technological solutions alone cannot be wholly depended on (Kluge *et al*, 2001: Marwick, 2001: Tsoukas, 1996).

However, before moving on, one should consider variation between supply chains, and how this might impact knowledge initiatives. Lin *et al* (2002) looked at the knowledge management architecture in collaborative supply chains and highlighted the following findings. In supply chains where product innovation and change are a constant requirement (design-centric industries) the knowledge flows are usually informally structured with the emphasis on knowledge creation and transfer (tacit knowledge generation using personalised systems). In supply chains where the product volume and structure (product-centric industries) the knowledge flows are usually more formally defined with the emphasis on knowledge capture, and transfer (explicit knowledge storage using codified systems). The research certainly supports the view of the researcher (and Tiwana, 2001) that knowledge focus will change depending on the type of product / service being delivered through the supply chain. However, Lin *et al* (2002) make their assumptions for knowledge practice across the whole supply chain. Thus in doing so, they fail to consider the complex operating relationships between the business components, and therefore, the varying knowledge creation and sharing needs and habits of the supply chain at an operational level.

Yuva (2002) also looks at knowledge and the supply chain from a top-level organization wide perspective. However, Yuva (2002) identifies five characteristics inherent in supply chain organizations with successful knowledge management models. These are:

1. **Awareness of knowledge and skills of others** – *How to get the skills mix right across the supply chain.*

2. **Time and space to create, share, and apply knowledge** – *Supply managers must be able to respond to other employee and supplier questions.*

3. **Trust** – *Does it exist within the organization? Who should/needs to trust whom, and how can this be encouraged?*

4. **Common language of understanding** – *Without common agreement on vocabulary and background context it is difficult to apply knowledge from one part of the organization to another.*

5. **Recognition mechanisms** – *For those actively contributing their knowledge.*

Although Yuva (2002) fails to clearly identify the criteria for assessing the knowledge capability of a supply chain the characteristics are interesting in that they focus on the 'softer' aspects of knowledge management. The focus is on the generation and sharing of knowledge, and not on its capture and storage.

4.4 Linking Knowledge to Performance.

The stream of research on organizational learning is diverse in terms of the meaning of the organizational-learning concept. However, it is not very attentive to strategic implications of learning (Crossan *et al* 1999). A range of highly impressive and well known texts on organizational learning, such as Daft & Weick (1984), Fiol & Lyles (1985), Cohan & Levinthal (1990), Huber (1991), and Nonaka (1994) focus on learning processes, not processes related to converting knowledge to performance improvements. Consequently, Crossan *et al* (1999) states that much of the research into organizational learning fails to realise the end to learning. They claim that March (1991) is a rare exception, who stipulates that organizational learning requires a balancing of 'exploration' and 'exploitation' of knowledge. Organizational learning studies have their relative advantages in the in-depth discussion about the dynamics of knowledge rather than strategy.

Sanchez's (2001) research supports this view by pointing out that the key feature of performance improvement is the transformation of knowledge into *competence*. However, the effective management of knowledge into set goals is not well covered by existing research.

According to Kalling (2003b) management research takes the question of connection between knowledge and value for granted and despite any assumed link the conversion of knowledge into improved performance is not automatic or free from problems. From a strategic perspective Kalling (2003b) points out that Knowledge is also approached without any detail discussion about the link between capabilities and performance. However, when we view knowledge as a 'capability' it suggests that knowledge can contribute to improved performance.

The field of research is slowly beginning to focus on knowledge management topics that look at, at least partially, the management of the conversion of knowledge into improved performance. A classic example of the conversion is the 'experience curve' (Darr *et al*, 1995; Yelle, 1979; Henderson, 1984).

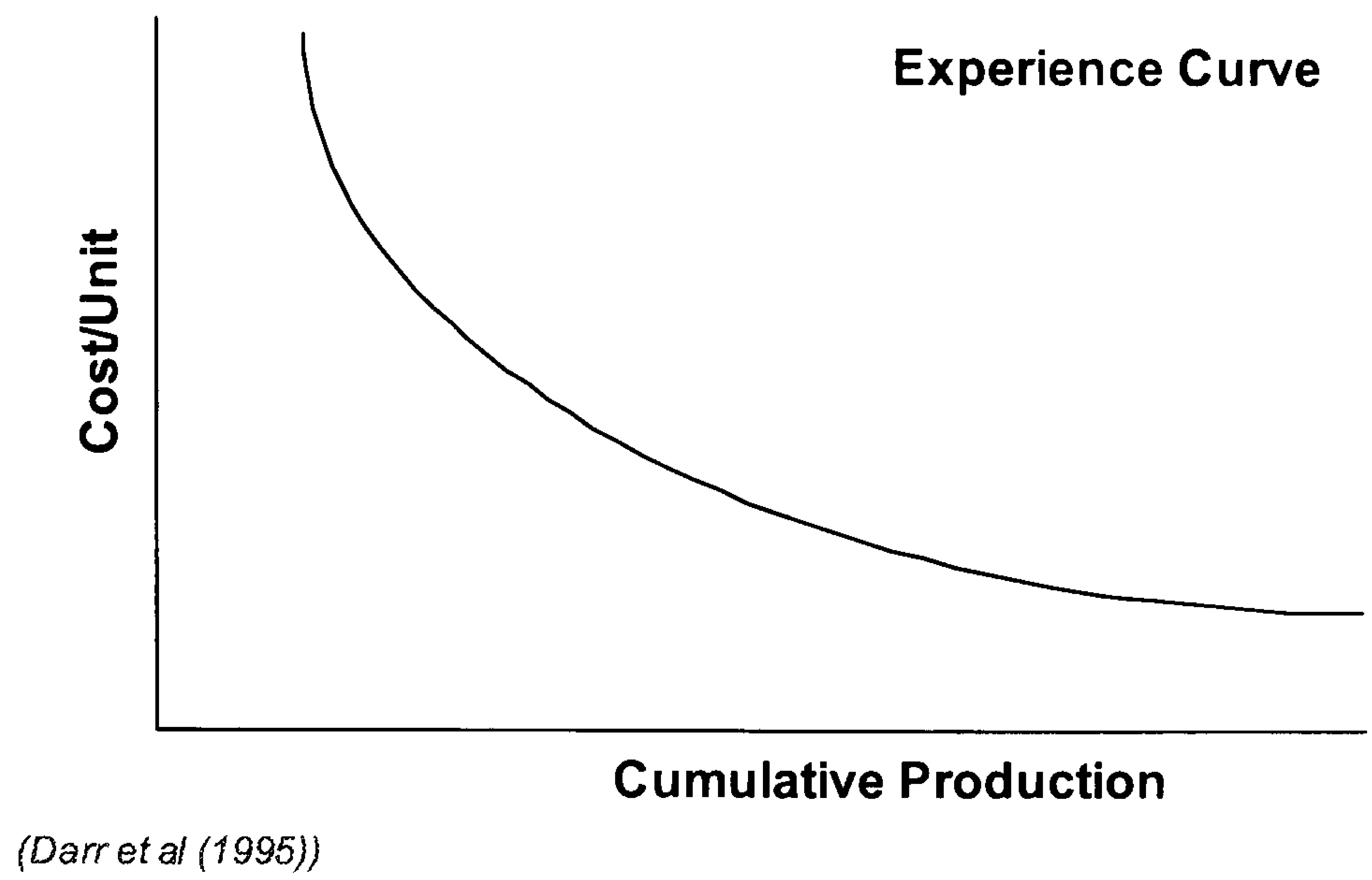

Figure 4.1 Experience curve. **Source: Darr *et al* (1995)**

This theory proposes that unit costs go down as experience accumulates, albeit at a decreasing rate. More recently Darr *et al* (1995) supported this theory by showing that the transfer of knowledge between units within the same organization does lead to improved productivity.

Szulanski (1996) found that in order to be successful, the management of causal ambiguity, absorptive capacity and relationships must accompany knowledge transfer between organizational units. However, in Szulanski's study the dependant variable is not improved performance, but rather the perception of respondents as to whether the transfer had been successful in helping the unit improve their routines and work tasks.

Argot (1999) used cost effectiveness as a dependant variable, whereas Baum & Ingram (1998) used 'survival' as a variable dependant upon knowledge. In an interesting and useful twist Argote & Ingram (2000) suggested that knowledge transfer could be measured by measuring changes in performance. Tsai (2001) in contrast used both innovation (rate of new innovations per year) and performance (profitability) as dependant variables to knowledge sharing within an organization. Tsai (2001) found evidence that both variables were improved if the unit in question had absorptive capacity and a central position within the organizational network.

So, obviously there are studies focusing on the performance results of knowledge management. However, normally emphasis is at best on cost improvement, rather then competitive advantage or profit. The underlying assumption, one might assume, is that all new knowledge is good knowledge that automatically brings improved performance. In cases where the dependant variable is stretched into cost improvement, it assumes that the other components of profit (volume and price) are not affected. From a managerial stand point, it appears that causal ambiguity, absorptive capacity, and organizational context are key factors (Darr *et al*, 1995; Szulanski 1996, 2000; Tsai 2001).

This overview of knowledge management oriented research indicates a strong focus on knowledge itself, and how it is managed. Managing knowledge to improve performance is less well discussed. In many approaches there is evidently an assumption that there are few obstacles to the efficient use of knowledge in improving performance. However, there appears to be a difference between managing knowledge in order to improve the quality of knowledge itself, and managing knowledge so as to improve the effective use of the knowledge. Expanding knowledge in depth or breadth by experience or learning, transferring it, codifying it, and explicating it doesn't necessarily mean processes or results are improved. As a consequence of this view Kalling (2003b) distinguishes between three causally related components (Figure 4.2).

1. **Knowledge Development** – *The objective of KD is to create or extend organizational knowledge.*

2. **Knowledge Utilisation** – *The objective of KU is to improve activities such as productivity, stock control, distribution etc.,*

3. **Knowledge Capitalisation** – *The objective of KC is to make sure improvements in activities are converted into reduced costs, a higher price, or a larger sales volume without a negative impact on profitability.*

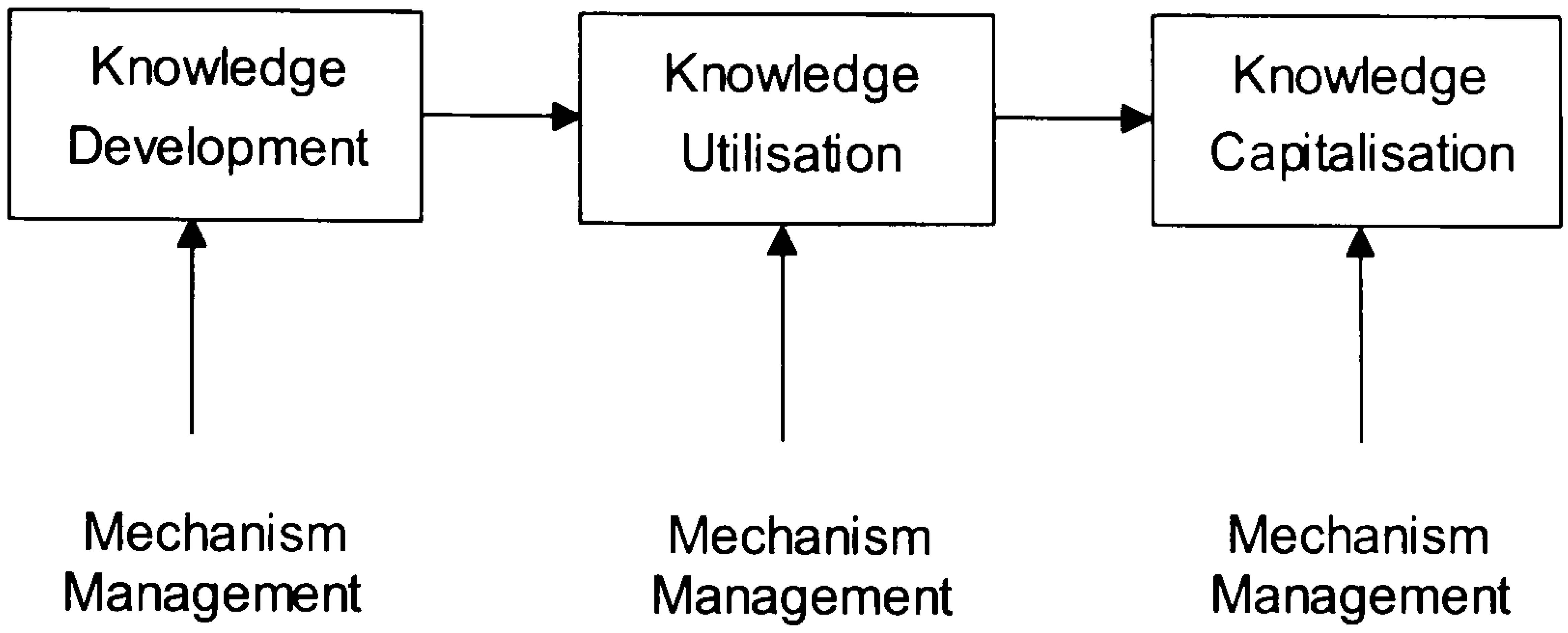

Figure 4.2 Knowledge capitalisation. **Source: Kalling (2003b)**

Kalling (2003b) states that this approach acknowledges that the link between knowledge and performance is not automatic. It also assumes that a successful link requires managerial and organizational effort. Kalling then argues that Knowledge is a resource that we know a lot about, particularly its nature, attributes and how to develop it. However, the factors that covert knowledge (and other resources) into improved and possibly unique offerings and performances are not well studied, especially not the management implications. In effect the point that Kalling (2003b) strives to make is that new learning might not always result in performance improvements.

Tsai (2001) also strives to look at the relationship between knowledge and performance – but also includes innovation as a key driver to the overall success of a 'knowledge aware' organization. Tsai's (2001) research conclusion suggest that an organization's innovation[2] capability is significantly increased by its centrality in the intra-organizational network, which provides opportunity for sharing, learning, knowledge transfer, and information exchange. Tsai (2001) goes on to state that the research does not show a significant association between an organization's network position and its business performance, and that more research is needed into determining the link, if any, between the effectiveness of networks, and knowledge transfer and utilisation pathways, and performance. This supports the view of

[2] Innovation in this instance, referrers to the number of new products to market over the number of planned products to market.

Fontaine (2004) that not all knowledge networks (CoPs) produce value-add knowledge.

Tsai's (2001) paper, whilst not providing clarification on performance does provide further insight into absorptive capacity. This refers to how an internal business unit's learning capacity can determine the extent to which it can absorb new knowledge from other parts of the organization.

There is no doubt as to the importance on absorptive capacity in knowledge development throughout an organization. However, this is, as Cohen *et al* (1990) point out, an intangible. They expand on absorptive capacity further by stating that it is more likely to develop and be maintained as a by-product of routine activity when the knowledge domain that the firm wishes to exploit is closely related to its current knowledge base. When, however, a firm wishes to acquire and use knowledge that is unrelated to its on-going activity, the firm must dedicate effort exclusively to creating absorptive capacity. Cohen *et al* (1990) do not go into any further detail as to how organizations decide on the level of effort to be expended, and how this should be done.

Lee and Choi (2003a) also look at knowledge and its role in performance improvement. However, the approach they take is to look mainly at the relationship between knowledge enablers (collaboration, trust, learning, centralisation, formalisation, t-shaped skills, and it support) and how they relate to the four stages of knowledge development through the Nonaka *et al* (1995) Learning Organization Model. Lee *et al's* (2003a) research findings highlighted the association between social factors (learning, trust, collaboration), and the importance shaping these factors has to any organization focused on improving knowledge creation. In essence a trust-based culture is the foundation of any knowledge management initiative. However, in reality many KM initiatives focus on the IT aspect and because of this some organizations will experience difficulty in implementing their KM initiatives due to unresolved cultural issues.

From Lee *et al's* (2003a) research they put forward the following findings:

- *Trust levels directly effect knowledge creation within an organization.*

- *ICT support had a positive impact on knowledge combination only (explicit to explicit knowledge transfer).*

- *Organizational creativity was found to be a critical factor for improving performance. i.e. neglecting ideas can undermine business performance.*

Although Lee *et al* (2003a) purported to look at performance, they really concentrated on the seven enablers and how they affect an organizations ability to learn with respect to Nonaka's learning model. The link between knowledge creation and transfer, and process improvement was not made.

However, they did look at performance as being simply more then reduced cost and / or improved profit; a view supported by Kalling (2003b). In their case they looked at organizational performance as being made up of the following indicators as compared with key competitors.

Performance is seen as improving if -

- *Relative to the competition, the business or process is more successful.*
- *Relative to the competition, the business has greater market share.*
- *Relative to the competition, the business is growing faster.*
- *Relative to the competition, the business is more profitable.*
- *Relative to the competition, the business is more innovative.*

The definition of performance is important, as it should simultaneously indicate the 'end-goal' and 'objective' of any process improvement within an organization. If process or organizational improvements are not going to improve the way resources are utilised, then should those improvements be made? Organizations, whether for profit or not, need to consider the impact their KM initiatives have on performance. As most organizations will have to carefully manage their resources in a way that supports the building of their competitive advantage, they must also learn to view their ability to create and share knowledge as a resource to be carefully managed.

4.5 Selecting the right KM Initiatives.

The question, as Kalling (2003b) proposed, is how do we know if the improvements will result in performance improvement? In order to stand any chance of understanding this we need to define the key attributes of performance. This will surely change depending on the nature of the organization's business. For example, a 'not for profit' organization will not have profit as a key performance indicator. Therefore, depending on the business objectives, the performance indicators will vary. From this the knowledge focus will also vary. So, should organizations develop organization-wide knowledge management initiatives that focus on developing and encouraging a 'push-pull' culture? Or should organizations focus their limited resources on identifying and implementing KM initiatives around core performance indicators?

The answer, as expected is not black and white. The question posed basically relates to two ends of a spectrum. Organizations need to focus on some knowledge initiatives from a corporate wide perspective – such as developing a 'push-pull' culture. However, resources, within any organization will be limited. Therefore, organizations must focus their knowledge initiatives in those areas that can directly improve performance. Some might say that the easy solution is to focus on organization-wide knowledge initiatives that also focus on the top-level performance drivers. This way the organization's knowledge initiative can be developed and driven from the boardroom. However, not just for the reasons Lee *et al* (2003a), Fontaine (2004), and Kalling (2003) point out, focusing on top level performance drivers might not be as practical as one might think.

4.6 Performance Indicators for the Supply Chain.

As the success of any business may not always be based on its ability to be profitable there are many other key performance indicators an organization may wish to use. In the case of complex organizations certain parts of the organization might not directly contribute to profit generation. However, those parts of the organization might act as enablers to allow other parts of the organization to engage in profit generating activities. Take for example manufacturing with IBM. Until recently manufacturing was seen as a cost to the business, and therefore, the main performance indicator was to remove cost from the manufacturing process. The actual profit gained from the sale of a computer was logged against the Brand (IBM PCD), who then paid IBM Manufacturing (a separate business Division) for building the computers. So, within IBM's Manufacturing Division the measurement of a knowledge initiative's success against profitability would not show up the initiative as being a wise investment, as the objective is not for one internal business unit to seek or make a profit from another internal business unit.

Therefore, Szulanski's (1996) approach to performance, where the level of improvement is related to the perception of respondents as to whether knowledge transfer had been successful in helping that part of the complex organization improve processes and /or work tasks, might be more suitable.

From a supply chain perspective, successful performance can be indicated by many things; order delivery time, hub stock turn-around time, customer satisfaction, order placement time, credit check turn around time, invoice accuracy, format, and delivery etc., Overall, profitability can be influenced not just by product cost, but also by the generation of repeat and sustained business based on quality and reliability of service. In the case of IBM there are six top-level indicators that are used to measure the performance, and the ISC's ability to create value for all of IBM (Radjou, 2005).

1. **Client satisfaction** – *How well ISC is performing end-to-end in meeting client expectation.*

2. **Cost reduction** – *How well ISC has decreased cost of doing business through end-to-end operational integration, innovation, and increased efficiency.*

3. **Cash generation** – *How well ISC creates positive cash flow through end-to-end operational integration, innovation, and increased efficiency.*

4. **Demand / supply synchronisation** – *How well ISC creates true visibility of supply and demand to effectively meet needs of clients and the business.*

5. **Cycle time** – *How effective ISC is in driving competitive end-to-end process excellence and responsiveness.*

6. **Sales force productivity** – *How much time ISC can give back to the sales force to spend with IBM's clients by minimising the time they spend on ISC activity and by playing a more active / direct role in the support of IBM's clients.*

If we look at IBM's top performance criteria in line with Kalling (2003b) we see the focus is on innovation, profitability, growth, and market share. This is very much at a top level across the organization. In order to realise these performance goals, business units or functions must interpret how best they can support the overall performance objects from within their respective business operating environments. This will result in a separate level of operational performance indicators, the sum of which will look to address the top-level performance goals of the organization.

For the purpose of this research a core supply chain process will be reviewed. The process is the 'order flow' process which manages customers orders for computers from initial order receipt right through to final order delivery. This is a core process whose performance has a direct impact on innovation, profitability, growth, and market share. However, the performance indicators along this process will vary in relationship to other core ISC processes. In this instance the main indicators are time taken between customer order receipt and order delivery, new product test and build, and time taken through the key stages of the process (this process will be covered in more detail later in the thesis).

4.6.1 The Problem with Implementation.

If an organization uses its top-level performance indicators to direct knowledge management initiatives the emphasis on knowledge type (tacit v explicit), culture (pull v push), and/or implementation (codified v personalised) might be wrong. As shown, top-level performance indicators are just that. In complex organizations different functions or business units may have more, or less, impact on different indicators. Therefore, knowledge initiatives need to focus on the actual performance mechanism operating within and across the different functions or business units.

From a complex process perspective this means developing certain aspects of the knowledge strategy directly around the information and knowledge needs of core business process. From a practical perspective, before even considering the motivation, trust, and causal ambiguity issues that shape the knowledge practices of employees, a clear understanding of how the core process links through the organization must be made.

4.7 Chapter Conclusions.

Darr *et al* (1995) demonstrated a link between knowledge and performance. However, this does not answer the concern of the researcher which is 'how does an organization gauge how much knowledge creation and sharing is impacting organization, or business unit performance?' Desouza *et al* (2004) believe that not all knowledge will impact the bottom line. Therefore, in a business environment where resources are limited, and the operating business model is complex, how does an organization ensure they focus on the 'value-add' knowledge initiatives?

There is very little research currently addressing this issue. Certainly, performance and knowledge, as separate research topics are, and have experienced a high degree of focus. However, the causal link between knowledge and performance is still an area for further investigation. The existing literature does provide some useful indicators that can in turn help direct organizations in selecting the best 'value-add' initiatives.

Limited resources and the need to develop a credible knowledge management programme should help organizations focus on the need to be selective about their knowledge initiatives. The practical concern now is how to ensure the link is made between knowledge and performance.

Communities of practices (CoP) provide the best examples of knowledge-to-performance transfer mechanisms. Even though, the research surrounding CoPs does not directly explore the link between knowledge creation and sharing, and performance, their formation and structure does provide some indication as to the best way to approach performance improvement through knowledge enablement. The researcher puts forward the view that to maximise the return on knowledge creation and transfer, relative to performance, knowledge initiatives should be allowed to form and develop from a bottom-up perspective. Organizations should then adopt and support those initiatives that best fit with identifying and driving changes that in turn impact performance. In essence, even though the CoP is in itself a knowledge initiative, the value-add comes from the CoPs ability to identify new and localised knowledge initiatives that improve knowledge practice for employees working within and around the area of shared interest of the CoP.

The development of bottom-up knowledge initiatives can, as the researcher believes, have significant impact across the organization. Couple this to the conclusions drawn through chapters 1 and 2 the researcher makes the following assumptions:

1. *Complex organizations looking to improve core process performance need to view their core processes as information and knowledge highways or arteries.*

2. *In order to understand how knowledge and information are created and shared, barriers to knowledge transfer must be identified along the core process.*

3. *In complex organizations the core process must be mapped from end-to-end in order to understand how the process connects and who operates the process.*

4. *Barrier impact may vary along the process and therefore, knowledge habits and requirements will also vary. Hence, organizations need to be aware that knowledge initiatives will need to be customised to support the varying knowledge needs along the core processes.*

Through the researcher's personal experience of operational processes, and through secondary research into knowledge transfer, the researcher believes that organizations need to focus knowledge initiatives on improving process performance, as this can produce three positive effects.

1. **Tangible return of investment** – *The knowledge initiative can be directly related to process performance. This helps negate the concern a lot of organizations have concerning the direct tangible benefit of knowledge initiatives.*

2. **Speed of deployment** – *By concentrating on process related knowledge initiatives as opposed to organization-wide knowledge initiatives, deployment and expected improvement maybe achieved over a relatively short timescale.*

3. **Employee / organization buy-in** – *Knowledge initiatives that show tangible improvements and can be implemented in a short timescale will help them to be seen in a positive light, and as something to be embraced across the organization.*

With the conclusions drawn in this chapter the researcher is now in a position to define a suitable research methodology, and methods that can be used to answer the research question. From a practical perspective the researcher must consider the following factors when deciding on a research approach; the need to map a core complex process (supply chain order flow process), understanding how barriers impact along the process, understand how best to identify knowledge initiatives, understand how identified knowledge initiatives impact performance, the need to develop an emergent theory, and then validate the theory against other complex organizations. To ensure the completion of these tasks fully support the answering of the research question a suitable methodology will need to be defined. The next chapter will look to address this issue in more detailed.

5. Choosing the Right Research Approach.

She asks the Cheshire cat, "which way I ought to go from here?" "That depends a good deal on where you want to get to," said the Cat. "I don't much care where," said Alice. "Then it doesn't matter which way you go," said the Cat.

Carroll (1928)

5.1 Introduction.

The quote at the top of this page (Carroll, 1928) is used to highlight the importance of choosing a methodology that is best suited to answering the research question; not to choose a methodology that the researcher is most comfortable with, and to then modify the research question to suit.

Through this chapter the researcher will look to identify a suitable research methodology that can be adopted to ensure academic rigour is used in answering the research question. The literature covering the different research methodologies is wide and varied. However, it is not the researcher's intention to review all aspects of academic research methodologies, but to concentrate of how a suitable methodology and research design can be formulated. In doing so the following chapter will cover the main schools of thought and the reasons behind why they are felt to be applicable, or not, to the research problem.

This is a critical point in the thesis as it is at this stage that the research design is defined based on what needs to be a comprehensive review and understanding of the strengths and weaknesses of the various methods.

Chapter 1 provided an overview of the problems as viewed by the researcher that have lead to the formulation of the research question. The researcher used a pre-understanding of the issues to help identify the problems – this use of pre-understanding has been an important factor in determining the shape and focus of the research. Therefore, it is only right and proper that the concept of 'pre-understanding' be discussed.

5.2 Pre-understanding the Problem.

The researcher's use of 'pre-understanding' to help identify and refine the research question is based on the work of Gummesson (1991). Gummesson stated that qualitative methodology and case studies provide powerful tools for many areas of management research and it is in this context that this thesis has evolved. The problem overview described in Chapter 1 was used to develop the initial research questions that would guide the researcher to develop new knowledge and theory.

Gummesson's (1991) theory takes cognisance of people's knowledge, insights, and experiences. In fact Odman (1985) defines pre-understanding in the following terms:

"***In response to frequent or everyday occurrences, individuals have developed a pre-understanding in order to avoid having to bother themselves with the interpretation of these events. Sense impressions, interpretation, understanding and language merge instantaneously, making it impossible to identify separate phases***".

Odman (1985)

Gummesson (1991) goes on to state that a lack of pre-understanding will cause the researcher to spend considerable time gathering the basic information; which, in this instance would be supply chain operations. As the researcher in this case is part of the supply chain operations team, this experience has allowed the development of the initial theory which in turn drove the formulation of the research question.

However, Gummesson (1991) also stated anyone relying on pre-understanding in order to define a research problem needs to be aware that there are certain aspects of this approach that a researcher must keep in mind. These are the need to be aware of paradigm, selective perception, and personal defence mechanisms. Therefore, the need to be open, mature and honest in any investigation is paramount if the resultant theories are to be understood and successful.

Source of Pre-understanding

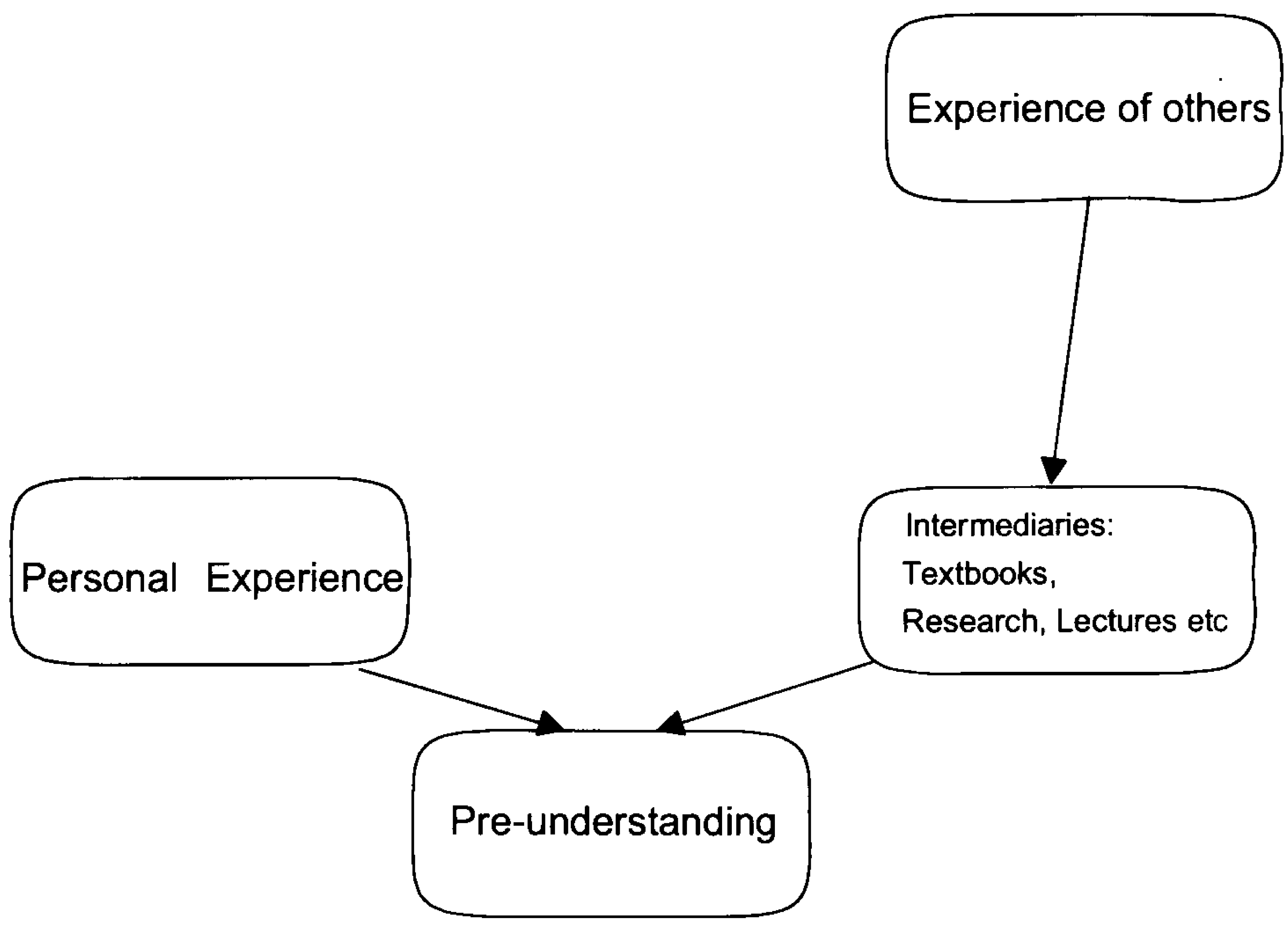

Figure 5.1 Source of Pre-understanding. **Source: Gummesson (1991)**

Figure 5.1 above shows how pre-understanding is developed. With respect to the current research question, the main areas that have contributed to the researchers level of understanding have been personal experience (working within the supply chain environment), and the experience of others (working within a complex matrix organization).

Pre-understanding has also been enhanced by additional knowledge obtained through academic research and prior academic post-graduate learning. All of which has contributed to the development of knowledge that in turn represents the level of pre-understanding underpinning this research.

5.2.1 From Pre-understanding to Understanding and Back.

Having set the scene with relation to the initial problem, as outlined by the researcher, it is important to point out that any emerging theory and subsequent conclusions are not formed from the initial pre-understanding of the problem. In fact any solution will be the result of an iterative learning effect based on pre-understanding refining into understanding thus leading on to a higher level of pre-understanding. Gummesson (1991) illustrated this idea through his description of understanding (Figure 5.2). Gummesson stated 'the researcher when approaching a project always has a certain amount of pre-understanding'.

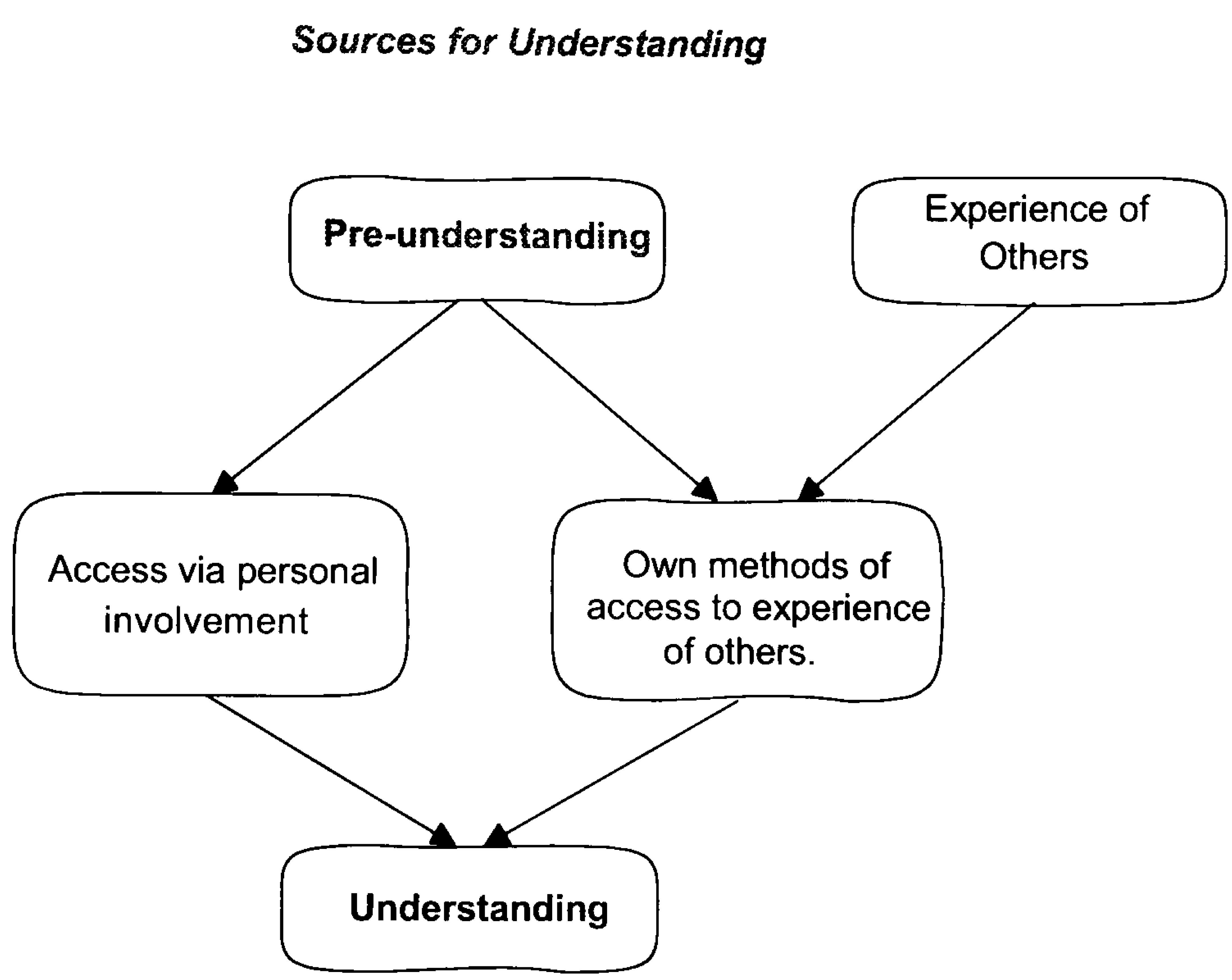

Figure 5.2 Sources for understanding. **Source: Gummesson (1991)**

The researchers' understanding is further enhanced by means of access via personal involvement or through the involvement of others. Gummesson (1991) also stated that in scientific theory, reference is made to the 'hermeneutic circle' and he illustrated this by the following statement "no understanding without pre-understanding" and "an understanding of the parts assumes an understanding of the whole." The hermeneutic circle, or as Gummesson renamed it the hermeneutic spiral is an iterative process where pre-understanding leads to understanding, as shown in Figure 5.2, but understanding then leads onto a higher level of pre-understanding. The hermeneutic spiral is illustrated in Figure 5.3.

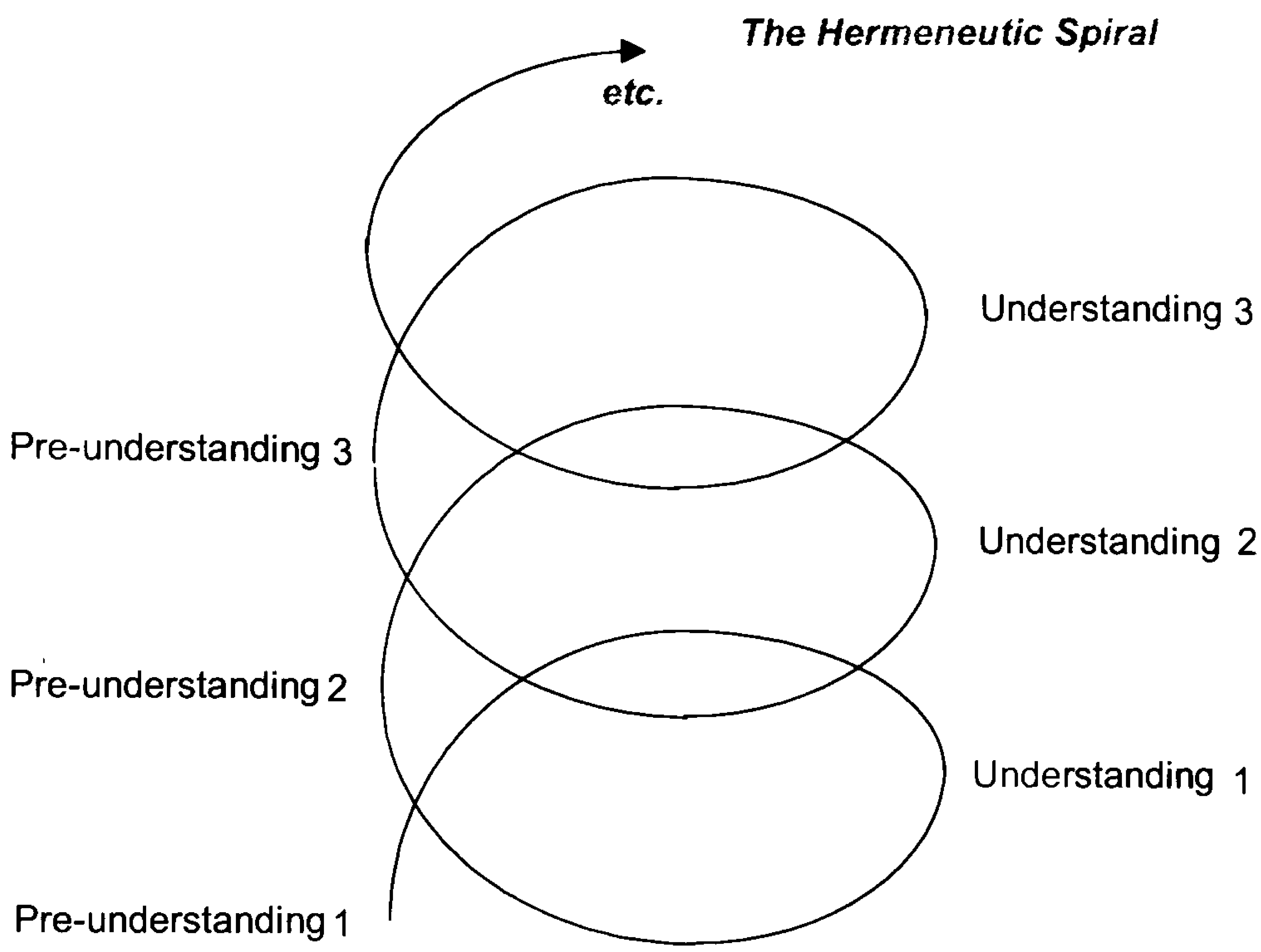

Figure 5.3 Hermeneutic Spiral. **Source: Gummesson (1991)**

5.3 Research Considerations.

Many writers (Buckley *et al,* 1976) on the subject of research methodology comment on the fact that the amount of information available to the novice researcher can be more of a hindrance than an aid when initially designing a research plan. This points more to the fact that there are no absolutes in research and so choosing the right approach is not as straight forward as the novice researcher may initially think. What is the right approach for one question may not be right for another. The methodology driving the design is not just dependant on the question, but also on other factors such as the researcher's understanding and involvement with the problem, the environment in which the research is to be conducted, the source from which the data is to be pulled, the sensitivity of the data etc, In fact there are many issues which need to be considered before finally deciding on a methodology (Blaxter, Hughes & Tight, 2001). It is the following issues that have helped the researcher to formulate the approach to be used in answering the proposed research question. The six issues/considerations are adapted from Punch (1998).

	Issue / Considerations when choosing a Method.
1.	**Research Questions.** What exactly are you trying to find out? Focus on the 'exactly' as this can lead you into either the qualitative or quantitative direction.
2.	**View point.** Are you interested in making standardised and systematic comparisons or do you really want to study this phenomenon or situation in detail?
3.	**The literature.** How have other researchers dealt with this topic? To what extent do you wish to align your own research with standard approaches to the topic?
4.	**Practical Considerations.** Issues of time, money, availability of samples and data, familiarity with the subject under study, access to situations, gaining cooperation.
5.	**Knowledge pay-off.** Will you learn more about this topic using quantitative or qualitative forms of research? Which approach will produce more useful knowledge? Which will do more good?
6.	**Style.** Some people prefer one approach over another. This may involve paradigm and philosophical issues or different images about what a good piece of research looks like.

Table 5.1 Considerations in choosing research methodology. Source: Punch (1998)

These are by no means complete and in fact Blaxter *et al* (2001) go on to refine points for consideration to the eight that are listed below (Table 5.2).

	Choosing a suitable research Methodology.
1.	What do you need or want to find out?
2.	What skills do you have?
3.	Will your methodological preferences answer the Research Question?
4.	How will your methods affect the answers you get?
5.	How will you affect your research?
6.	Which methods are acceptable?
7.	Using one or more methods?
8.	Are you allowing for possible changes of direction?

Table 5.2 Choosing a research methodology. Source: Blaxter *et al* (2002)

The researcher will use these considerations (Table 5.2) when formulating a research methodology.

5.4 Research Question and considerations.

Through a pre-understanding of the issues relating to performance, efficiency, and effectiveness of IBM's supply chain, and an extensive literature review, the following section re-caps on the key research question, and supporting sub-questions. The researcher has also highlighted key assumptions that have helped to shape the respective questions.

RQ: ***How does a supply chain organization ensure barriers to performance related knowledge transfer are identified and managed?***

The following assumptions are made:

- The research is *not* focusing on aspects of the supply chain particular only to IBM. The intent is to identify the *primary* core process for order flow / management, which although it may not appear as one within other organizations, will have elements which match.
- The research will focus on the way knowledge transfer is inhibited along the supply chain order process, and how an organization can identify these barriers and management them.
- Once the barriers are identified and their impact on performance is assessed this information will be reviewed with other complex organizations for concurrence.

In order to answer the research question the following sub-questions (SQ) will need to be addressed.

SQ1: Why the need for Knowledge Management (KM) within a supply chain (complex) organization?

- What does current research say about how KM impacts organizational performance, and in particular how KM impacts horizontally and vertically aligned organizational performance. (*Secondary Research*)

SQ2: What is the core process flow for order management through the supply chain?

- Need to identify and map the business process for order flow. (*Primary Research*)
- Need to identify the KPI performance points within the process flow. (*Primary Research*)
- Need to identify the 'map' points through the process where knowledge transfer needs to happen in order to support performance. (*Primary Research*)

SQ3: What are the key performance indicators in a supply chain?

- What are the KPIs for the supply chain, both from an IBM perspective, but also from a generic industry wide perspective? (*Primary & Secondary Research*)
- Investigate using primary research of company reports and serviceability documentation. Also use secondary research from journals / textbooks to identify generic KPIs. (*Primary & Secondary Research*)

SQ4: Where are the knowledge transfer points that support the order process flow within the supply chain?

- Map the organizational ownership boundaries over the core order process to help identify where the main cross boundary transfer points in the process are. (*Primary Research*).
- Separate out the IBM specific transfer points if not relevant to generic KPI metric generation, or process flow. (*Primary Research*).

SQ5: What are the barriers to knowledge transfer?

- What does the current research say about barriers within organizations to efficient knowledge transfer? (*Secondary Research*)
- How does this research relate to knowledge transfer within a horizontally aligned organization? (*Secondary Research*)
- The need to understand the difference between knowledge and value add knowledge. (*Secondary Research*)
- What are the knowledge transfer barriers within the core order flow process? (*Primary Research*)
- How do these barriers relate to key performance points within the process? (*Primary Research*)

5.5 Research Objectives.

The key research methods will depend on how the research questions and objectives are defined (Sarantakos, 1998). As the questions have been stated the objectives of the research now need to be defined. This is an important step in deciding on the most suitable research methodology. For the purposes of this research the following key objectives have been identified.

- *Identify the major barriers to knowledge creation and transfer within a core element of complex business (supply chain) process. In the case of IBM it will be the order management process.*

- *Analyse process performance bottlenecks and see if they are being influenced by a failure to focus on KM, and if indeed the bottlenecks can be correlated to known knowledge management barriers.*

- *Develop a list of generic barriers that organizations should acknowledge if they wish to develop knowledge strategies for complex (supply chain) organizations.*

In order to meet these objectives, and answer the research questions, a clear path must be defined which will weigh up the pros and cons of qualitative and quantitative methodologies. This needs to happen prior to any methods being chosen for data collection and analysis.

5.6 Types of Social Research.

Before embarking on a particular research methodology it is important to have an appreciation for the different types of research available. The variety within social research and the respective subtle differences need to be understood if the researcher is not to be limited in choice. Sarantakos (1988) outlines the many diverse practices and uses of social research that have been complied by the researcher into the Table below (Table 5.3).

Research type	Basic Description
Quantitative research	*Refers to the type of research that is based on Positivism and Neo-positivism, and adheres to the standards of strict research design developed before the research begins.*
Basic research	*Usually employed for the purpose of gaining knowledge that will advance our understanding of the social world.*
Applied research	*This type of research is directly related to social and policy issues and aims at solving specific problems and establishing policy programmes that will help to improve social life in general. – Types of Applied research are social impact studies, action research, and evaluation research and cost-benefit analysis.*
Longitudinal research	*This type of research involves the study of a sample on more than one occasion. Versions of this type of research are panel studies and trend studies.*
Qualitative research	*This type of research refers to a number of methodological approaches, based on diverse theoretical principles, employing methods of data collection and analysis that are non-quantitative, and aiming towards exploration of social relations, and describes reality and experience by the respondents.*
Descriptive research	*This type of research is quite common, and is mainly used as a preliminary study or an exploratory study. It aims to describe social systems, relations or social events, providing background information about the issues in question as well as stimulating explanations.*
Classification research	*The aim of this type of research is to categorise research units into groups, to demonstrate differences, explain relationships and clarify social events or relationships.*

Comparative research	*In this type of research the researcher is interested in identifying similarities and/or differences between units at all levels, for example at a historical or cultural level.*
Exploratory research	*This research is usually undertaken when there is not enough information available about the research subject. The use of library research, case studies, or expert consultation as sources of data is commonly employed in this form of research. Qualitative studies are more likely to use this type of research as a study per se than quantitative research.*
Explanatory research	*Here the research aims to explain social relationships or events.*
Causal research	*This is considered the most 'respected' type of research in social science and is employed to explain the causes of social phenomena and their consequences. The research aims to establish a relationship between variables so that one is the cause of the other; and so that when the one variable occurs so will the other.*
Theory-testing research	*Its aim is to test the validity of a theory. This may employ other types of research to achieve its purpose.*
Theory-building research	*For many social scientists the purpose of research is to establish and formulate theories. It is expected to provide the data and the evidence to support a theory.*
Action research	*This is the application of fact finding to practical problem solving in a social situation with a view to improving the quality of action within it, involving the collaboration and cooperation of researchers, practitioners and laymen.*
Participatory action research (PAR)	*This is a form of research characterised by the strong involvement and high degree of participation of members of organizations or communities in the research process.*

Table 5.3 Types of social research. Source: Sarantakos (1988)

These research types are not mutually exclusive, and researchers will usually employ more than one type through the course of their research (Sarantakos, 1988). The researcher needs to decide which types of research best suit the research problem and combine the forms accordingly. However, the two well established major domains of social research according to Sarantakos (1988) are *qualitative* and *quantitative* research.

In order to help clarify which research domain will be best suited to answer the research question it is important to understand the basic philosophy behind qualitative and quantitative research.

5.7 Research Philosophy.

The nature of philosophy is to seek answers to questions – to this end a research methodology and method is the practical application of this art. In order for the answer to be valid, however, the approach to finding the answer must be objective. Understanding this is important to the researcher as this helps clarify different designs and methods for a particular research (Easterby-Smith *et al*, 1999). Easterby-Smith *et al* (1999) also point out that there are three reasons why an understanding of philosophical issues is important.

- *It can help clarify research designs.*
- *Knowledge of philosophy can help the researcher to recognise which design may work and which may not.*
- *Knowledge of philosophy can help the researcher identify, and even create, designs that may be outside his or her experience.*

Before looking at actual methodologies it is important to first understand the main philosophical paradigms and see how they relate to the research question. Positivism and Realism, according to Easterby-Smith *et al* (1991), lie at opposite ends of the philosophical spectrum. However, as stated already, research does not necessarily mean the researcher is limited to an either/or approach to choosing a methodology, but can look to combining elements of different methodologies where appropriate. To this end the research also looks at a mixed approach (Amaratunga & Baldry 2001, Remenyi *et al* 1998).

The main philosophical approaches reviewed are:

- Positivist Approach
- Constructivism Approach
- Realism (Phenomenological) Approach
- Mixed Approach.

5.7.1 Positivist Approach.

The *positivist* approach, often referred to as quantitative research, believes that the subject under analysis should be measured through objective methods rather than being inferred subjectively – through sensation, reflection or intuition (Remenyi *et al*, 1998). Among the major implications of this approach are the need for independence of the observer from the subject being observed, and the need to formulate hypotheses for subject verification. Positivism searches for causal explanations and fundamental laws, and generally reduces the whole into its simplest possible elements in order to facilitate analysis (Easterby-Smith *et al*, 1999, Remenyi *et al*, 1998).

In contrast to the positivist paradigm, constructivism and phenomenological paradigms are more suitable for exploring complex social phenomena that require working with people and real life experiences and where the researcher seeks to understand the problem by reflecting, probing, understanding and revising meanings, structures and issues (Hirschman 1986, Orlikowski *et al* 1991). Not all research issues allow an entirely value-free, one-way mirror between phenomena and the researcher.

The identifying of knowledge barriers to supply chain performance does not just seek to identify causal relationships as one would in a positivistic paradigm but would consider the complex nature of the research problem by reflecting, probing etc the issues surrounding how knowledge is shared and transferred. For the researcher to do this totally independently of the observer would not be practical.

5.7.2 Constructivism Approach.

This methodology investigates the beliefs of the individual rather than investigating an external reality, such as the tangible and comprehensible economic and technological dimensions of management. The constructivist paradigm, perception by itself is not reality but is a blend of perceptions and external reality. Multiple realities cannot be the focus of constructivist research. Constructivism is interested in the values which are beneath the findings, thus uses inductive logic.

The inductive methods of constructivism require the researcher to be a 'passionate participant' (Guba & Lincoln, 1994). This paradigm means problem solving through the construction of models, diagrams, plans, organizations etc. This mode of research is widely used in technical sciences, mathematics, operations analysis and clinical medicine (Kasanen & Siitonen 1993). Christie *et al* (2000) stated that in contrast, any research that has to deal with multiple realities that have elements of both positivism and constructivism, such as those detailed in this thesis, then the approach is realism.

5.7.3 Realism Approach.

The *realism* approach, also known as the interpretive or phenomenological approach, understands reality as holistic and socially constructed, rather then objectively determined. Susman & Evered (1978) talk of an "epistemological crisis" in management research which has arisen out of the application of the positivist model of science in the social sciences and hence realism, an approach which arose in the last half of the twentieth century.

According to this philosophy the researcher should not gather facts or simply measure how often certain patterns occur, but rather appreciate the different constructions and meanings people place upon their own experiences and the reason for these differences. The realism approach tries to understand and explain a phenomenon, rather than search for external causes or fundamental laws (Easterby-Smith *et al*, 1999; Remenyi, 1998). Realism provides a worldview in which an actual social phenomenon can be ascertained even though it is imperfect.

The central premise of non-positivist research is that the researcher should be concerned with understanding the phenomena in depth and that the understanding should result from attempting to find tentative answers to questions such as 'What?' 'Why?' and 'How?' Phenomenology (realism) contends that such an understanding can result from using methods other than measurement, unlike the assumption positivism, which is ultimately concerned with answering the questions of 'How many?' or 'How much?' (Remenyi *et al*, 1998).

For the realist the means to determine the reality of a social phenomenon is through the triangulation of cognitive processes. A perception for realists is a window on to reality from which a picture of that reality can be triangulated with other perceptions (Christie *et al* 2000). Within this framework, the discovery of observable and non-observable structures and mechanisms, independent of the events they generate, is the goal of this research methodology. Realism researchers observe the empirical domain to discover knowledge of the real world, by naming and describing the generative mechanisms that operate in the world and result in the events that may be observed. Given this complexity of the social science world, reality is considered real but fallible.

Therefore, this methodology appears to fit the problem described in this thesis of how does a complex organization ensure barriers to knowledge transfer are identified. As the investigation is to discover through identifying, describing and analysing the variables of the structures and generative mechanisms of the knowledge transfer processes and the relationship that is necessary to improve individual and team performance.

However, before the realism approach is concluded a further review of the three methodologies is required. The philosophical assumption that supports the three (positivist, constructivism, and realism) theoretical paradigms relates to ontology, epistemology, and methodology, and these are summarised in Table 5.4.

Item Paradigm	Positivism	Constructivism	Realism (Phenomenology)
Ontology	**Naïve realism:** Reality is real and apprehensible.	**Critical relativism:** Multiple local and specific 'constructed' realities.	**Critical Realism:** reality is 'real' but only imperfectly and probabilistically apprehensible and so triangulation from many sources is required to know it.
Epistemology	**Objectivist:** Findings true.	**Subjectivist:** Findings created.	**Modified Objectivist:** Findings probably true with awareness of values between them.

Common Methodologies	**Experiments/Surveys**: verification of hypothesis: chiefly quantitative methods.	**Hermeneutical/Dialectical**: Researcher is a 'passionate participant' with the world being investigated.	**Case studies / Convergent interviews:** Triangulation, interpretation of research issues by qualitative methods.

Table 5.4 Basic belief systems of alternative inquiry paradigms. Source: Guba & Lincoln (1994)

It is worth noting that two of the main philosophical approaches to developing research, positivism and realism (phenomenology) have been subject to longstanding debate in management science. While the two approaches have been analysed above in relation to the research subject there is an argument that a pure approach can be unrealistic. Therefore, a mixed approach can be considered an appropriate route (Amaratunga & Baldry, 2001).

5.7.4 Mixed Approach.

Concerning the *mixed* approach Remenyi *et al* (1998) argue that positivism and realism are not totally different in terms of their impact on research, and in the generalisation of findings. Both approaches need a convincing argument that the findings are valid before these results are accepted as a valuable addition to the body of knowledge. Ultimately, it is more useful to see these two approaches as complementary rather than as two opposite extremes (Remenyi *et al* 1998).

Remenyi *et al* (1998) suggest that the world is essentially non-deterministic (in any absolute sense) and repeated positivist research will produce different results; a balanced approach is, therefore, more 'realistic'. Furthermore, because an intention was to understand the holistic context of knowledge transfer, a 'realism' approach would help to provide the means to interpret practice allowing a study of the various different practices that companies use within the theoretical framework.

A pure positivist approach will not be applied, as there is an expectation that, to a certain degree, other researchers should be able to apply the same research methodology and obtain similar results. This assumption is incompatible with the basic fundamentals of a 'pure' realism approach where establishing 'different views' is one of the preferred research methods.

	Positivist Paradigm	Realist Paradigm
Basic beliefs:	The world is external and objective. Observer is independent. Science is value-free.	The world is socially constructed and subjective. Observer is part of what is observed. Science is driven by human interest.
Researcher should:	Focus on facts. Look for causality and fundamental laws. Reduce phenomena to simplest elements. Formulate hypotheses and then test them.	Focus on meaning. Try to understand what is happening. Look at the totality of each situation. Develop ideas through induction from data.
Preferred methods include:	Operationalising concepts so that they can be measured. Taking large samples.	Using multiple methods to establish different views of phenomena. Small samples investigated in depth or over time.

Table 5.5. The characteristics of positivist and realist paradigms. Source: Easterby-Smith *et al* (1991).

Before discussing the route that this research methodology is taking, it is appropriate to point out there is no single research method or strategy that is ideal for all types of research (Easterby-Smith *et al* 1991). Consequently, the researcher must continually use judgments to select the most appropriate research strategy. In fact, acquiring the knowledge and skill to select the most appropriate research strategy is one of the most important outcomes of conducting management research (Buchanan, 1980).

5.7.5 Critical Realism.

As discussed a purely positivist or realist approach does not fit with the researchers view of the socially constructed research environment. Although a 'mixed' approach attempts to address the limitations of both positivist and realist approaches (Remenyi *et al*,1998) combining both methodologies can be difficult to reconcile. However, there is a more pragmatic approach which fits more with the researchers view of the research problem.

According to Bhaskar (1978) critical realists reject 'empirical realism' as an example of the 'epistemic fallacy' that lets the question 'what can we know?' determine our notions of what exists. Critical realism refers to the theory that some of our sense-data (for example, those of primary qualities) can and do accurately represent external objects, properties, and events, while other sense-data (for example, those of secondary qualities and perceptual illusions) do not accurately represent any external objects, properties, and events. In short, critical realism refers to any position that maintains that there exists an objectively knowable, mind-independent reality, whilst acknowledging the roles of perception and cognition Bhaskar (1978).

Bhaskar (1986) argues that, apart from in astronomy, constant conjunctions in the natural sciences occur only in the artificially enclosed environments created by experimental control, even though the resultant experimentally determined knowledge is often successfully applied outside those experimental contexts. As Johnson & Duberley (2003) point out, the purpose of an experiment is to isolate one mechanism, which normally operates alongside others, so as to create a closed system where a given cause will always produce the same effect. However, Johnson *et al* (2003) go on to say that such closure is rarely spontaneous and seldom occurs without strenuous human intervention since most natural open systems are composed of a multiplicity of mechanisms which combine to produce events. Therefore, extrapolation in the natural sciences can only be explained by invoking critical realist ontology of real, but unmanifest, generative mechanisms that underlie the appearance of events in the 'open' natural world which lies beyond the confines of experimental protocols. This is an important defining point, as the researcher does not believe that the expected findings will, or could be replicated, as the research environment fits with the 'open' natural world as proposed by Johnson *et al* (2003). The intent of the research is not to show barriers existing and behaving in a deterministic way, but to show that a pre-defined list of barriers can exist, and through their existence they can effect knowledge sharing practices.

It is this approach that best fits the researcher's views of the research environment, and the manner in which knowledge transfer barriers impact this environment. Referring back to Table 5.4 the 'Realism' column more clearly identifies the philosophical perspective with which the researcher views the research question. Therefore, it is the intent of the researcher to approach the research question from a critical realist perspective.

5.8 Problem Definition.

Research methodology can be divided into two wide areas - problem finding and problem solving. Research problems may be generated formally or informally (Buckley *et al*, 1976). Formal problem finding implies that careful and methodical procedures are used to discover the research problems. Obviously, scientific research needs a formal approach to ascertain the research problems, while an informal approach uses a subjective and non-routine process of problem finding. Problem definition is an important aspect in conducting research. Many research projects have failed because of poor problem definition. An appropriate research problem is characterised by the following attributes (Buckley *et al* 1976):

1. *The problem is defined properly. It is labelled and described accurately.*
2. *The problem is expressed in solvable terms.*
3. *The problem is connected logically to the environment from which it is drawn and the solution can be applied within such an environment.*
4. *The problem has been screened against the existing body of knowledge to assure its uniqueness, i.e. it has not been solved previously.*
5. *The solution to the problem must be viewed as making a potential contribution to the body of knowledge.*

Buckley *et al* (1976) also emphasised that literature search is an important part of problem definition. The intent is to see whether the problem has surfaced previously, to examine the environment from which it was drawn, and to evaluate proposed solutions to the problem. From the literature review conducted in this research, gaps in theory were identified from the literature review, which provide potential research areas (Chapters 1 to 4).

5.9 Research Mode.

In Buckley *et al's* (1976) framework for research methodology, he highlighted two modes of research, induction and deduction. The characteristics of induction and deduction modes are highlighted in Table 5.6.

Research Mode	Objective	Type of Research
Inductive	Theory building, fact finding.	Which, where, who, why, what, when, how.
Deductive	Theory testing.	Will, how many, how much, set response questions, task response questions.

Table 5.6 Characteristics of induction and deduction modes. Source: Buckley *et al* (1976)

Induction is the process by which theory is generated. Deduction is the process by which it is tested. If a researcher does not have an answer to a question and embarks on a fact-finding mission, he/she is engaged in inductive research. If the researcher has what he/she believes to be an answer to a research question, but wishes to confirm or apply it through further testing, he/she is engaged in deductive research (Buckley *et al* 1976).

5.9.1 Deductive Mode.

In deductive research, theory is tested. This may be done by validating theory or testing its applicability to a given set of circumstances. Deductive research is guided by 'a priori' hypotheses, which precedes the research activity. The results of the research may prove or disprove the hypotheses. Deductive mode is used when a researcher adopts positivism paradigm. Easterby-Smith *et al* (1991) pointed out that one of the implications of positivism ideas is that science proceeds through a process of hypothesising fundamental laws and then deducing what kinds of observations will demonstrate the truth or falsity of these hypotheses. He also stated that positivism paradigm tries to generalise about regularities in social behaviour through investigating sufficient size of samples. Deductive research moves from specific ideas to general phenomena.

Identification of whether research mode is induction or deduction is an important issue, since it affects the definition of problems, the researcher's attitudes and the selection of research methodology. A deductive research method entails the development of a conceptual and theoretical structure prior to its testing through empirical observation (Gill & Johnson 1997). The deductive theory-testing research methods of positivism do not necessarily sufficiently capture the intricacy of social organizational settings (Kaplan 1986).

5.9.2 Inductive Mode.

The aim of inductive research is to generate theory based on the fact-finding activities carried out in the research, that is when the researcher does not have an answer to a question on the research, or when the outcome of the research is not known in advance. In other words, there is no substantive 'a priori' hypothesis. Researchers who adopt the phenomenological research philosophy use inductive mode. Easterby-Smith (1991) pointed out that one of key features of phenomenological paradigms is that the researcher develops ideas through induction from data. The research moves from general phenomena to a more specific idea as indicated in the Figure 3.5 above. Inductive approaches are intended to aid an understanding of meaning in complex data through the development of summarised themes or categories from raw data. Gill *et al* (1997) states that in sharp contrast to the deductive tradition, in which a conceptual and theoretical structure is developed prior to empirical research, theory is the outcome of induction. However, the modern justification for taking the inductive approach tends to revolve around two related arguments. First, is that explanations of social phenomena are relatively worthless unless they are grounded in observation and experience. The most famous rendition of this view is provided by Glaser & Strauss (1967) in their book. '*The Discovery of Grounded Theory*'. The second argument arises from a critique of some of the philosophical assumption embraced by positivism. One of the main themes of positivism and much of the deductive tradition is the concept of a scientific method constructed from an approach in the natural sciences, particularly physics. This entails the construction of covering-laws that explain past and future observations, through causal analysis and hypothesis testing. The format of this explanation is; A causes B *or* variation in A cause's variation in B *that is* stimulus A causes response B. Gill *et al* (1997) commented on this critique of positivism that supporters of induction reject the causal model, because they considered that this kind of explanation is inappropriate.

5.9.3 Combining Deduction and Induction.

In the near ideal research world the researcher will conduct either inductive or deductive research. However, not every question can demand so specific an answer as to warrant either a dedicated qualitative or quantitative research strategy. The reality of the situation facing this research project is that it contains elements of both deduction and induction. According to Gibbs (2005) and Bulmer (1979) it is not uncommon for social research to be simultaneously inductive and deductive. This is a situation Bulmer (1979) refers to as 'Retroduction'. From a top-level perspective the research question drives a deductive – inductive focus (Figure 5.4).

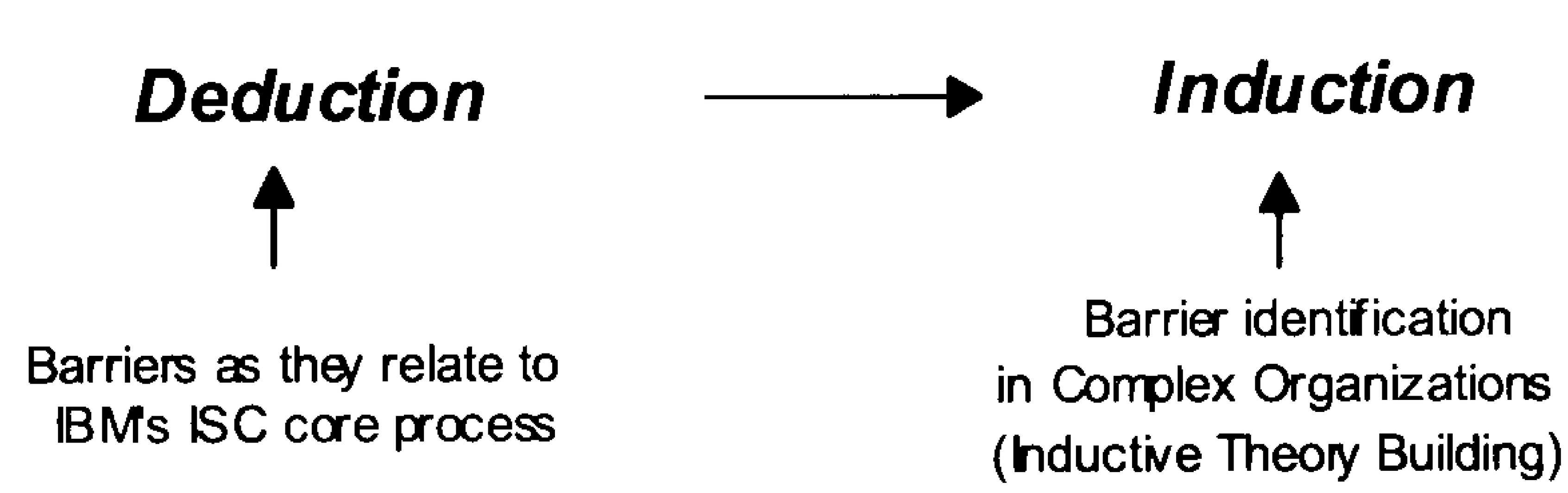

Figure 5.4 Research Modes. **Source: Developed for research.**

However, it is important to note that the research question drives an inductive theory-building response. The deductive elements of the research support at the beginning of the research process the identification and mapping of barriers to a specific IBM process, and then at the end of the process, the matching of the emergent theory to specific organizations that have no organizational ties with IBM. So, in essence, the initial deductive research set the scene for the inductive theory building, whilst the final deductive research helps test and validate the findings from the inductive theory building.

5.10 Research Methodology.

The conclusion when reviewing the major philosophical paradigms was that a critical realism approach would provide a more practical framework to follow in conducting the research. Although a critical realism approach can contain elements of qualitative and quantitative enquiry, its logic is predominantly inductive. This indicates a more qualitative approach. However, it is important to understand the more practical differences between qualitative and quantitative methodologies. As Sarantakos (2005) points out the main types of research can be generally categorised into qualitative and quantitative methodologies and methods. Sarantakos (2005) outlines the difference between the two methodologies in Table 5.7.

Feature	Quantitative methodology	Qualitative methodology
Nature of reality	Objective: simple, single, tangible sense impressions.	Subjective; problematic; holistic; a social construct.
Cause and effect	Nomological thinking; cause-effect linkage.	Non-deterministic; mutual shaping; no-cause effect linkages.
The role of values.	Value neutral; value-free enquiry	Normativism; value bound enquiry.
Natural and social sciences	Deductive; model of natural sciences; nomothetic, based on strict rules	Inductive; rejection of the natural sciences model; ideographic; no strict rules: interpretations.
Methods	Quantitative, mathematical; extensive use of statistics.	Qualitative, with less emphasis on statistics; verbal and qualitative analysis.
Researcher's role	Passive; distant from the subject: dualism.	Active; equal; both parties are interactive and inseparable.
Generalisations	Inductive generalisations; nomothetic statements.	Analytical or conceptual generalisation; time-and-context specific.

Table 5.7 Perceived differences between quantitative and qualitative methodologies. Source: Sarantakos (2005)

Flick *et al* (1991) also compare and contrast qualitative and quantitative methodologies against similar criteria. In order to help clearly define the methodology the researcher assessed the research question against a combined list of criteria. The findings are listed in Table 5.8.

Difference	Type in the case of research question.	Research Type
Logic of theory	*Inductive and Deductive*	**Qualitative & Quantitative**
Nature of reality	*Subjective and holistic*	**Qualitative**
Theory Building or Theory Testing.	*Begins with a 'reality' as perceived by the researcher of knowledge management and performance in complex organizations. (Theory Building)*	**Qualitative**
Verification.	*Data generation, analysis and theory verification will take place concurrently.*	**Qualitative**
Methods	*Qualitative, but with some emphasis on statistics.*	**Qualitative & Quantitative**
Concepts	*The concepts for this research are not yet clearly defined.*	**Qualitative**
Role of Researcher	*Active and engaged with the subject. Researcher is part of the organization being researched.*	**Qualitative**
Generalisations	*The research will be looking at a group specifically involved with Supply Chain Management, and in particular looking at the effects of a system roll out on their work/performance environment. The findings will not be generalised to fit a wider, less specific population.*	**Qualitative**

Table 5.8 Assessment of RQ against methodology criteria. Source: Sarantakos (2005)/ Flick *et al* (1991).

The findings listed above help define the reason for choosing a mixed methodology, that is predominantly qualitative in nature with some quantitative elements, which is based on an assessment of the research question against a comparison of theory constructs (Flick *et al* 1991, Lamnek 1999, Vlahos 1984, Sarantakos 2005). This assessment also ties in with the features of qualitative research as outlined by Patton (1990).

5.11 Addressing the Weaknesses of Qualitative Research.

Qualitative research has its strengths and weaknesses. What is important is that these weaknesses are understood, and every opportunity is taken to minimise their effects on the overall outcome of the research (Chadwick *et al*, 1994). As pointed out by Sarantakos (2005) the weaknesses of this type of research are related to its very nature and reflect the positivistic prejudice of assessment. He goes on to say that understanding qualitative research is a unique type of academic activity and should be assessed in its own context. The main weaknesses (Chadwick *et al* 1994) that will need to be watched for and addressed are as follows:

Weakness with Qualitative Research.	Actions.
Reliability problem caused by subjectivity.	*The nature of the research means that I will have prior knowledge of the field of research. This can introduce subjectivity. This can be countered by using peer review of findings by supervisor / PhD students / IBM employees not related to supply chain organization.*
Risk of collecting meaningless data.	*Need to ensure disciplined approach to keeping research focused on the key area.*
Very time consuming.	*Need to ensure research project time line does not start to drift. Need to plan sample sizes, group sizes prior to data collection. However, focus group format will depend somewhat on interview and questionnaire outcome.*
Problems with representativeness and generalisability of findings.	*In this case the research is specifically looking at the impact of a KMS on a supply chain. The principles of KM and supply chain are understood. Therefore, the findings from this research will, it is believed, allow inductive reasoning which can be applied by other complex organizations.*
Problems of ethics.	*Ensure ethics approval is granted for all stages of research data collection.*

Table 5.9 Weaknesses with qualitative research. **Source: Chadwick *et al* 1994**

Table 5.9, as outlined by Chadwick (1994), assesses the impact of the weaknesses in qualitative research. The assessment is made against the research problem, and actions identified which the researcher will need to adhere to throughout the research process.

5.12 Selecting the right Qualitative Approach.

Now that the main approach will be qualitative it is important to decide which type of qualitative research is best suited to answering the research question. Dawson (2002) puts forward the following approaches: action, ethnographic, feminism, grounded theory, and case study. However, Creswell (1998) looks at the approaches from a slightly different perspective. Table 5.10 outlines the different reporting approaches and provides a breakdown of their different characteristics.

When the research question, sub-questions, and research objectives are assessed against the table below (Table 5.10) ethnography, grounded theory, and case study stand out as suitable approaches for conducting the qualitative research. Although any one of the three approaches could be used to support the research, one approach may be more suitable then the others.

Reporting Approaches	**Biography**	**Realism**	**Grounded Theory**	**Ethnography**	**Case Study**
Focus	Exploring the life of the individual	Understanding the essence of experiences about a phenomena	Developing a theory grounded in data from the field.	Describing and interpreting a cultural and social group	Developing an in-depth analysis of a single case or multiple cases.
Discipline origin	Anthropology, literature, history, psychology, sociology	Philosophy, sociology, psychology	Sociology	Cultural anthropology, sociology	Political science, sociology, evaluation, urban studies, other social sciences.
Data collection	Primary interviews and documents	Long interviews with up to 10 people.	Interviews with 20-30 individuals to saturate, categorise and detail a theory.	Primary observations and interviews with additional artefacts during extended time in the field (6-12mths)	Multiple sources- documents, archival records, interviews, observations, physical artefacts.
Data analysis	Stories, epiphanies, historical content	Statements, meanings, meaning themes, general description of experience.	Open coding, axial coding, selective coding, conditional matrix.	Description, analysis, interpretation.	Description, themes, assertions.

Narrative form	Detailed picture of an individual's life.	Description of the 'essence' of the experience.	Theory or theoretical model	Description of the cultural behaviour of a group or an individual.	In-depth study of a case or cases.

Table 5.10 Different Qualitative Approaches. **Source: Creswell (1998)**

In order to determine which approach should be used the criteria for each approach needs to be considered. However, it must be remembered that the criteria identified apply outlines that fit the ideal research question. In the real world we will more likely be directed to the qualitative approach that proves the 'best fit'.

5.12.1 Grounded Theory.

This theory was developed by Glaser & Strauss (1967) and has become popular amongst many social scientists. The theory gets its name because it is created through, and grounded on empirical data (Sarantakos, 2005). The idea behind grounded theory is not to collect volumes of data but to organise the variety of thoughts and experiences the researcher gathers during the analysis of the data.

According to Strauss (1991) and Hildebrand (1991) the most important criteria of grounded theory are listed in Table 5.11. The research question will now be evaluated against these criteria.

Criteria	Detail	Relevance to Research	Met Criteria?
An Autonomous Unit	*The subject of research is autonomous in that it relates to a specific aspect of the organization and business. Therefore, findings will relate to this aspect alone, and not be transposed to relate to anything else.*	The intent of the research is to find generic barriers which can be related to other supply chain functions, and even complex organizations not directly related to supply chain ops.	No
Interpretation of Reality	*Will the researcher approach the 'reality' of the situation in an unprejudiced manner?*	The researcher will approach the situation in an open and objective manner. However, pre-understanding of the problem has shaped the research question.	No
Everyday Thinking	*There is continuity from everyday thinking to scientific thinking. Primary thinking is*	Primary experience plays a key part in helping to define the research problem and topic.	Yes

	very important for the development of grounded theory.		
Development of Concepts	*Theories will be continuously developed and refined and tested.*	The researcher will continually review and analyse findings. However, the findings will not be used to continually modify or update the question or objectives. It is not the intention that the research question be open-ended.	No

Table 5.11 Central criteria for Grounded Theory. **Source: Hildebrand (1991)**

From the findings in Table 5.11 it would appear that grounded theory may not be the best fit when considering a methodology for conducting the research. Some of the key criteria listed in Table 5.11 would be difficult to meet considering the environment and conditions under which the research is to be carried out. To start with, reviewing the research subject as an autonomous unit is not in line with what the research is trying to achieve. One of the objectives of the research is to identify knowledge transfer barriers at a generic level that can then be related to other complex organizational structures. To do this the researcher needs to look at the problem holistically whilst using issues of knowledge transfer within IBM's supply chain to identify specific barriers, leading to generic indicators. Identifying barriers at separate and distinct key points within the supply chain would notionally do this. Then these barriers would be collated and analysed in order to identify any common barriers that reside throughout the supply chain. Therefore, this approach does not fit with a grounded theory approach that looks to investigate a particular phenomenon as a one off instance.

A key question over which researchers still debate is the extent to which a priori theory should be applied in a grounded theory study. Some claim that a clear mindset is important in order to avoid interpreting in accordance with existing theories (Glaser & Strauss 1967), whereas others (Miles 1979, Eisenhardt 1989, Yin 1994) claim that priori theory is important for positioning the emergent theory and to stimulate creative analysis. Certainly the second view is more appropriate to the research subject identified in this thesis. As already stated 'pre-understanding' has played a significant part in shaping the initial research problem and subsequent questions. Therefore, if grounded theory is to be the methodology of choice then it must be accepted that the researcher will bring a level of pre-understanding to the task. However, this does not mean that the researcher will approach the task in a subjective manner. Irrespective of the methodology chosen, the researcher must remain as objective as possible throughout.

Data collection will also be an issue. Creswell (1998) talks about the need to conduct interviews until a certain 'saturation' level is reached. Although the supply chain organization is large (300+) for the purposes of this research the number of in-depth interviews required in order to reach saturation would require 20-30 in-depth interviews around every knowledge transfer hotspot. This could quickly ramp up to over 100 interviews, which considering the time scale for conducting the research, and the dynamic nature of the business means the categorisation and development of a theory is un-manageable. This on its own is a key reason for not using grounded theory in this instance. As saturation is important in developing a grounded theory, if this cannot be achieved due to lack of input then all the other reasons for using grounded theory become void.

With grounded theory the research usually centres on one case, and the disadvantage of only using one case is obvious; lack of generalisation. However, the purpose of this research is exploratory in nature. The method is qualitative in the sense that it does not claim to deliver statistical but theoretical generalisations (Yin 2003), meaning the improvement of existing theory. In this case, the theories of knowledge management and strategy are the objects of interest, and empirical findings are used to propose extensions to existing theory.

5.12.2 Ethnography.

To date ethnography has been used predominantly within the field of anthropology. However, over the past 20 years this form of research has been applied to areas concerned with Marxist and Feminist research (Creswell 1998). Zaharlick *et al* (Zaharlick, 1992; Zaharlick & Green, 1991) outline some key criteria that should be considered prior to embarking on an ethnographic research plan. Table 5.12 details the criteria and assesses it against the actual research question. It then highlights whether, or not, the research 'needs' fit the criteria.

Criteria	**Detail**	**Relevance to Research**	**Met Criteria?**
First hand information	Information gained through direct contact with respondents	Not all information will be gained face-2-face. Some information will be gathered via questionnaires.	No
The researcher as learner	The researcher knows very little and wants to learn from the respondent.	In the case of this research it has already been established the researcher has a pre-understanding of the problem and issues which in turn is driving the research topic and question.	No
Participant observation	A key part of this type of research requires the researcher to be part of the community under study.	Researcher is currently employed within the area of study.	Yes
Social relationship	Assumes a long term relationship with respondent.	Considering the geographical separation of respondents this is not possible.	No
Naturalistic observation	Research captures social life as it unfolds, and also in natural situations.	Difficult to gauge interaction other than through interview and questionnaire. Very difficult to do in office environment.	No
Ethnographe r as a research instrument	The whole personality of the researcher is used in the research.	Due to a pre-understanding of the problem and a desire to find an answer, the personality of the researcher will be present.	Yes
Interactive reactive approach	Answers are used to shape understanding and further questions. Drives ongoing changes to methods.	It is expected that initial responses from employees will shape questions directed at Senior Management, once barriers are identified by employees/performance metrics	Yes
Holistic approach	Attempts to understand social structures and processes of elements of the system in terms of reference to the whole socio-cultural system.	Social structures are not as important as factors effecting individual interaction (knowledge transfer)	No

Table 5.12 Criteria for ethnographic research. **Source: Zaharlick (1992)**

There is no weighting associated with any of these criteria so relevancy is assumed to be equal. When the research problem was assessed against the criteria the areas of compliance were found to be participant observation, ethnographer as a research instrument, and interactive/reactive approach. However, these areas are not unique to ethnography, and could be applied equally to the criteria for any qualitative research.

5.12.3 Case Study.

According to Kromrey (1986) and Sarantakos (2005) valid case study research is dependant on the study of individual cases within their natural environment, and conducted over a long, albeit relative, period of time. The case study can, and usually does employ a number of different data collection methods. Yin (2003) provides a very concise definition of a case study as follows:

"A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between the phenomenon and context are not clearly evident; and in which multiple sources of evidence are used."

Yin (2003)

This approach certainly fits in with the researcher's previous assessment that a 'mixed' approach should be considered when tackling the research question. However, before committing to using a case study approach it is worth considering the views of Olorunniwo *et al* (1982) and Yin (2003) who state that case study analysis is a type of research that is different from other forms of investigation, and demonstrates the following characteristics.

Case-study characteristics	Fit with Research problem	Fit with research problem (Y/N)
It studies the whole units in their totality and not aspects or variables of these units.	Research is looking at overall knowledge management throughout a key aspect of the supply chain.	Yes.
It employs several methods primarily to avoid or prevent errors and distortions.	Intend to define problem areas using process mapping, and then questionnaires. To identify Management perspective through 1 to 1 interviews.	Yes.

It often studies one unit: one unit is one study.	Each knowledge bottleneck in the supply chain process can be looked on as one case.	Yes.
It perceives the respondent as an expert not just as a source of data.	Data will be captured from subject matter experts (process mapping), and general operatives working around particular performance hotspots.	Yes.
It studies a 'typical' case.	The study will look at a particular case and hope to identify generic issues that other organizations can learn from.	What is 'typical'?

Table 5.13 Characteristics of Case Study research. Source: Modified from Sarantakos (2005)

As well as the characteristics outlined in Table 5.13, the researcher has been involved in supply chain operations for a number of years, and has developed the research problem and subsequent questions based on time served within the organization. This also fits with a case study approach. According to Bauer (1994), Berger (1989) and Lemnek (1988) case study research is also used for the purpose of exploration and for the following reasons.

- *To gain more information about the structure, process and complexity of the research object when relevant information is not available of sufficient.*
- *To facilitate conceptualisation.*
- *To assist with formulating hypotheses.*
- *To guide the process of operationalisation of the variables.*
- *To illustrate, explain, offer more detail or expand quantitative findings.*
- *To test the feasibility of the quantitative study.*

Considering the limited research available concerning knowledge transfer within a supply chain environment and the researcher's desire to understand, or conceptualise how knowledge transfer happens within this environment the above reasons provide a good fit. Sarantakos (2005) states that in qualitative research the case study does not serve as a stepping-stone to quantitative studies but as a research enterprise of its own, aimed at developing hypotheses or even theories. Case studies are no longer seen as providing second-rate or preliminary research supplemental to quantitative enquiry but as a suitable alternative to quantitative research.

This viewpoint also supports the view of the researcher who needs to weigh up the practicalities of doing the research, such as operating research environment, pre-understanding of the problem, researcher's level of involvement with the subjects, dynamics of the business environment, and the need for ethical and academic rigour in completing the data gathering.

5.13 Research Design.

Having decided on a mixed case study approach, Sarantakos (2005) identifies two types of qualitative design; *fixed* and *flexible*. These are by no means the only types of design, but they are the most common. Sarantakos (2005) then goes on to distinguish between the two as follows.

5.13.1 Fixed Design.

This employs a relatively structured approach resembling the quantitative model. The steps are the same as those of quantitative research, as in the direction of the process, which is a one-way path, from the choice of the topic to the conclusion. This design approach assumes the researcher has a very clear idea as to the nature of the research topic, and analysis of the data is done on completion of the fieldwork. This mode very much supports a 'theory testing' research plan.

However, the research question which forms the basis of this thesis requires an 'inductive' logic to support a predominantly 'theory building' approach. As a fixed approach is not best suited to this the flexible design needs to be reviewed for consideration.

5.13.2 Flexible Design.

This is the more commonly used design approach. Sarantakos (2005) outlines the steps to follow when developing a flexible qualitative design. Flexible qualitative design provides a context within which research procedures are conducted as required by the research outcomes. They entail a dynamic process that builds itself as it goes. The key steps for flexible design and their explanation are outlined in Figure 5.5.

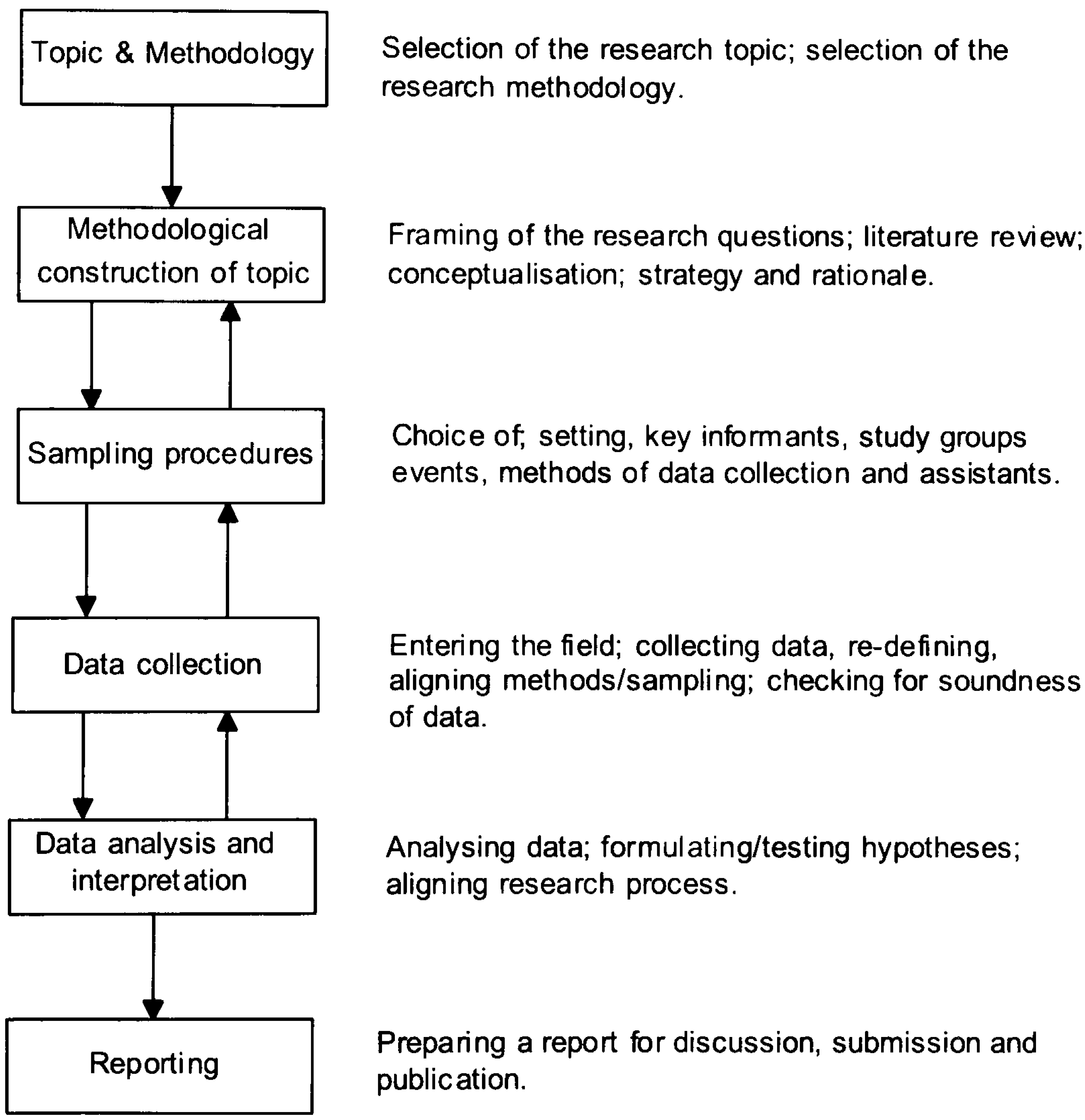

Figure 5.5 Steps of flexible qualitative design. **Source: Sarantakos (2005)**

As Figure 5.5 demonstrates, the flexible design contains iterative steps that allow the researcher to analyse and modify the research question right up to the point of reporting the findings. This is not to say that in this case it is the intention of the researcher to keep re-evaluating the research question. As already intimated the researcher has a good understanding of the nature of the problem and question. However, the design process as outlined will allow for the researcher to review findings that in turn may shape additional questions. This is the nature of inductive, theory building research. It is also important to note that the process flow in Figure 5.5 is the same as the one proscribed by Yin (2003) specifically for case study research.

5.14 Defining a Case Study Approach.

As 'case study' has been chosen for the research methodology it is important to understand how the researcher intends to approach the problem of identifying the different cases for the purpose of gathering the necessary data. The supply chain is a large organization from a people, process, and geographical spread perspective. If the researcher is to define any meaning as to how knowledge is transferred / handled within the organization then the area of research will need to be broken down into manageable blocks.

Defining the type of case study will be largely influenced by the type of answer being sought to the research question. As the research is looking to build on the current research surrounding knowledge transfer across complex organizations based on the experiences identified within one organization, the approach, or case study procedure can be referred to as '*analytic induction*' (Gibbs, 2005). Analytic induction, also known as 'explanation building', consists of two stages. The first is the building up and testing of a set of causal links amongst events within one case. The second is testing, or validation of the findings through an extension of the testing into multiple cases.

5.14.1 Explanation Building.

The explanation process is iterative in nature. This is because after initially proposing a theory, the research then tries to validate, or more accurately, falsify the theory through an iterative refinement process involving multiple case studies. The outcome of this process is an inductively refined theory. Yin (2003) and Gibbs (2005) summarises the iterative process in seven steps. The Table 5.14 shows how the seven steps relate to this researcher's case study approach.

	Iterative Process Stages	**Research Stages.**
1.	Make an initial theoretical statement or an initial proposition about policy or social behaviour.	Assumption based on pre-understanding, which drives development of research questions
2.	Compare this against the findings of an initial case.	Compare findings on barrier existence, and impact of knowledge initiatives on process performance, with published findings. Data gathered from initial case.
3.	Revise the statement or proposition so it fits the case.	Develop an emergent theory concerning the management of knowledge enablement for the purpose of process improvement. Theory developed from finding of initial case.
4.	Compare other details of the case against the revised statement or proposition.	Identify aspects of theory for testing against other similar organizations. (validity testing).
5.	Again revise the statement or proposition.	Test key aspects of emergent theory with other similar organizations.
6.	Compare revision to the detailed second, third, or more cases.	Review findings with case study participants in order to refine theory.
7.	Repeat this process as many times as needed.	As above.

Table 5.14 Iterative Stages to Exploratory Case Study. Source: Yin (2003)

Through the process data will be gathered from multiple sources including existing company documentation, archival records, questionnaires, interviews, direct observation, and physical artefacts. All are legitimate sources of information for case study analysis (Yin, 2003). As one would expect there are strengths and weaknesses to all forms of data, and care must be take to ensure an objective perspective is maintained throughout the data gathering process.

5.14.2 Multiple versus Single Case Study Design.

Case studies can be single or multiple in their design. Multiple cases provide a more rigorous and complete approach then single research, thus increasing confidence in the robustness of the emerging theory. According to Eisenhardt *et al* (Eisenhardt 1989, Stake 1994, Yin 2003) this is because of the triangulation of evidence. The use of multiple cases for this research is driven by the need to breakdown a complex environment into distinct process, organizational, and performance related areas.

The evidence for multiple case studies is often considered more compelling and is regarded as more robust. Whether a resulting theory can be 'generalised' is related to the complexity of external validity i.e. whether external conditions are thought to produce much variation in the phenomenon being studied. As with all experimental observations, case study results can be generalised to theoretical propositions, analytical generalisation, but not to populations or universes. Thus the aim of case studies cannot be to infer global findings from a sample to a population, but rather to understand and articulate patterns and linkages of theoretical importance. Amaratunga & Baldry (2001) stated that it is important to emphasise that case studies deal with unique situations and, because of that, it is not possible to elaborate detailed and direct comparisons of data.

5.14.3 Identifying the Main Case for Research.

The initial data gathering will centre on the complex order flow process, which is a core business process of IBM's Integrated Supply Chain organization. The data gathered will be used to understand and develop a view of how knowledge transfer barriers impact along the core process. Through this research an understanding as to how the organization develops and operates its core processes from a knowledge implementation strategy will be developed. The initial case surrounding IBM's order flow process will investigate how knowledge transfer barriers are identified within each key stage or milestones along the process. Table 5.15 identifies the key milestones in the process.

Milestone	Description
1. Order Receipt (OR) to Order Entry (OE).	*Process for getting an order from a customer and loading into the IBM fulfilment system.*
2. Order Entry (OE) to Order Drop (OD).	*Process for clearing the order through the fulfilment system to a point where order is ready to 'drop into manufacturing for building.*
3. Order Drop (OD) to Order Ship (OS).	*Process for getting an order through manufacturing to a point where it is ready to ship.*
4. Order Ship (OS) to Order Delivery (ODel).	*Process for consolidating an order into a shipment and delivering the order to the customer.*

Table 5.15 IBM Supply Chain Order Process Milestones. **Source: IBM ISC.**

However, prior to conducting the research the order flow process must be mapped. As each business function, with IBM's ISC, operates as an independent business unit there is no overall process descriptor available, and therefore, the first step in conducting the research will be to map the order process. Once the order process is mapped and validated, through peer review, it will allow the mapping of performance hotspots to key areas where organizational ownerships can be identified.

Once the date is gathered and analysed it will provide some insight into the key issues which employees feel are preventing, restricting, or indeed aiding performance related knowledge transfer. It is intended to use questionnaires to collate the data for this part of the research. On completion of this stage the data will be analysed and initial findings used to develop a theory relating to process management and knowledge transfer.

5.14.4 Addressing the Pitfalls of Exploratory Case Studies.

The greatest pitfall with exploratory case study involves the drawing of premature conclusions: the findings may seem convincing enough for inappropriate release as conclusions (Gibbs, 2005). Other pitfalls include the tendency to extend the exploratory phase. As the iterative process progresses the researcher may slowly begin to drift away from the original topic of interest. Also the researcher must safeguard against selecting case studies that are an inadequate representation of diversity (Yin, 2003).

The researcher can compensate for these pitfalls through adherence to the basic guidelines that hold true for all case study analysis. That is ensuring case study protocol concerning data to be collected is defined prior to the data gathering stage, the establishment of a suitable case study database, and following the chain of evidence (Yin, 2003). For the purpose of this research a dedicated documentation database has been established specifically for holding and sorting data relating to the emergent theory building stage. All responses received from participants across the base case study will be held separately in an Nvivo narrative database. However, separate consideration will need to be given to ensuring end-to-end research validity. For this Yin (2003) provides the necessary guidance.

5.15 Ensuring Validity of Research.

According to Yin (2003) the quality of any given design can be judged according to the following four tests outlined in Table 5.16:

Validity Test	Test Details.
Construct Validity	*Establishing correct operational measures for the concepts being studied.*
Internal Validity	*Establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships.*
External Validity	*Establishing the domain to which a study's findings can be generalised.*
Reliability	*Demonstrating that the operations of a study – such as the data collection procedures can be repeated with similar results.*

Table 5.16 Tests for Research Validity. **Source: Yin (2003)**

Yin (2003) states that any research study, for it to be valid, should conform to, and pass certain design tests (Table 5.16). Although multiple case studies introduce a degree of triangulation, which in turn provides a level of validation to the data findings, it is important to build in validation and reliability testing throughout the research design. Table 5.17 outlines where within the research design for this thesis the researcher will test for validity and reliability.

Test	When conducted	Phase of Research
Construct Validity	Use multiple sources of evidence (observation, peer review, questionnaire).	Data collection.
	Key informants to review draft case study reports.	Data write-up
Internal Validity	Literature review	Data analysis
	Conduct pattern matching across multiple cases.	Data analysis.
	Conduct explanation building.	Data analysis.
	Do time-service analysis	Data analysis.
External Validity	Use replication logic in multiple case studies.	Research design
Reliability	Use case study protocol	Data collection.
	Develop case study database.	Data collection.

Table 5.17 Validity and Reliability Research Checks. **Source: Yin (2003)**

Embedding these reliability and validity check points within the research helps ensure the research conforms to and repeats good academic practice as well as making sure the research outcome remains relevant to the original research question.

Tying emergent theory to existing literature also enhances the internal validity and the generalisation of case study research. After cross case comparisons the emergent theory is compared with the theoretical framework identified at the literature review phase. While linking results to the literature is important in most research, it is particularly crucial in theory building research because the findings so often rest on a limited number of cases. This is particularly relevant with this research as the amount of research on knowledge management within a supply chain environment is very limited.

Figure 5.6 show the key stages of the research project, and where testing for reliability and validity has been built into the overall design.

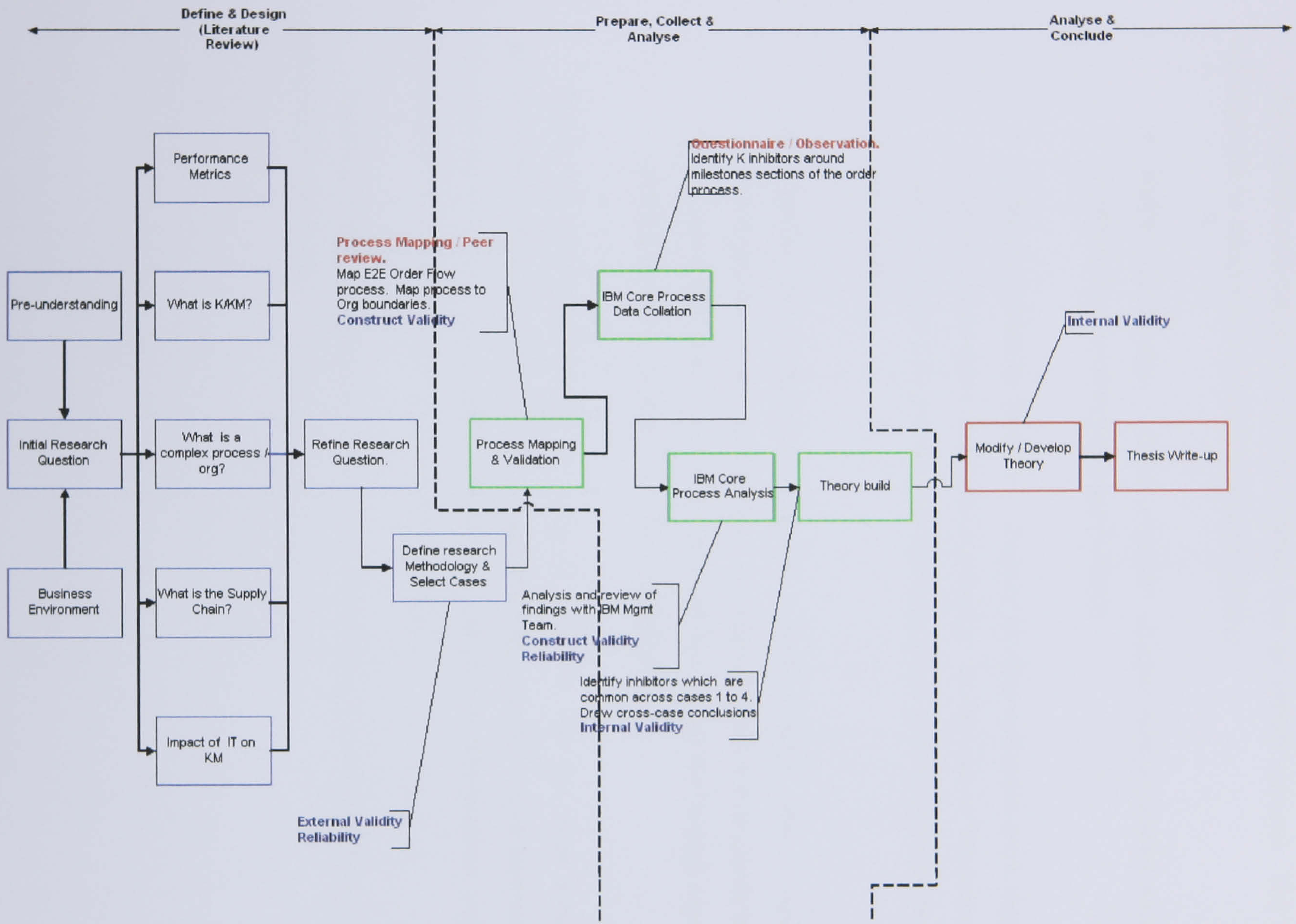

Figure 5.6 Key Stages of Research.

Source: Developed for research.

5.16 Main steps in the Research Process and Data gathering.

The process will follow the flexible research flow as already covered. The main activities can be categorised into three areas (Yin, 2003).

- **Define and Design**. – *Define problem, conduct reviews, define research methodology, and develop research design.*

- **Prepare, Collate & Analyse**. – *Prepare for data collection (pick sample), develop questionnaire and interview format. In the case of this research, map core order flow process and determine areas to be targeted for further data gathering.*

- **Analyse and Conclude**. – *Analyse overall findings with a view to developing theory (theory building). Although analysis will be conducted at the end of each case the final analysis will look to pull the findings together to see if a theory or hypothesis can be identified.*

Figure 5.6 also breaks down the research overview into the three areas as proscribed by Yin (2003). The methods for gathering the data will not be restricted to one type but will cover questionnaires, interviews, peer review, observations, support documentation, network analysis and process mapping.

Figure 5.7 outlines the key process steps and how they link into one another from a precedence perspective.

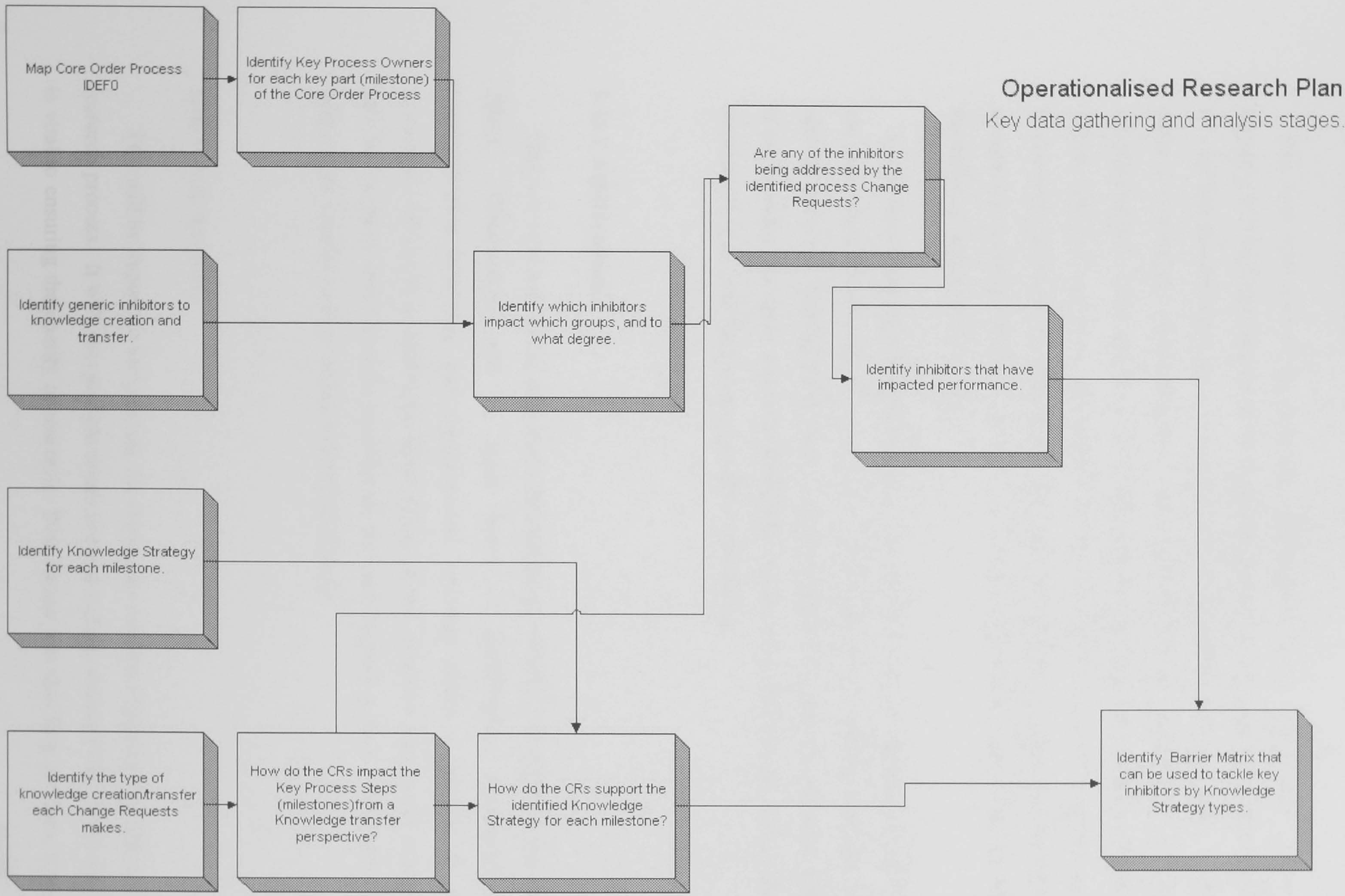

Figure 5.7 Research Overview. **Source: Developed for research**

5.16.1 Process Mapping.

This is a vital part of the research. Although it is not expected that process mapping will highlight any direct findings concerning the development of any theory, it is critical that this exercise is completed, as it will highlight the main areas. as they relate to the supply chain milestones where performance hot spots exist. This is a complex piece of work and as an end-to-end process overview has not been conducted before, this piece of work will provide for the first time an overview of the main business process interlocks throughout the order flow process. In order to validate the process a peer review will be conducted with the subject matter experts familiar with the different segments of the process.

The process mapping will not just rely on documented process segments but also on the input from actual users of the process. The intent of the mapping exercise is to identify the actual process being used, as opposed to the 'desired' process to be used. If performance hot spots are to be referenced to the order flow process then a clear understanding of how the process actually works is vital.

5.16.2 Observations.

This is a valid part of any case study data gathering exercise (Yin 2003, Sarantakos 2005). Observations will be made based on performance documentation, communication structures, and organizational boundary issues as viewed by the researcher. However, to ensure the observations remain objective, case study write-up will be reviewed with the main contributors for each respective case. This will also help ensure internal and contextual validity throughout.

5.16.3 Peer Reviews.

This will be important for ensuring the researcher remains objective throughout the research process. It will also provide reliability and validity testing (Yin, 2003) which is vital to ensuring the quality of research. Peer review can also help generate further insight into the findings or data collected through a case study. However, the researcher needs to make sure peer review input is germane to the research and does not mislead the researcher into drawing wrong conclusions. Therefore, it is important that a peer review group are selected based on their familiarity with the case study area of research, and are limited to commenting on the finding that specific case study. Overall, the important aim is to seek concurrence in the review team's assessment of the case study findings.

5.16.4 Interviews.

This will allow the collation of more in-depth knowledge on performance, whilst also ensuring an improved response rate over that of a questionnaire. The target group for interview will be key management individuals within the ISC organization and the customer support organization. The intent will be to use the interviews to gauge senior management understanding of how knowledge and performance are linked within the supply chain process, what they believe the issues are in improving knowledge flow (if indeed they believe this to be an important aspect of performance management), and how senior management think knowledge should be managed (codified or personalised systems, or a combination thereof). This will allow the researcher to gain an understanding of their perceptions of what the performance indicators are, should be, and what they believe the KMS will do to improve performance.

The target research group will be the senior managers responsible for each milestone within the supply chain order flow process, and the supply chain director who has overall responsibility for supply chain performance. The intent is to gauge the perceived view of management to knowledge management within the order flow process. If the key findings are made available prior to interview it might shape the senior managers responses to what should happen as opposed to what they think is happening. It is this difference in understanding that needs to be captured through the interview process. The interviews will steer away from commercially sensitive material. As these interviews will be time consuming they will only be carried out with about 6-8 members of the senior management team. The interviews will be semi-structured in format.

5.16.5 Questionnaires.

An on-line questionnaire will also be used to target a wide sample of individuals within each of the functions (procurement, fulfilment, distribution, service support, and supply) that make up the supply chain organizations. Questionnaires will be distributed via the intranet thus saving time and cost in delivering them to the target population. However, care should be taken in the formulation of the questions in order to ensure the responses are not vague, or the result of leading, biased questioning, or that the questions lead to a format effect due to similar structure (Foddy, 1993). As well as this the questionnaires will be self-administered. This will reduce cost and response time; however, the response rate will be lower than that of an administered questionnaire. Therefore, a large target audience will be selected for this stage of the data collection.

The questionnaires will be used to pull data on employee's understanding of the knowledge management performance related issues in and around the main milestones within the order flow process. The questionnaires will be distributed to those individuals who are connected to parts of the order flow process that have been identified as key performance bottlenecks. The questionnaire may contain a quantitative element that will be used for triangulation.

5.16.6 Focus Groups.

The use of one-to-one interviews will provide a sound understanding of what the organizations performance goals are. The use of questionnaires / surveys will help confirm / deny whether the organization's Knowledge Management Strategy (KMS) in question is meeting the performance indicators.

The main reason for using a focus group will be to externally and contextually validate the case study findings. The focus group will be made up of professionals involved with complex process operations within complex organizations external to IBM. The intent of the group will be to understand how their respective organizations handle process development from a knowledge transfer perspective along a core complex process, albeit at a high level, and see if other organizations have experience of the same issues as identified within the initial IBM case. The output from the focus group will help shape / reshape the construction of a theory or hypotheses based on the key findings of the multiple case studies. For a theory to have any relevance out with IBM's supply chain it is important to understand how the findings relate to other organizations. For this reason the best approach is to use a focus group (Crabtree & Miller 1992, Patton 1990).

The benefits of using this method of data collection are the low cost and speed as compared with one-to-one interviews. From a quality of data perspective the focus group can help highlight abstract ideas and provide a weighted importance to them. However, when running the focus groups it is important to bear in mind the following:

- *Focus groups may provide a less rounded picture of individual participants.*
- *Need to be aware of sensitive topics and the group's willingness to discuss them.*
- *Peer pressure may come to bear. Need to ensure individuals are given the opportunity to contribute freely.*
- *It can be difficult to test the awareness / knowledge of individuals to the topics being discussed. Therefore, need to keep the group focused on the research area.*

5.16.7 Social Network Analysis.

An interesting aspect of the research is to understand how barriers to knowledge and information creation and transfer impact along an identified core complex process. As current research into barrier existence and impact relate to the organization as a whole some method must be used to understand how the barriers relate to key parts of the process, and the work groups who experience them.

Social Network Analysis (SNA) is a research technique used to highlight the relationships between people and organizations (Mead, 2001). SNA is commonly used to describe the relationship, examine information flows, and analyse patterns that develop between individuals and organizations (Wasserman & Faust, 1994). A very useful aspect of SNA is its ability to provide a visual representation of a network. In the case of this research the network of interest is the one that supports the order flow process. Figure 5.7 demonstrates the different views of organizational structure SNA can provide. The hierarchical view shows an organization's structure based on lines of command and control, whereas, the network view shows an organization's structure based on defined relationships between employees or groups of employees.

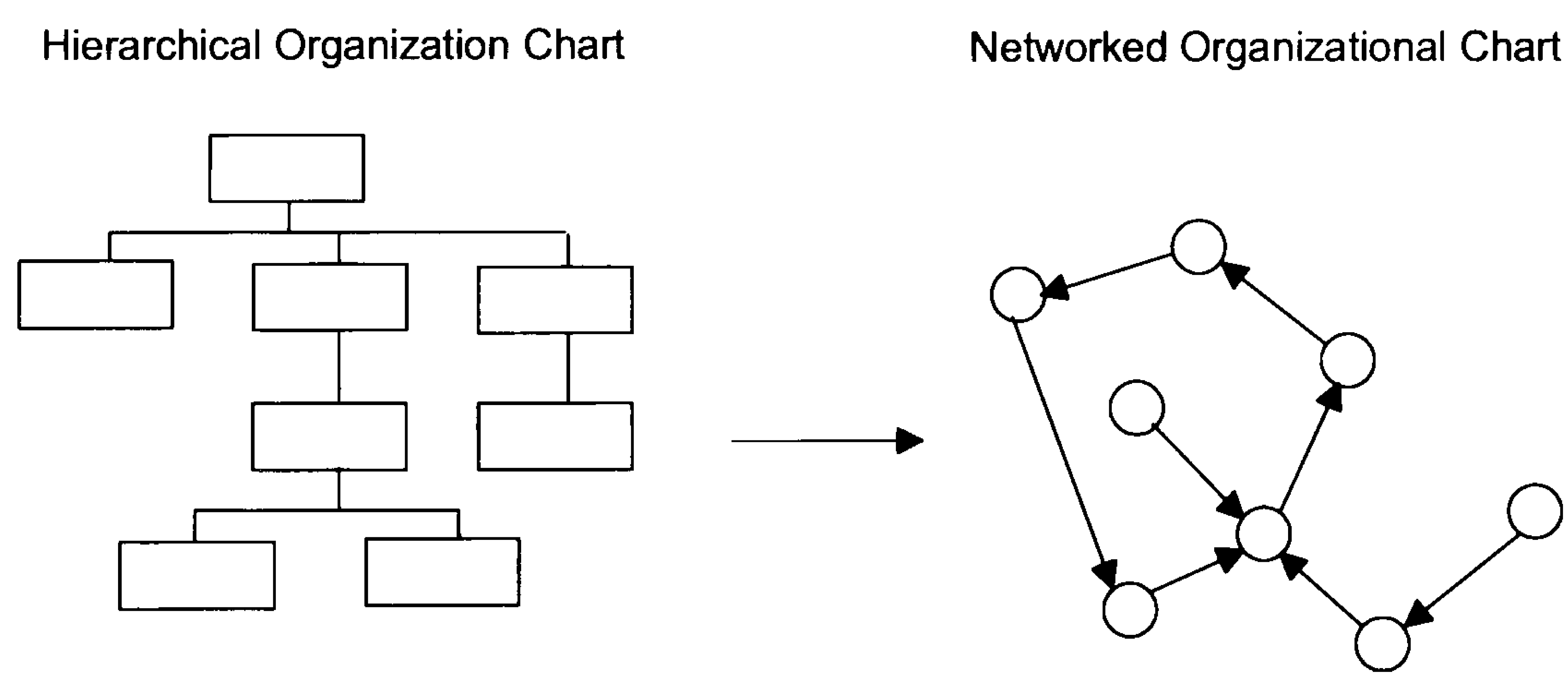

Figure 5.8 Organizational Representations. **Source: Developed for research.**

Before mapping the parts of the ISC organization responsible for the order flow process onto a network diagram, the type of network must be defined. In general, there are two types of network; ego-centred and whole or global networks (Mead, 2001; Scott, 2005; Mitchell, 1969). Ego-centred networks centre on a particular individual and the connections that individual has with others. Global networks look at the relationship between individuals or groups based on a particular activity. For the purpose of this research the global approach would be adopted as the research at this point is not about a particular individual's communication network, but more about the way the different business functions connect together across the order flow process.

5.17 Ethical Issues.

Ethical approval was sought from the School of Business and Management prior to all interviews and / or questionnaires being issued. Approval was sought on two separate occasions. The first being for the purpose of data gathering with IBM, across identified supply chain employees. The second ethical approval was sought for the purpose of gathering data from external organizations; the analysis of which would be used to test the emergent theory developed by the researcher.

All participants were given clear written and verbal information on the study, the possible benefits of the study, and the likely personal advantage to the researcher. They were also given the assurance that anyone wishing to participate, but remain anonymous would have their identity protected.

The researcher has no direct career / line management responsibility over any of the people participating in this research, and as such the researcher's position cannot be perceived as leverage in getting information from individuals, which in turn maybe heavily biased towards the interviewee's perception of what they believe the researcher wants to hear.

5.18 Chapter Conclusions.

In order to effectively answer the research question posed in this thesis a suitable research methodology needed to be identified. The researcher had no prior practical experience of any of the key methodologies, but was keen to ensure the selected methodology was chosen based on its ability to help answer the question, and not because of its ease, or convenience of use for the researcher. However, what the researcher does bring to the project is a 'pre-understanding' of the problem. This does not mean that the research question is based on this pre-understanding alone, but that the pre-understanding helps focus the initial research that in turn then helps define the research question.

A review of the main research philosophies with respect to the research question, and research environment highlighted a critical realism approach (Johnson *et al*, 2003) as providing the best fit. From here the researcher reviewed the research modes and determined the mode to be predominantly '*inductive*' in nature. This fits the form and implied direction in which the research question directs the researcher. However, due to the complexity of the question and the various sub-questions that need to be answered before the main research question can be addressed the overall mode of the research follows a deductive - inductive pattern, in line with Buckley *et al's* (1976) definition. This mixed mode of research is referred to as 'retroduction' (Bulmer, 1979).

Although the main objective is to develop, through inductive theory building research, a theory concerning how organizations identify and manage barriers to knowledge transfer, how the barriers identified through existing research can be applied to a supply chain organization is a deductive process. Once the theory has been built there will be a need to provide some testing in order to validate the theory. The testing of the theory then follows a deductive research mode, as the generalised theory is applied to specific organizations for the purpose of comparison and validation.

The research methodology chosen was then based on the inductive / deductive nature of the research. In deductive and inductive research methods are not specifically aligned to quantitative and qualitative research respectively. However, inductive usually relies on qualitative, whilst deductive relies on quantitative. Considering the mixed nature of the research and possible spread of data sources, both primary and secondary that the researcher would pull from, and the primary focus of exploratory theory building, the most suitable research methodology is 'case study'.

As case study research predominantly focuses on inductive, theory building a flexible design framework would be followed. However, to ensure identified pitfalls inherent in exploratory case studies do not occur, testing for validity and reliability (Yin, 2003) would be built into the research plan.

So, after identifying a suitable research philosophy (critical realism), mode (retroductive), design (flexible), and methodology (explorative, multiple case studies) methods for data capture and analysis need to be defined. Case study research allows for data to be acquired from multiple sources; this research project would, in this case, be no exception. Data gathering and analysis would utilise quantitative and qualitative analysis, using questionnaires, interviews, forums, social network analysis, process mapping, peer review, and observations to collect relevant data.

From an ethical perspective the research conducted adheres to the ethical guidelines for social research as stipulated by the University of Glasgow.

6. Understanding the Process.

"A company must continue to focus on its processes so that they stay attuned to the needs of the changing business environment. To accomplish this, the company must actively manage its processes. Indeed we can see now that the heart of managing a business is managing its processes: assuring that they are performing up to their potential, looking for opportunities to make them better, and translating these opportunities into realities."

Hammer (1996)

6.1 Introduction.

To fully understand the effect knowledge management has on the complex process that drives order flow in the supply chain, the process steps need to be identified and mapped. Due to the organizational structure operating within IBM's Integrated Supply Chain (ISC) organization process descriptors existed for specific business units, but process linkages between the business unit functions are not tightly managed. Therefore, when business unit and re-engineering process analysts were asked for an overall end-to-end (E2E) descriptor none existed. Certainly the re-engineering team have systems maps that showed how the various IT systems (SAP, i2, DB2) interacted, but there was no process map that showed how the functional business processes tied together from end-to-end.

The IBM Integrated Supply Chain (ISC) has experienced, through 2003/4, significant change. Changes, which have been driven by market forces, have impacted every aspect relating to how IBM as a corporation manages its supply chains. IBM is not unique; supply chain considerations impact upon a great many organizations as they attempt to find integrated solutions to complex problems (Chandra & Kumar, 2000). However, within IBM, this transition, which has affected organizational structure and alignment, process, and IT support, has not been without its problems. The drive to shift from a 'functional' to a 'process' control alignment, as identified by Hammer & Champy (1993) and further developed by Champy (2002), has required a shift in the mindset of the organizations employees. The ISC is not alone in facing continuous organizational change. Many organizations struggling with the management of complex change have implemented re-engineering initiatives, which have failed to live up to their promises of performance improvement (Morberg *et al*. 2003; Wastell *et al*, 1994). Organizations need to be able to develop flexible end-to-end (E2E) processes that can be 'tweaked' and modified to meet changes in customer demand, product availability and overall performance (Lee *et al*, 1997; Rajiv, 2006).

This chapter examines the issues that were impacting upon IBM's supply chain performance. In particular it is interested in the way the organization viewed the inter-connected relationship between IT and knowledge systems, people, process, and the prioritisation of change through an integrated decision-making process attempting to add value to all stakeholders (Walters & Lancaster, 2000).

How IBM, or any other complex organization, manages the re-alignment of supply chain relationships must surely impact both immediate and future performance (Lee *et al*, 1997; Troyer, 1995). Performance is not simply down to the implementation of elaborate IT systems (Kotter, 1995), but requires the alignment of key personnel in an understanding of the knowledge management aspects relating to the end-to-end processes (Wiig, 1997; Tsoukas, 1996). This requires management to think about how the business operates from a process as opposed to a functional perspective (van Weele, 2002). What is certain is that if an organization does not have an end-to-end understanding of its core business processes it cannot expect to effectively manage performance through those same processes.

6.2 Pro-active Management of Process Improvement.

In May 2004 overall end-to-end performance of the supply chain with respect to the provision of IBM hardware within the Europe, Middle East and Africa (EMEA) region, was below target. Additional people were drafted into critical business units but the under performance continued. The problem was that while the poor performance could not be traced to any obvious drivers, there were multiple factors impacting upon performance. An overall end-to-end view of the process did not exist making it difficult to identify either the drivers or their inter-relationships.

As the end-to-end order flow process is complex and time critical, problem resolution tended to focus on fixing symptoms rather than addressing the core causes.

Resolution was largely taking place at a business unit/functional level, which meant solutions were not being prioritised from an overall end-to-end impact perspective. The intuitive response was to manage problem resolution of performance pressures from a functional alignment perspective as opposed to that of process alignment. As the organization did not yet fully understand the end-to-end processes involved, the functional approach was, at the time, the only available tool.

During May 2004 the EMEA ISC management team worked together to identify the key issues, which the team as a whole needed to concentrate on in order to drive up performance. A three-day workshop was held and the outcome was a list of 24 key performance improving change request (CRs) initiatives that needed to be addressed. As an end-to-end process overview was not available, the business unit leaders most affected by the resolution of the agreed CRs based their decisions on the perceived impact of the work items on localised and subjective reasoning. The overall impact of the work items was not clear, as without 'joined-up' processes and end-to-end understanding; the implications on other areas of activity could not be fully assessed.

In order to link the work items to specific supply chain activities, as opposed to business units, the CRs were initially categorised by the management team under the following headings:

- **Systems effects** – *Issues relating to system interactions and delivery dates. Delivery dates were unstable causing customers to lose their belief in IBM's ability to forecast accurately.*
- **Supply availability** – *Issues relating to supply availability and more specifically manufacturing's ability to commit to a build date.*
- **Options/Tied orders** – *Issues relating to delays in shipping due to mis-matching of customer orders for hardware options to the computers being built.*
- **Management system** - *Issues relating to identifying and managing failures within the management systems to enable E2E supply chain performance management.*
- **Priority customers and business partners** – *Issues relating to ensuring priority service to the top 10 customers and business partners.*

The issues identified were allocated to a senior manager (Function Head) to ensure they were resolved in a timely manner. A review meeting was held twice weekly to ensure progress was being made and focus maintained. Although the management team was driving change, the effect of the change was not known. The approach was not holistic, with each CR being viewed and managed as a separate entity. From a complex systems perspective the proactive approach was really a reactive response to a poor system performance (Senge, 1999). If sustained performance was to be realised the end-to-end process would need to be better understood. A clearer understanding of how the identified CRs impacted upon each other was required. In order to do this the process would need to be mapped. To get the necessary level of detail, subject matter experts would need to be included in the mapping process, and a management decision-making system developed to capture, prioritise and resolve issues.

6.3 Defining an Objective View of the Process.

The supply chain organization is made up of professional, well-educated individuals who have a lot of experience in the areas of manufacturing, procurement, customer fulfilment, demand planning, and distribution. However, the end-to-end performance of the supply chain was not what it should have been. Why?

Highest level of education achieved.	**Number of employees meeting level. (Total population = 1097)**	**Percentage of employees meeting level**
Secondary Education including college.	217	19.8%
Vocational Training	341	31.1%
Bachelor Degree	314	28.6%
Masters Degree	219	20.0%
Doctorate	6	0.5%

Table 6.1 Education Demographic for EMEA ISC. **Source: IBM ISC (2004)**

IBM's ISC employs a codified approach to defining its knowledge strategy; therefore, systems play a significant part in the transfer and storage of information, of explicit knowledge. Information is readily available on system performance; however, the semantic information is difficult to identify from the syntactic information. So, not only is the work force well educated, but also there is an abundance of semantic information. From the researchers discussion with subject matter experts throughout the organization, their level of knowledge on their particular aspect of the business is excellent. Couple this with the flow of information throughout the organization and the question remains; why the failure to address performance issues?

A possible explanation is provided from a number of academic sources. In particular, Stacey (2005) draws us back to the starting principle that knowledge is the result of a cognitive process carried out by the human mind. Bhatt (2001) stresses the need to ensure the integration of knowledge management solutions across the human/systems boundary. There is no doubt that knowledge exists within the minds of the professionals within the ISC. The problem is how this knowledge can be extracted from the individual and made part of the available collective knowledge of the organization. This is an area where Marwick (2001) and Malhotra (2001) believe the implementation of technology fails to support business needs. This problem becomes more acute within an organizational context when inter/intra organizational boundaries need to be bridged more regularly in order to achieve expected business goals.

6.3.1 ISC Optimisation Team.

The initial identification of 24 key issues was a starting point in driving improvement through the supply chain. However, as already stated the effect of these changes could not be gauged until they were fully implemented. In order to gain a better understanding of the impact these and any future changes would have, the researcher concluded that the process to which these changes related would need to be understood. Suggested changes would need to be assessed against the process to ensure their effect whilst deemed to be positive to some business areas would not have a negative impact in other areas. As the ISC worked through the 24 key issues, this served to uncover or identify additional issues. If the impact were to be understood then some way of assessing, prioritising, and managing these new issues would need to be implemented. To prevent the management of these existing and new issues from becoming unmanageable not only would the process need to be mapped, but also the issues would need to sorted and prioritised, and their overall impact understood by a team who had end-to-end supply chain awareness. As this team did not exist at this time the researcher formed a cross-functional optimisation team.

The optimisation team was made up of subject matter experts (SMEs) from the different parts of the supply chain. In particular these areas included re-engineering, customer fulfilment (order management), customer scheduling (supply and demand planning), control towers (manufacturing), global logistics (distribution), customer programmes (serviceability management, and top 15 customer support), and customer care (quality and customer focus). Participants were non-management supply chain professionals who were perceived, by their respective management teams, to be knowledgeable practitioners within their own fields. Figure 6.1 shows in general how process change requests flowed between the different business functions and Re-Engineering (who are responsible for implementing the change) prior to the formation of the optimisation team (not all business functions have been shown in the figure).

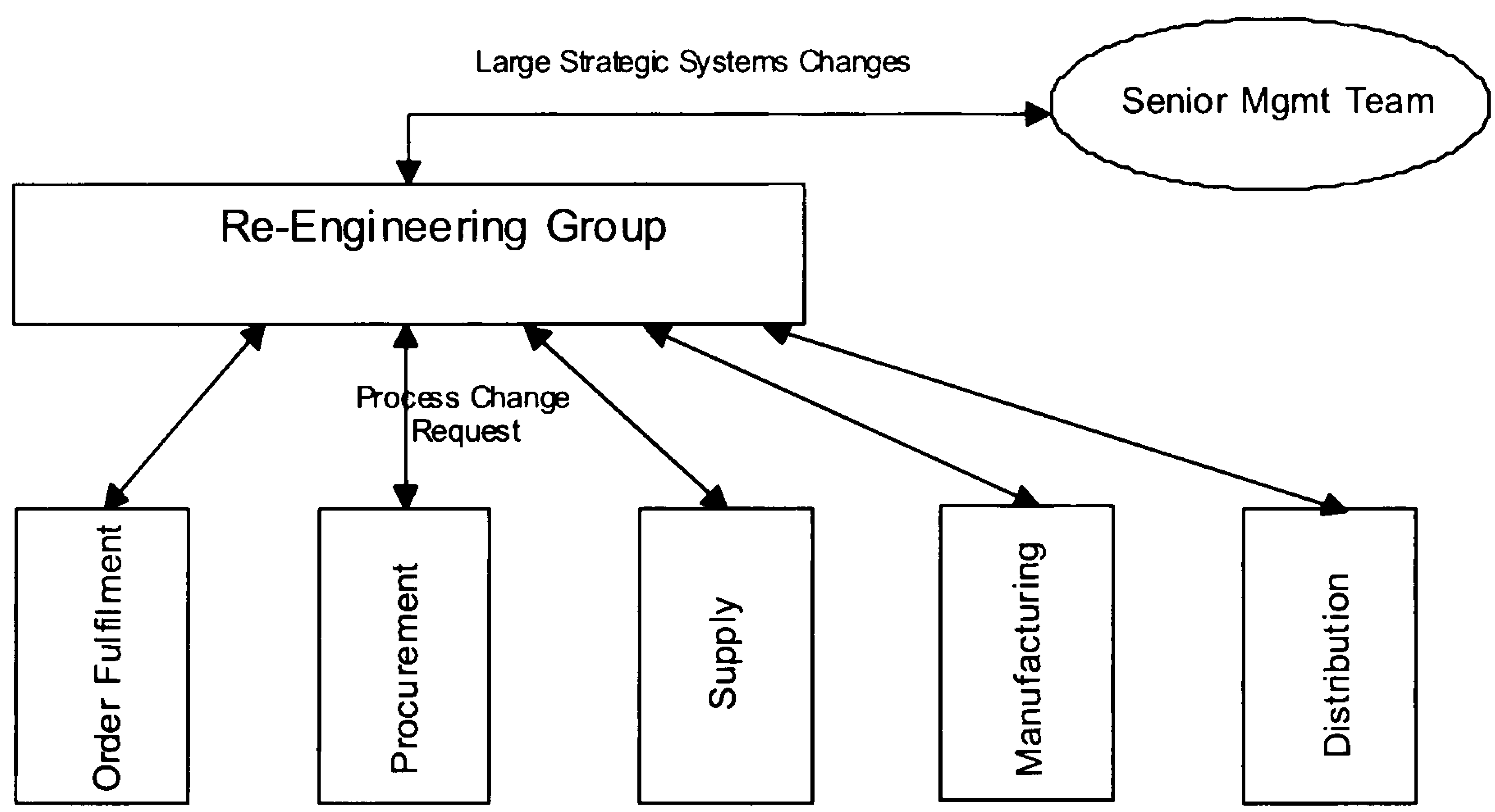

Figure 6.1 Managing Process Change Requests. **Source: IBM ISC (2004).**

Whilst the optimisation team was made up of subject matter experts (SMEs) from the different parts of the supply chain, they were selected due to their common understanding of the order flow process. In particular participants were selected from areas included Re-Engineering (process and systems change), Customer Fulfilment (order management), Customer Scheduling (supply and demand), Control Towers (manufacturing), Global Logistics (distribution), Customer Programmes (serviceability management, and top 15 customer support), and Customer Care (quality and customer focus). Figure 6.2 shows the new process for identifying process change requests and how the optimisation team sits within this structure. Once again for neatness not all business functions have been shown in this diagram.

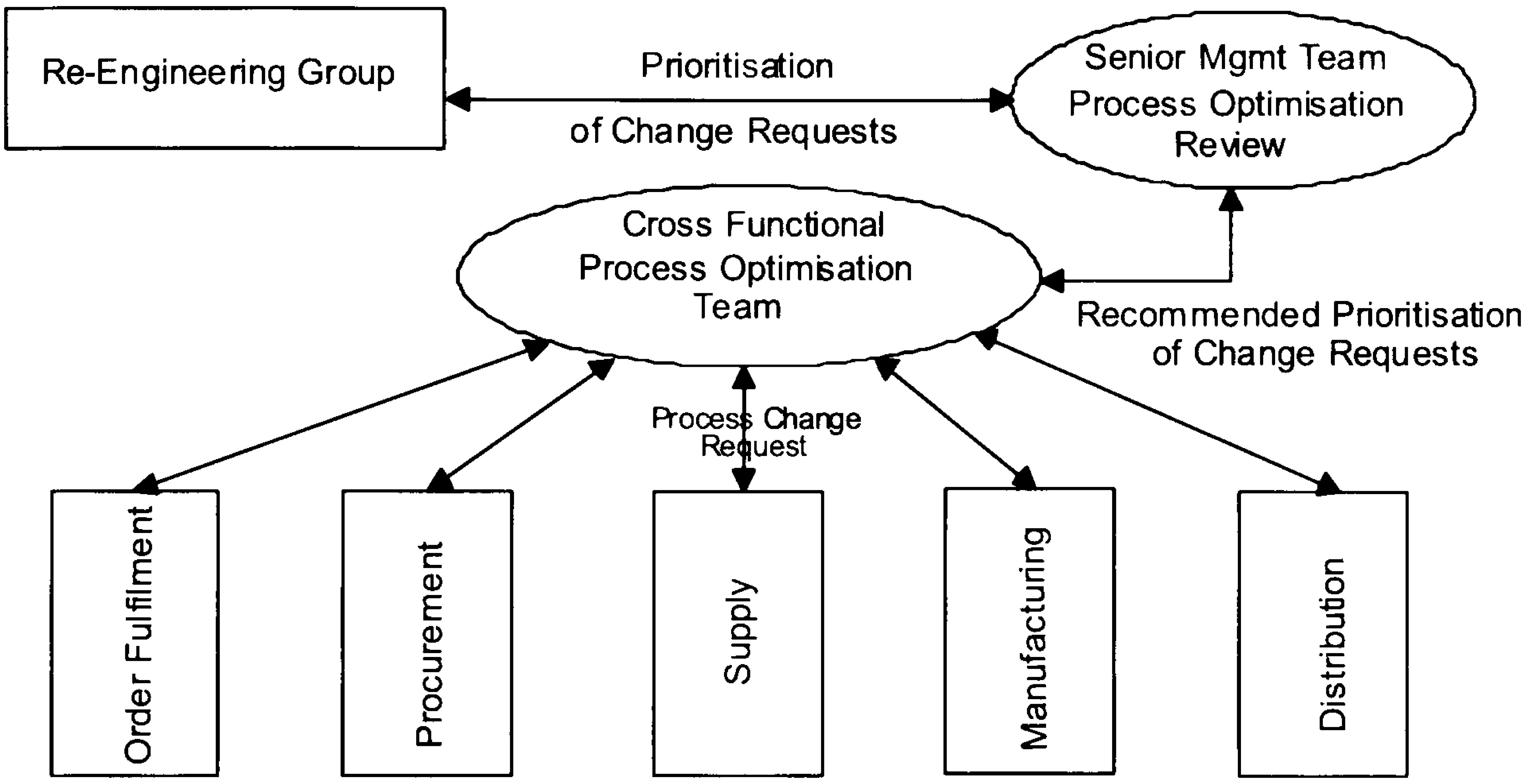

Figure 6.2 Managing Change Requests via the Optimisation Team. **Source: IBM ISC (2005).**

The optimisation team was formed and led by the researcher. In order to ensure proactive management of existing and new issues the researcher set out the following aims for the optimisation team.

1. *Develop an E2E process map of the current supply chain for order processing. The process should start with order receipt and conclude with order delivery to the end customer.*

2. *The team should act as a conduit for their respective business units and table all changes which impact the E2E process to the optimisation team.*

3. *The team should review each issue collectively in order to understand the impact any tabled changes would have on the E2E process.*

4. *Once tabled changes have been reviewed and their impact understood, the team should prioritise each change request based on the prioritisation matrix in Figure 6.3.*

5. *Prioritised changes will then be presented to senior management on a weekly basis where the senior management team will confirm/change prioritisation in line with operational and strategic drivers, and allocate to re-engineering and individual senior managers to champion and drive to conclusion. The weekly review would also be used to provide feedback and updates on change requests previously allocated.*

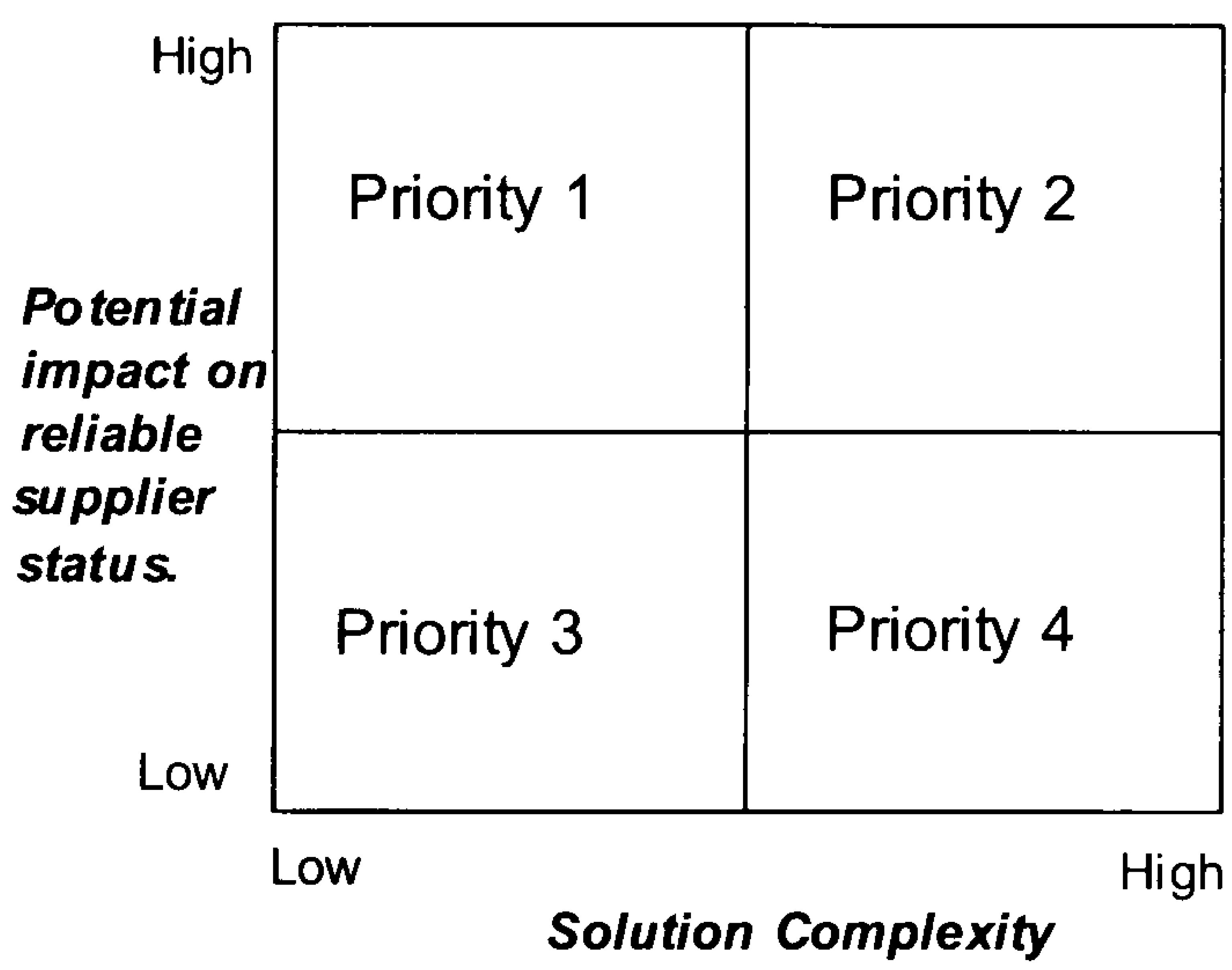

Figure 6.3 Prioritisation Matrix. **Source: IBM ISC (2004).**

The optimisation team would use the matrix in Figure 6.3 to provide an initial prioritisation of all new changes (The matrix was adapted from the Paton & McCalman (2000) Tropics test). Assessment would be based on their understanding of the overall impact of the CRs (potential impact on reliable supplier status), and an assessment of what would be needed to implement the change (solution complexity). Each potential change and decision prioritisation would have to reflect the operational and strategic realities; evaluations must take into account the context (Hailey & Balogun, 2002). It would be senior management's responsibility to agree the prioritisation and allocate the resource necessary to effect the change. In effect what the optimisation team would do is identify and prioritise the necessary end-to-end process changes based on organizational capability and business need, and not simply on IT capability, into the Re-Engineering department. This change in perspective is seen as a key step in the development of responsive information systems (Land, 1996).

6.3.2 Management System.

In order for the optimisation team's efforts to be effective they would need to integrated into the overall ISC management system, and have the support of the senior management team. As part of this process the researcher identified 3 key meetings which would need to happen to ensure that the optimisation team's efforts would be embedded into the management system. The matrix in Table 6.2 shows when reviews need to happen, who needs to attend and what the expected output should be from each review/meeting.

	Who attends	**When review / meeting to be held.**	**Output from review/meeting.**
Weekly Optimisation Team Review	Cross-functional subject matter expert (SME) representatives.	Every Tuesday (90 min session) AM	Collate and initial prioritisation of issues. Also look at outlining solution framework. Develop E2E process map.
Weekly Senior Mgmt Review	Senior Management Team and nominated problem resolution owners.	Tuesday PM.	Ensure prioritisation in line with strategic/operational requirements. Ensure additional resource and focus is applied where necessary.
Daily Functional Manager Focus Meeting.	Functional / Business Unit Manager plus Optimisation Team rep.	Daily as required.	Ensure input into Optimisation Team review is consistent with issues being faced.

Table 6.2 Optimisation Management System. Source: Developed for research.

As with the optimisation team the researcher provided clear guidelines to the participants of the senior management review and the functional managers focus meeting. This was to ensure focus was maintained on managing the key change requests. To that end the senior management team were issued with the following guidelines for their weekly review (which the researcher would run and minute).

Making it work – Senior Management Review.

- Weekly focus from senior management and issue owners must happen.
- Senior management and issue owners would form the core team. Additional people can / will be invited to sessions depending on issues being discussed.

- Identified issues once reviewed by senior management will be feed to Re-Engineering department. The intent being the output from the review will be the primary workload driver for Re-Engineering department.

- The weekly review will focus on the following:

    - Adjust / agree problem priority in line with operational capability / strategic intent.

    - Agree priority workload for Re-Engineering department.

    - Identify and resolve resource issues.

    - Drive problem escalation and focus where needs are.

The researcher made the final point that for this process to work full buy-in from the senior management team would be necessary.

The daily reviews / meetings at a functional / business unit level were also very important to the review process. It would be at this point new issues would be identified and passed to the optimisation team representative for tabling at the optimisation team meeting. If there was a disconnect at this point it could result in the optimisation team representative failing to capture important change requests, or feeding back progress updated on change requests which were being worked. Therefore, the researcher also provided the following guidance to function / business unit managers.

Making it work – Functional / Business Unit Owners.

- Need to meet with and work closely with their nominated optimisation team representative to ensure that issues and change requests are captured and properly represented at core meetings.

- Need to initiate and drive problem resolution in line with core team input and senior management expectation.

The responsibility for running these meetings rests with the respective functional manager.

6.3.3 Capturing the Issues and Change Requests.

As the optimisation team were now tasked with the job of identifying additional change requirements above and beyond the original 24 issues, a means of capturing and tracking the change requests and their status would need to be provided. Considering the amount of semantic and syntactic information that would need to be handled, the researcher decided to use a database to capture and store the information, thus effectively providing a codified knowledge management strategy in order to handle the information.

Although, the information contained within the database is important, any decisions made would not be made purely on the information contained in the database, but through the interaction of the individuals participating in the optimisation and senior management reviews. It would be within these environments where a shared understanding of context could be developed in line with a shared awareness of the end-to-end process. Here, individuals would develop a clearer understanding of what drives and influences the performance of the supply chain, and make decisions as to which changes best enable overall end-to-end performance improvement. The knowledge component that is most important, as a catalyst to change is tacit knowledge. Although explicit knowledge would have a database designed and built in order to capture it, the explicit knowledge would only be used to ensure uniform awareness of the issues being raised. The main component of the 'knowledge management system' would be the formation and management of the optimisation team and its controlled integration into the existing senior management operational management system. The database, in order to be effective in capturing change requests, would have to be accessible to all those directly involved. However, control would need to be maintained so requests could not be updated out of synch with the review cycle. This was an important control point as change requests tabled at the optimisation meetings would need to be prioritised, and their solutions scoped before senior management would be expected to review them. Therefore, any database or document repository would need to meet the following criteria. The criteria were set by the researcher in line with the operational demand to provide a solution for managing the change request data as soon as possible.

1. **Accessibility** - *Database / document repository would need to be easily accessible to all involved in the optimisation work.*
2. **Availability** - *Database / document repository would need to utilise existing ICT infrastructure as there would be no funds available to purchase additional applications and then deploy them.*
3. **Access control** - *Database / document repository would need to have tiered access levels to ensure people could view, deposit, edit, and manage access based on their role within the optimisation review cycle.*
4. **Level control** – *Information relating to each change request will change daily. Therefore, to avoid confusion all access should be via one master copy of change requests.*
5. **Ease of use** – *Data entry and navigation through the database / data repository would need to be intuitive as education would need to be kept to a minimum in order to bring the system on line as soon as possible.*
6. **Data manipulation** – *The data / information within the database / document repository would need to easily manipulate into views that best suit the management system. This would mean individuals should be able to develop personal views in order to best suit the way they would view and interpret the information held within.*

The researcher considered three options as highlighted in Table 6.3.

Criteria	**Spreadsheets** (Example: 1-2-3, Excel)	**Relational Databases.** (Example: DB2)	**Non-relational Database** (Example: Lotus Notes)
Accessibility	Everyone has access to spreadsheets.	Limited access to Relational databases (RDBs). RDBs mainly used for controlling data flow for production systems.	Everyone has access to Lotus Notes as primary work tool.

Availability.	Not a distributed application. Standalone.	Distributed application that can be downloaded by individuals via network.	Distributed application. Available on all deployed employee computers.
Access control.	Provides limited access control.	Provides read, write, and delete access at record level.	Provides read only. depositor, author, editor, and manager access at document and field level.
Level control.	Not a distributed application. Therefore, ensuring level consistency amongst a wide audience will be very difficult.	Distributed application, therefore, everyone with access permission can access one source of data.	Distributed application, therefore, everyone with access permission can access one source of data.
Ease of use.	Most employees have basic spreadsheet data manipulation skills.	Requires a basic understanding of Standard Query Language (SQL) that is not expected amongst senior mgmt, or professions engaged in anything other then data analysis of production data.	Uses a GUI that is comfortable to most if not all employees.
		Good for numerical data analysis.	Not good for numerical data analysis.
Data manipulation	Requires limited understanding of functions and macro language.	Requires sound working knowledge of SQL and RDBMS principles.	Data can be arranged to allow user to access 'point and click' information views.

Table 6.3 Application comparisons. **Source: Developed for research.**

From the comparisons outlined in Table 6.3 the application that best fits the criteria is Lotus Notes. This is an application that is already widely proclaimed as a 'knowledge management' application. In this case the expectation is not one where the researcher expects the Lotus Notes database to drive knowledge creation within the organization. However, the database is expected to facilitate information flow to the relevant parties who, based on the information presented, will make 'knowledgeable' decisions, which in turn will affect end-to-end order flow performance. As the database will be used as a tool to facilitate information, or explicit knowledge flow, it is not intended to spend any more time directly discussing it. Figure 6.4 and 6.5 below show how the information can be viewed within the database.

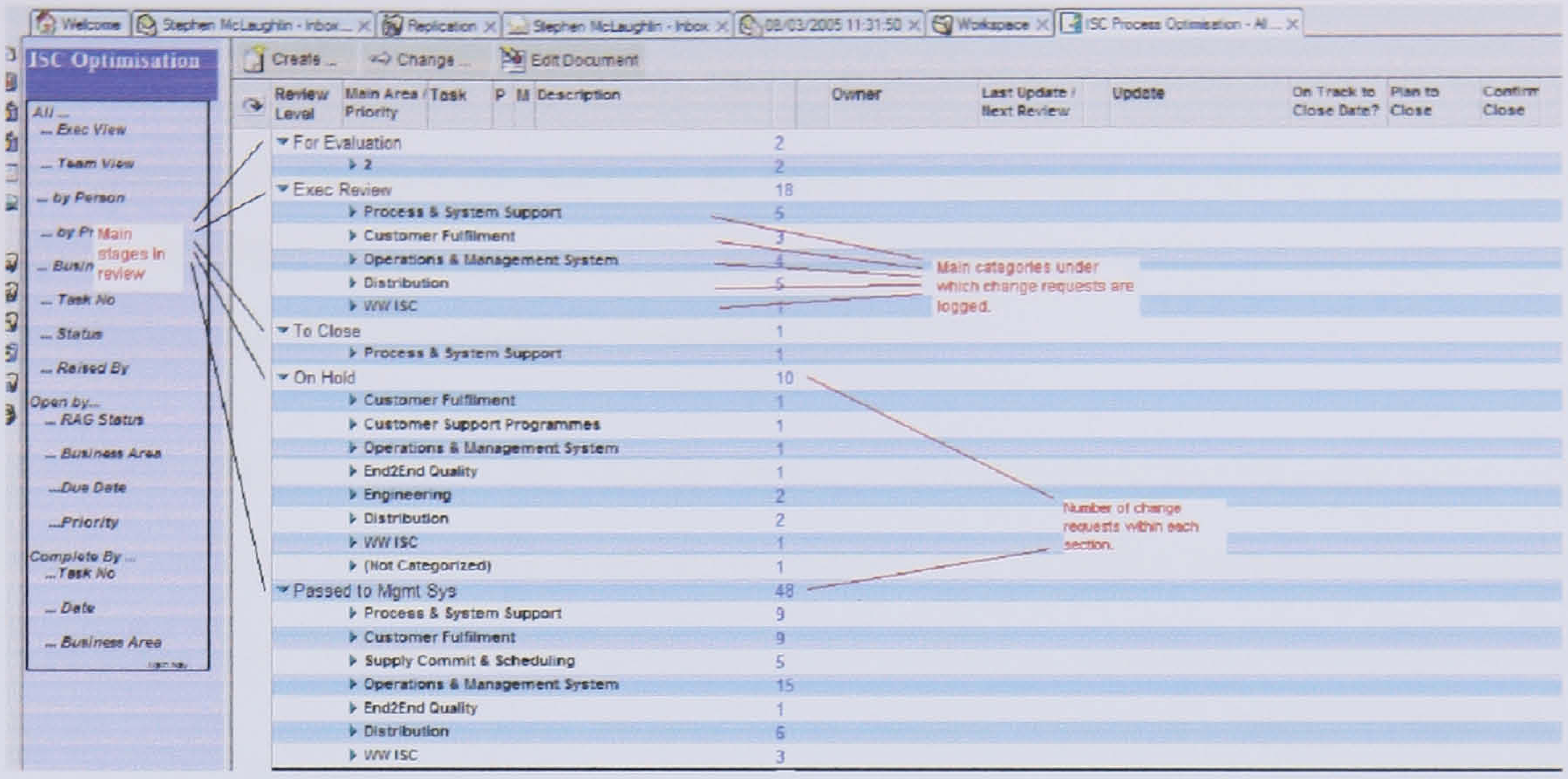

Figure 6.4 Optimisation Database. **Source: Developed for research**

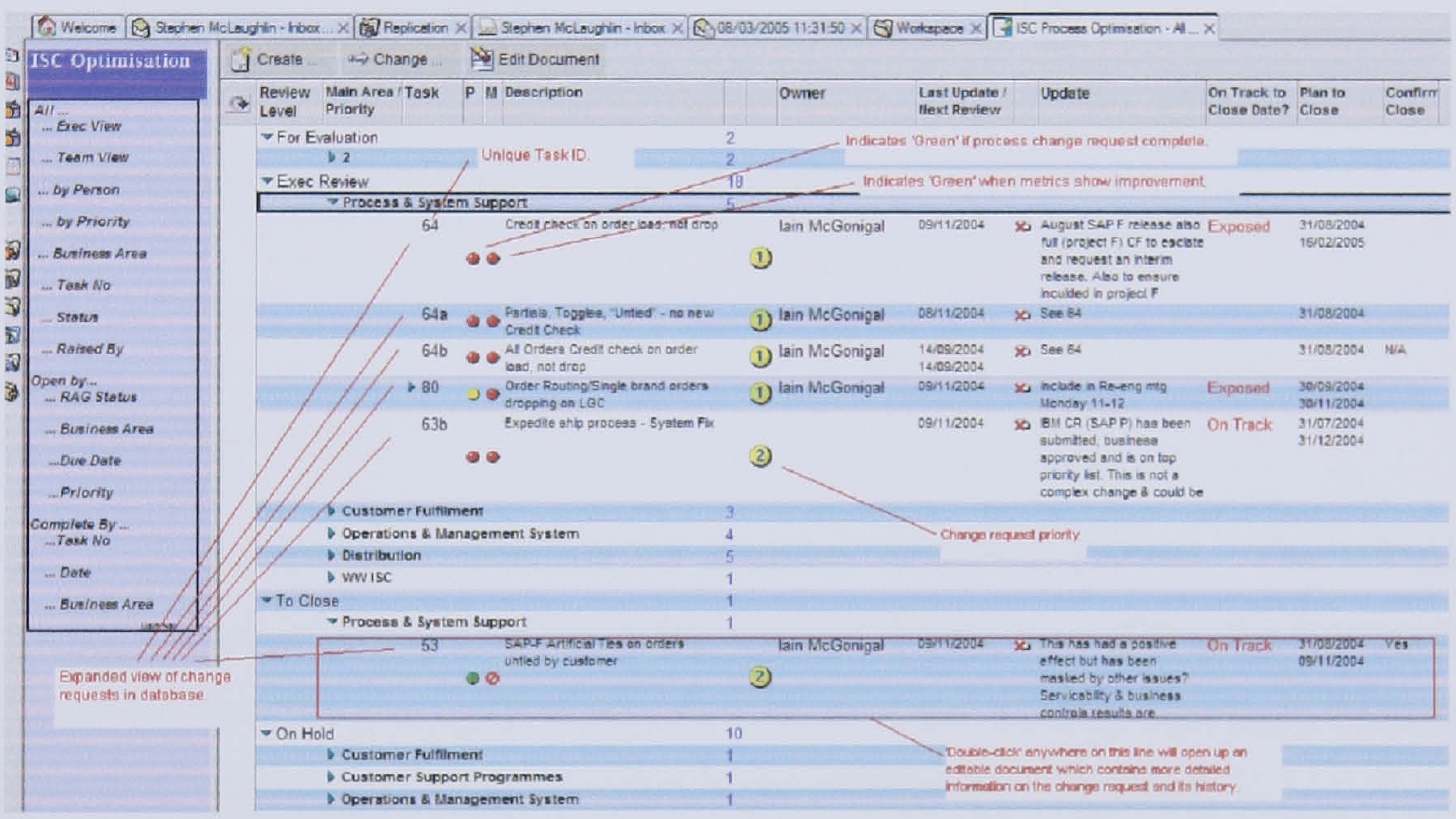

Figure 6.5 Optimisation Database expanded. **Source: Developed for research**

6.3.4 Mapping Method.

As discussed already most business units had process maps that pertained to specific systems and business processes. On investigation the researcher found that many of the process maps focused more on the systems used to manage data then the process required from a business perspective. Also, the methods used to define the processes varied significantly throughout the organization. As process mapping was very much an 'in house' exercise within the different business units there was no real common approach or method applied to ensure uniformity in developing process descriptors. In effect there was no single complete reference model which represented the organizations order flow process from end-to-end.

Therefore, if the impact of the change requests through the order process were to be understood a process map would need to be developed. In order to ensure the process was described in a uniform and commonly agreed format a mapping convention would need to be used. This is a view supported by Smart, Maull & Childe (1999) who identify the need for a commonly accepted and used reference model in order to 'manage, operate and support' enterprise wide business processes.

There are many different mapping conventions; however, the main two are the IDEF and CIMOSA conventions.

6.3.4.1 IDEF Convention.

This is the **I**ntegrated **DEF**inition for function modelling (IDEF). The US Air Force as part of its program developed this method during the 1970's for Integrated Computer Aided Manufacturing (ICAM). As a result of the ICAM programme different variations of the IDEF convention were developed (FIPS Pubs 183, 1993).

The IDEF and other methodologies were developed out of a need for integration of special purpose methods. The IDEF family of methods is intended to strike a balance between special purpose methods, which are limited to specific problem types, and 'super methods' which attempt to include everything. The balance is maintained by providing explicit mechanisms for integrating the results of individual methods within the IDEF family (Mayer *et al*, 1992).

The IDEF methodology comprises of IDEF0 (USAF, 1981a), IDEF1 (USAF, 1981b), IDEF2 (USAF, 1981c), and IDEF3 (Mayer *et al*, 1992). These are methodologies for functional, information, dynamic, and process modelling respectively. There are also two versions of IDEF1- IDEF1 (USAF, 1981b) and IDEF 1x (Bruce, 1992; Loomis, 1986). IDEF 1 is used for requirements specification, while

IDEF 1x is used for the design of relational databases. IDEF0 as the basis for the other IDEF methods provides the following characteristics (FIPS Pub 183, 1995).

1. *It is comprehensive and expressive, capable of graphically representing a wide range of business, manufacturing and other types of enterprise operations.*
2. *It is a coherent and simple language, providing a rigorous and precise expression, and promoting consistency of usage and interpretation.*
3. *It enhances communication between systems analysts, developers, and users through ease of learning and its emphasis on hierarchical exposition of detail.*
4. *It is well tested and proven.*
5. *It can be generated by a variety of computer graphics tools that are numerous and commercially available.*

6.3.4.2 CIMOSA Convention.

CIMOSA stands for **C**omputer **I**ntegrated **M**anufacturing **O**pen **S**ystem **A**rchitecture, and like the IDEF method was developed for computer integrated manufacturing applications as a series of ESPRIT projects (EP 688, 5288, and 7110) with the support of the European Commission. The aim of CIMOSA is to provide the manufacturing industry with the following (Berio & Vernadat, 2001).

1. *An enterprise-modelling framework (EMF) that can accurately represent business operations, support their analysis and design, and lead to executable enterprise models.*
2. *An integrated infrastructure (IIS) used to support applications and business integration.*
3. *A methodology to be used along the System Life Cycle (SLC) to assist users in deploying their CIM programmes.*

According to CIMOSA reference architecture (AMICE, 1993) manufacturing enterprise systems can be viewed from at least four complementary viewpoints: function, information, resource, and organization.

6.3.4.3 CIMOSA or IDEF.

Both CIMOSA and IDEF are process-mapping conventions that can be used to identify and develop an organization's understanding of end-to-end processes. For the purpose of mapping the order-flow process either approach would suffice. However, CIMOSA's richer mapping capabilities (Berio & Vernadat, 2001; Wilson, Aguiar & Edwards, 1999) would allow for a deeper understanding of the organization's view of the process in terms of responsibilities and authorities to be allocated to organization entities being in charge of particular jobs, or responsible for some other aspects of the process. Where IDEF0 will look at the functional process flow for the business unit in question, the CIMOSA expands on this by also looking at information, resource, and organizational views (Cheng-Leong, Pheng, & Leng, 1999). In essence the CIMOSA approach equates more to a combination of all the IDEF methods then simply to just IDEF0. However, in practice models from each viewpoint tend to be built independently of one another using different methodologies and in different environments (Cheng-Leong *et al*, 1999). Methodologies may also be incompatible with each other and the following problems may materialise. (Cheng-Leong *et al*, 1999)

1. *Modelling process involves repeated capturing of the same information and is time consuming* (Wang *et al*, 1993)
2. *It is very difficult to identify the effects of changes to one model on the others* (Kim, 1996).
3. *Incompatibility between the different but interrelated models* (Wang *et al*, 1993).
4. *Model maintenance is difficult because of (2) above.*
5. *Seamless transition in the systems development life cycle is difficult because of (3) above.* (Kim, 1996).

6. *It is difficult for systems users and systems developers to communicate and work together* (Kim, 1996).

7. *Similarly, it is difficult for several systems developers who have different purposes and backgrounds and who are working on the same systems to communicate and work together* (Kim, 1996).

According to CIMOSA recommendations (Cheng-Leong *et al*, 1999), a comprehensive modelling methodology termed IDEF* and its supporting software tool have been developed to overcome these problems. The methodology is termed IDEF* because it is an enhancement of the IDEF methodology. IDEF0 is also chosen as the basis of IDEF*. In producing a complete system description model, an IDEF0 model first builds a process or functional map, and then other details are added progressively to the IDEF0 model so that:

1. *Functional description of the system can be achieved at any level of abstraction.*

2. *Complete systems descriptions can be realised sequentially.*

3. *Model compatibility can be maintained by using the same functions among different models.*

Throughout the process, the IDEF0 model is used as the basis for the collection of relevant details. Three main reasons for choosing the IDEF0 model as the basis of the IDEF* methodology is:

1. *IDEF0 is one of the few functional modelling methodologies that is popular with the industrial community* (Feldmann, 1998).

2. *IDEF0 is superior to many other functional modelling methodologies in terms of simple graphics, conciseness, rigor, and precision, consistent methodologies, levels of abstraction, and separation of organization from function* (Hunt, 1996; Mandel, 1990).

3. *It is the de facto international standard, and a US Federal Information Processing Standard* (FIPS 1993) *for functional modelling.*

So, considering the issues surrounding the use of multiple methodologies in order to develop a functional, informational resource, and organizational process map, IDEF* is the methodology to be used.

To employ a CIMOSA methodology (pre-IDEF*), or a combination of IDEF0, 1, 2, and 3 would not be practical. The complexity in understanding the different methods and their interactions would prohibit a quick deployment of any mapping exercise. Real issues are being highlighted in real time and the organization has a need to understand the impact of these issues as they are presented. The CIMOSA or combined IDEF0-3 approach will take time to understand and implement.

The IDEF* process is also complex. However, as it is based on the IDEF0 mapping methodology and relies on gaining understanding through building on the foundation mapping exercise, this approach becomes attractive. The IDEF0 method is simple, clear and easy to understand and follow. Considering the time pressure to understand the end-to-end implications of change requests this method can be used and deployed without the researcher or optimisation team requiring any in depth training or software applications.

The researcher and optimisation team have used IDEF0 as the basis for process mapping, as this is also the foundation mapping technique for IDEF*. As it is the intention of the management team to keep the optimisation team meeting on a regular basis, the IDEF0 process mapping exercise can and will be used not only to allow a clearer understanding of the end-to-end process, but also as the first stage in a future IDEF* mapping process.

However, the IDEF* mapping process is not within the scope of this research project, as in order to answer the research question it is only necessary to have an end-to-end order flow process awareness.

The IDEF0 process maps produced during the mapping exercise are quite extensive and provide a great deal of sensitive information concerning alignment and operational performance. However, to provide some idea as to the scope of the order flow process a top level process (non-IDEF format) map has been included in Appendix A.

6.4 Identifying issues that Effect Process Performance.

The optimisation management system was established as the only forum for change requests relating to the ISC order flow process. The optimisation team and management systems have been in effect since August 2004, but due to the time required to map the end-to-end process the optimisation team have only been assessing change requests with respect to their impact on the process since the end of September 2004. Issues logged prior to this date were reassessed and prioritised in line with their predicted impact.

In order to understand the impact and type of change request being implemented change requests will be assessed to determine the type of knowledge transfer they infer (socialisation, internalisation, combination, externalisation), and what type of strategy the changes support (codified or personalised). The assessment in both cases would be made by the optimisation team based on their understanding of the impact of each request, and methods employed in implementing them. Change requests (CRs) will also be assessed to see the scope of their impact across the different milestones. As the optimisation team is taking a systemic approach to identifying and managing the change requests affecting the end-to-end order flow process, it is expected that some of the CRs identified will have an impact across the different process stages, or milestones.

Table 6.4 provides a more detailed assessment as to how each change request will be categorised by the optimisation team.

Assess Change Requests for…	Criteria	Assessment Method
Process Area Impact	Assess each change request against the number of milestones they will impact.	What are the impact points on the E2E order flow process, and how do these relate to the different milestones?
Knowledge Strategy	Assess each Change Request (CR) as to whether it supports a codified or personalised strategy. The assessment was based on the criteria laid out by Tiwana (2000).	CRs were assessed against the following… 1. How much old material, such as past project data, existing documents, and archived projects do you reuse as a part of new projects? 2. How best can you describe the role that IT plays in your company's work processes? 3. How is knowledge exchanged and transferred? 4. What are your typical team structure demographics?
Knowledge Transfer	Assess each CR to see what type of knowledge transfer is expected. Each request is assessed as being: • Socialisation T -> T • Externalisation T->E • Combination E->E • Internalisation E-> T (E – Explicit Knowledge, T – Tacit Knowledge)	Each CR is reviewed to determine the direction of 'new' knowledge flow. This is not about how information is created or flows, but to look at how 'value add' is created. T->T: Where the CR facilitates new knowledge being created between individuals. T->E: Where individuals are provided with a means of capturing their experiences, thoughts, ideas onto electronic / documented (codified) systems. E->E: Where CRs focus on improving data flows and systems access within the order flow process. E->T: Where CRs facilitates improved decision making based on improvements to syntactic and Symantec information flows.

Table 6.4 Change Request Assessment. **Source: Developed for research.**

6.5 E2E Performance Improvement.

The researcher examined performance improvement throughout the end-to-end order flow process for the fourth quarter of 2004. All improvements identified as having an impact on the end-to-end order flow process were captured and assessed by the optimisation team, and their implementation tracked and managed through the management system. Issues raised as change requests (CRs) were assessed by the optimisation team to understand not just the localised impact of the change, but also to understand the up and down stream impact such changes would have through the supply chain. Through the fourth quarter overall end-to-end performance was seen to improve significantly. Across all routes to market the overall performance improvement increased by 20% to 22%. In effect this means a 20-22% increase in the number of customer orders processed, manufactured, and delivered to the customer within the agreed time frame. Table 6.5 shows a more detailed breakdown of the improvements by milestone.

Milestone	% Performance Improvement.
Order Receipt to Order Entry (OR-OE)	50%
Order Entry to Order Drop (OE-OD)	30.3%
Order Drop to Order Ship (OD-OS)	41.6%
Order Ship to Order Delivery (OS-ODel)	19.7%

Table 6.5 Performance Improvement across key SC milestones. Source: IBM ISC.

The percentage improvements in Table 6.5 relate to the number of customer orders processed through each milestone within the pre-defined time frame allocated for each part of the process. It can be noted that the 'average' improvement for the milestones would appear to be better than 20-22%. However, in the drive to optimise every part of the process further delays may be introduced between key milestone stages. This is a known phenomenon that can be caused by mismatches in business unit goals in a functionally aligned organization (Lee *et al*, 1997). An example of this might be the distribution department holding back on order delivery until they have enough orders to fill a transporter. This in turn might negate any time saved in one or more of the other up-stream processes.

The failure to capitalise on the improvements as outlined in Table 6.5 indicates that although significant improvement in process performance has been made, there is scope for further process optimisation. Optimisation, the researcher believes, cannot be fully realised until the organization moves further along the road from functional to process alignment. A more detailed breakdown of the change requests and how they impacted the core order flow process is provided in Chapter 7.

6.6 Chapter Conclusions.

What is outlined in this chapter is effectively a case study report concerning the optimisation of a core IBM supply chain process - a process, it has to be said, that is unique to IBM. So what value does this research present to the wider academic audience? From a 'case study' validity perspective the information has allowed the researcher a clearer insight into how IBM, as a complex organization, struggles with the management of its more complex processes. From this 'inductive' research approach observations have been drawn that the researcher feels can be of value to other complex organizations struggling with end-to-end performance issues. In short, the IBM case illustrates how one might enhance decision-making by focusing on the 'whole' process and optimising outputs based on a holistic view rather than that of the 'functional silo'.

Because there was a clearer understanding of the end-to-end processes the optimisation team were able to better understand the up and down stream impact each change would have on the process, thus allowing the senior management team to better allocate finite resources to those CRs which would provide the best benefit. However, through this process the researcher has made a number of key observations:

Observation 1: Process Alignment – *Through the formation of the optimisation team an in-depth E2E understanding of the core process was developed. This allowed the optimisation team to identify and understand where change was needed and its potential impact. In effect the optimisation team was setup as a 'process aligned' team. The process improvements then identified by the optimisation team provide some indication to the overall benefits that a process-aligned organization* *will have over a functionally aligned organization from an E2E process optimisation perspective.*

Observation 2: People - *Within a complex environment, made up of autonomous business units that need to work together in order to achieve a common business goal, senior management must understand the cross-functional impact of any process change requests. This is not an easy task as the volume of change requests can be significant. Therefore, a cross-functional team and supporting management system needs to be established to screen, assess, and present an impact analysis statement to senior management. This is expected to be even more significant for supply chains that extend beyond one organization's boundaries.*

Observation 3: Prioritisation of Change - *Without a clear E2E understanding as to how the key inter-connected processes work, process change management will be reactive and localised. Therefore, the business management of these changes will be localised and fragmented. This may lead to changes being prioritised not on their overall impact to the business but on ease of change to IT systems. This 'tail wagging the dog' syndrome may see important 'value-add' changes being pushed down the priority ladder in favour of easy fix solutions which may in turn have little impact of performance improvement.*

Observation 4: IT and Knowledge Systems - *Codified systems should not be relied upon as the main mechanism for managing knowledge creation and distribution during times of organizational change. As the organization changes, the lead-time in IT systems deployment makes it difficult for IT systems to keep in step with the changing ways in which information is created and distributed. Personalised pro-active systems should be used as they support the tacit knowledge creation process (Stacey, 2005) that in turn is a key element in driving innovation and change through the organization.*

While this case is unique to IBM and its organizational processes the wider relevance for other businesses with this degree of functional complexity is believed to be high. It cannot be unique that timely response in changing IT systems to match different market situations is made more difficult by a functional rather than a supply chain process viewpoint. The intervention and management processes successfully developed and used in this case are recommended for other similar applications and in particular the need for personal as well as organizational learning systems is highlighted.

The researcher also identified similarities between role of the optimisation team and a successfully performing community of practice. Although the optimisation team was set-up from a top-down perspective, the team's participants were motivated to share and create process improvements; an aspect of top-down communities of practice that usually takes time to develop (Fontaine, 2004). This was largely due to the fact that poor performance had resulted in manually intensive interventions. The team were, therefore, motivated to improve the process in order to improve their working conditions.

Where this chapter has dealt with the practical aspects of identifying and managing process improvement, the next chapter will look at how knowledge barriers are identified and exist along the same core process. The next chapter will also look at matching CRs to barrier type in order try and determine the dominant change types, from a knowledge perspective, that were implemented along the process, in order to produce performance improvement. As all process change requests were identified and handled by the optimisation team a direct correlation between the implementation of CRs and process improvement can be assumed. Therefore, this provides a unique opportunity, as no research has yet been conducted in such a way, to analyse a core process from a knowledge barrier impact and process improvement perspective.

7. Barrier impact across the ISC.

"The ability to perceive or think differently is more important than the knowledge gained."

Bohm (1917-1992)

7.1 Introduction

In order to try and determine as clear a picture as possible of the barriers affecting each key part of the order flow process, the researcher would draw on different sources of evidence. In line with Yin (2003) the researcher drew on evidence in the form of existing internal performance documentation, direct observations, interviews, and participant observations. Information drawn from these sources was used to build a picture showing how the different barriers are perceived to impact the organization as aligned along the order flow process. The changes made to the process in order to optimize performance were also analysed to see how they impacted the different barriers.

7.2 Ensuring Principles of Data Collection are adhered to.

In order to ensure the principles of data collection are adhered to, the three principles as outlined by Yin (2003) have been used. Although, the data being collected and analysed at this stage is relevant to IBM's Integrated Supply Chain (ISC), the findings will be assessed against other companies. Therefore, the integrity of the data needs to be assured, and recorded in line with Yin (2003) even at this stage. The three principles that are being followed are:

1. **Multiple sources of evidence** - *The more sources of evidence used the better substantiated the findings. For the purpose of this part of the research questionnaires, interviews, on-line documentation, performance metrics, and direct observations would be used.*

2. **Creation of a case study database** – *As the data acquired can come from multiple sources it is important that it is kept should further validation of findings be required. For the purpose of the research a case study database has been created by the researcher that contains all documentation, questionnaire data, performance data, etc., which has been accessed and used during this research. As the content of this data is commercially sensitive access is controlled via the researcher.*

3. **Maintaining a chain of evidence** – *To increase the reliability of information in a case study a chain of evidence must be maintained. The principal is to allow the reader of the case study to follow the evidence presented and therefore draw the same conclusion as the researcher. However, the key point here for the researcher is that no evidence should be excluded through carelessness or bias. All the facts should be presented. As Yin (2001) identifies if this happens then the case study will have addressed the methodological problem of determining construct validity, and thereby increasing the overall validity of the case. Therefore, for the purpose of this research the intent of the researcher is to include all evidence acquired whether it appears to support or not any findings.*

For the purpose of this research only change requests assessed and prioritised against the end-to-end order process, and implemented between 31/09/04 and 31/12/04 would be included in the data collection. This is because only these changes will have impacted performance, and therefore, can be seen to have had some effect on the barriers impacting the organization.

7.3 Understanding the Complexity within the Order Flow Process.

The primary metric for assessing IBM's supply chain performance, and more specifically order flow performance, is the end-to-end cycle time performance metric. This looks at the time taken from initial receipt of a valid order to the delivery of the complete order to the customer. IBM does not sell its PCs directly to the public but through contracted resellers and large enterprise clients, and as such before a computer is shipped as part of the contracted deal, certain criteria must be met. In this case the criteria are that the customer must have a suitable credit level with IBM, the customer must be placing orders for agreed product type and configuration, and the customer must submit the order from a contractually agreed source and format. If the customer does this then the order is considered valid. If not, then the order desk will hold the order until such time as any issues with the order can be corrected or clarified. Only when the order is valid will the system start recording the time taken to process the order through to delivery.

An added complexity to the order flow process is that IBM uses the same process to manage products to four different distribution channels, or 'routes to market' as they are referred to. Although the products shipped through these channels are from the same family, the volume and complexity of the products vary significantly. Table 7.1 outlines the differences between the channels.

Route to Market	Overview	Product Configuration Complexity	Volume Shipments	Distribution Model
Large Enterprise Direct	Direct shipment of highly customisable product to select end user customers throughout EMEA.	**Low to high software / hardware configuration.**	Low to Medium	**Simple to High Complexity**
Channel	Shipment of all products from product family to PC resellers throughout EMEA. Reseller will configure product for end user customer.	**Low software / hardware configuration**	High	**Simple / Medium Complexity**
Partner Choice	A select group of resellers with special credit arrangements. Also have higher priority on product supply and order management. Product range is not as extensive as for the Channel route to market.	**Low software / hardware configuration**	Medium	**Simple / Medium Complexity**
Top Seller	Shipment of selected product at discounted price for high volume orders to PC resellers throughout EMEA.	**Low software / hardware configuration**	Medium to High	**Simple / Medium Complexity**

Table 7.1 Routes to Market. **Source: Developed for research.**

These routes place different strains on the order flow process. As their respective orders pass through, complex configurations may take slightly longer through the supply/demand planning process and manufacturing process, whereas high volume orders can impact the priority of orders through the manufacturing process when mixed with low volume orders. The different routes to market need to be managed across the supply chain's order flow process in order to ensure orders are not re-prioritised due to order size or order complexity. The ISC organization does this by tracking order receipt (OR) to order delivery (ODel) cycle times for each route to market.

The order complexity, and focus on performance within the key milestone areas, has developed an approach to the order flow process that needs to be managed from an end-to-end perspective. Through the interview process and through general observation the main focus within each milestone varies (as shown in Figure 7.1).

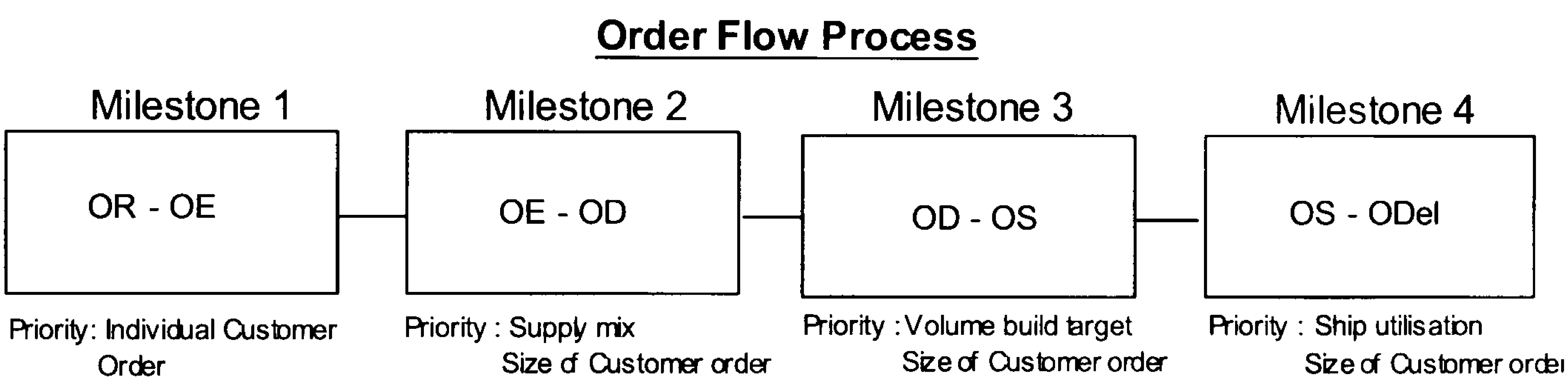

Figure 7.1 Focus through the Order Flow Process. **Source: Developed for research.**

From Figure 7.1 the focus through milestone 1 is on the individual customer order. However, as the order progresses through the process the focus shifts off the individual and becomes more associated with volume attainment and ship utilisation. In order to try and counteract any serious customer dissatisfaction due to orders being delayed, the groups involved with the order flow process need to be aware of what is happening to individual orders throughout the process. This requires effective communication links and information systems. A breakdown description of each stage or milestone in the order flow process is provided in Table 5.14.

Through 2004 the ISC cycle time performance was well below target. The previous year IBM had outsourced manufacturing to Sanmina SCI, whilst at the same time embarking on a world wide deployment of SAP as its backbone fulfilment and manufacturing systems; significant changes from both an organizational and technological perspective. As the organization passed year-end and started into 2004, average performance for all routes to market declined to 63%.

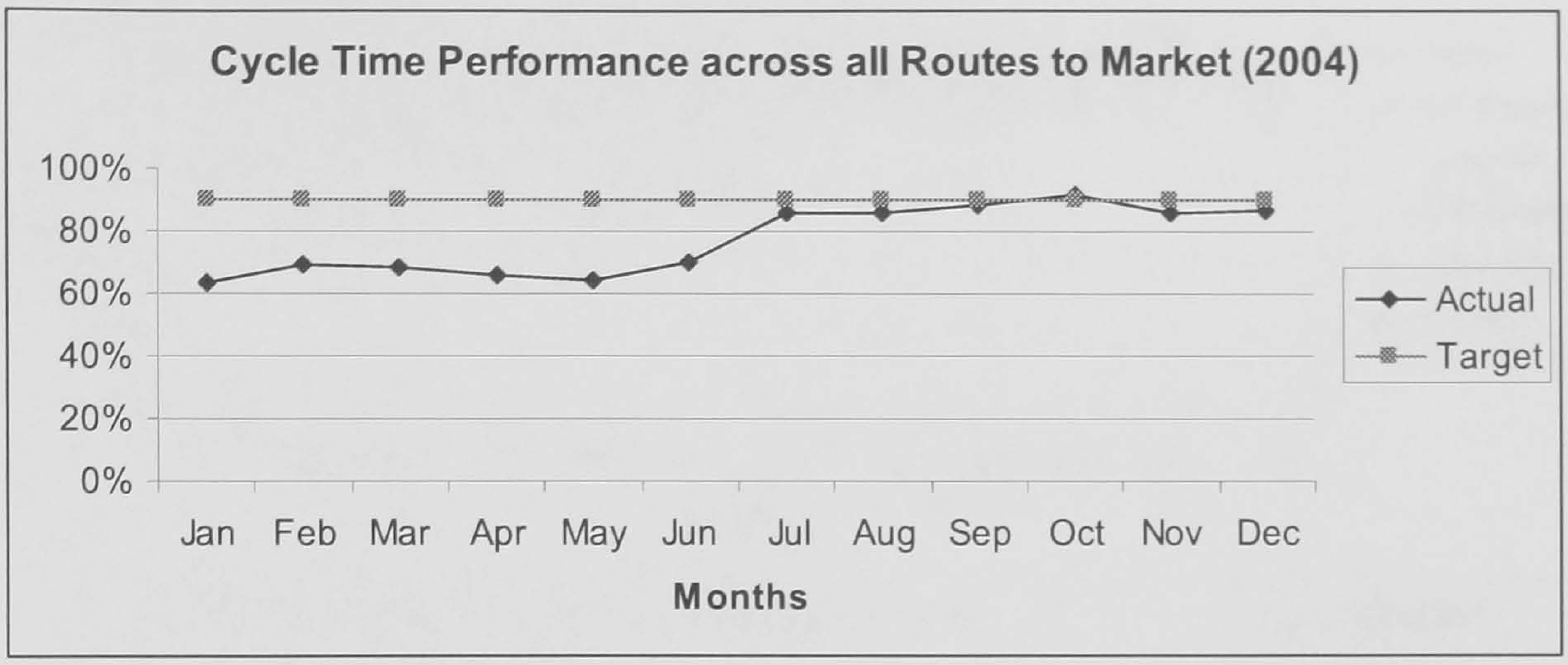

Figure 7.2 Overall Cycle Time Performance. **Source: IBM ISC.**

The reason for the decline in performance was not attributable to any one thing. In fact the organization's complexity and lack of end-to-end order flow process knowledge made it difficult to identify the causal problems from the symptoms.

However, certain routes to market performance were significantly lower then other routes. Although worldwide supply constraints were impacting across the industry, in particular for monitors and microprocessors, this could not explain in some cases a 25 - 30% difference between the performances of the different routes to market. As the same organization managed all routes to market, something other than just supply constraints was impacting performance.

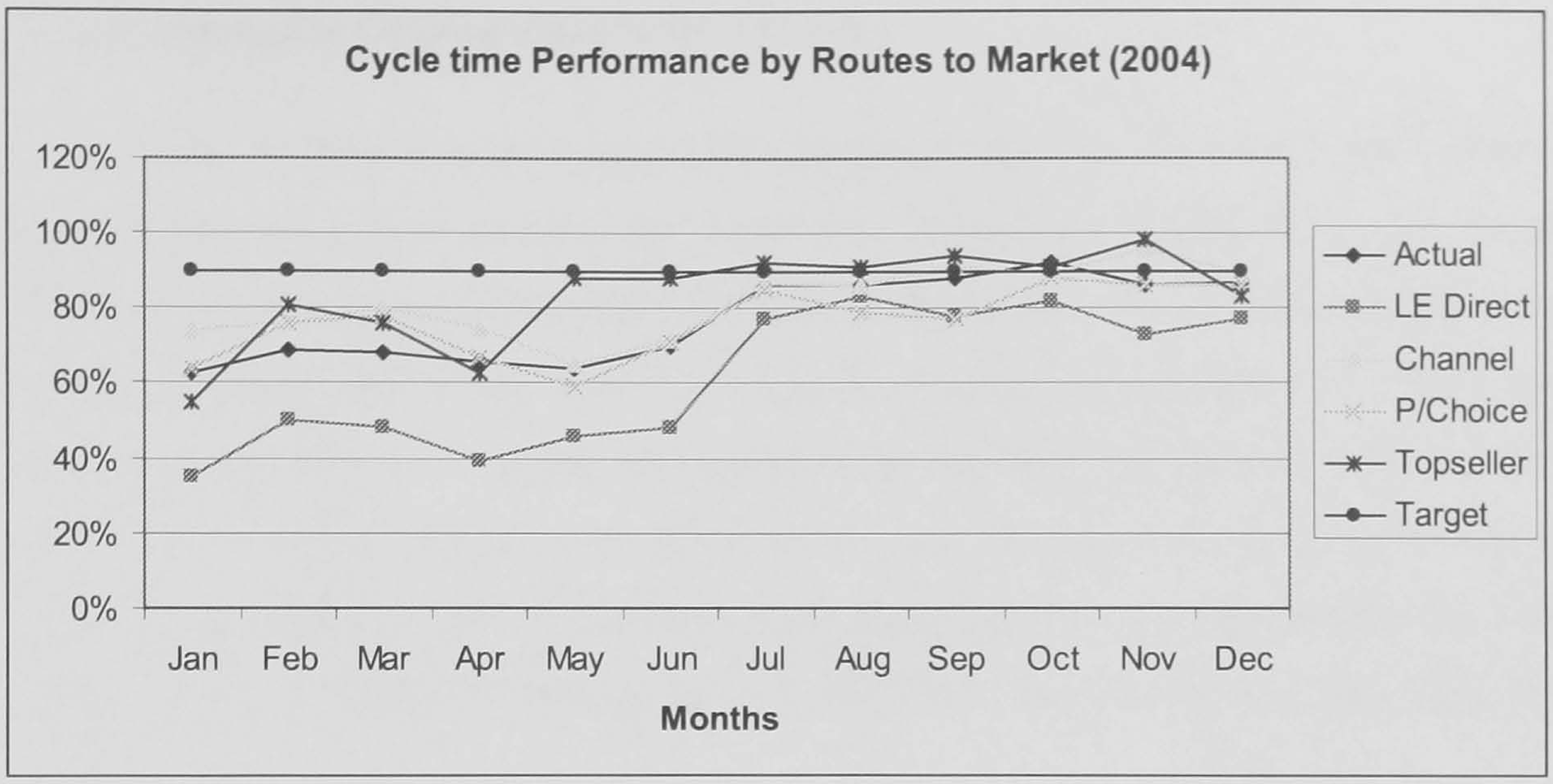

Figure 7.3 Cycle Time Performance by Route to Market. **Source: IBM ISC.**

Figure 7.3 shows the different routes to market and how they performed through 2004. From the graph 'Large Enterprise (LE) Direct' order performance sees the most significant drop off in performance through the first quarter 2004. LE Direct orders on further inspection are usually more complex as IBM does the customisation and personalisation of the product. In terms of order volume size LE Direct orders also tend to be smaller. Although the researcher has no reason to believe LE Direct orders have been deliberately re-prioritised based on order size, the complexity of the order process and the scope of the product range being handling means the organization must have a management system that can help pro-actively manage the performance.

From a systems perspective the organization is using the latest groupware software to aid communications (Lotus Notes / Sametime), the latest order processing and scheduling applications (SAP / i2 - Demand Planning), and robust data warehousing applications (DB2 / Websphere B2B). Certainly significant investment has been made into ensuring the ICT systems within the organization are scaleable, compatible, and reliable. So why is the organization finding it difficult to understand how the performance has been impacted so significantly, and more importantly, what should be done to resolve the problems?

7.4 Matching the Organization to the Process.

In order to determine how the barriers to knowledge transfer impact performance through the order flow process the researcher needed to identify the parts of the organization directly involved with order flow management. The intent being that these groups of individuals would then be surveyed regarding their respective experiences relating to the barriers. Using the available hierarchical organization charts would provide a list of the different departments within each business unit that in turn make up the ISC organization. However, hierarchical structures do not easily identify the links between those departments that manage the order flow process directly, and those that do not.

If the researcher is to understand which barriers are impacting the process then a clear indication of what is involved with operating the process must be achieved. A hierarchical organization map will not do this, as its structure is top down and functional. As the process flow dictates which departments and business units are relevant an approach must be taken which links the departments and business units together based on process linkages as opposed to functional order. An effective method of making the connections between departments / business units with respect to process control is social network analysis.

7.4.1 Social Network Analysis (SNA).

As already stated a very useful aspect of social network analysis (SNA) is its ability to provide a visual representation of a network. In the case of this research the network of interest is the one that supports the order flow process. In this part of the research, social network analysis is used to help identify the key groups along the 'order flow' process. However, before launching into sociogram / network diagrams some consideration needs to be given to the means of data collection. This is necessary in order to build an accurate network representative of the key groups involved with the order flow process. Scott (2005) identifies two principal types of data referred to as 'attribute' and 'relational'. The former relates to the attitudes and opinions of the individual as they relate to the network being investigated. The main source of data collection is through questionnaires and interviews. The latter data type focuses on the contacts, ties, and connections which relate one group to another, and which cannot be reduced to the properties of the individual agents themselves.

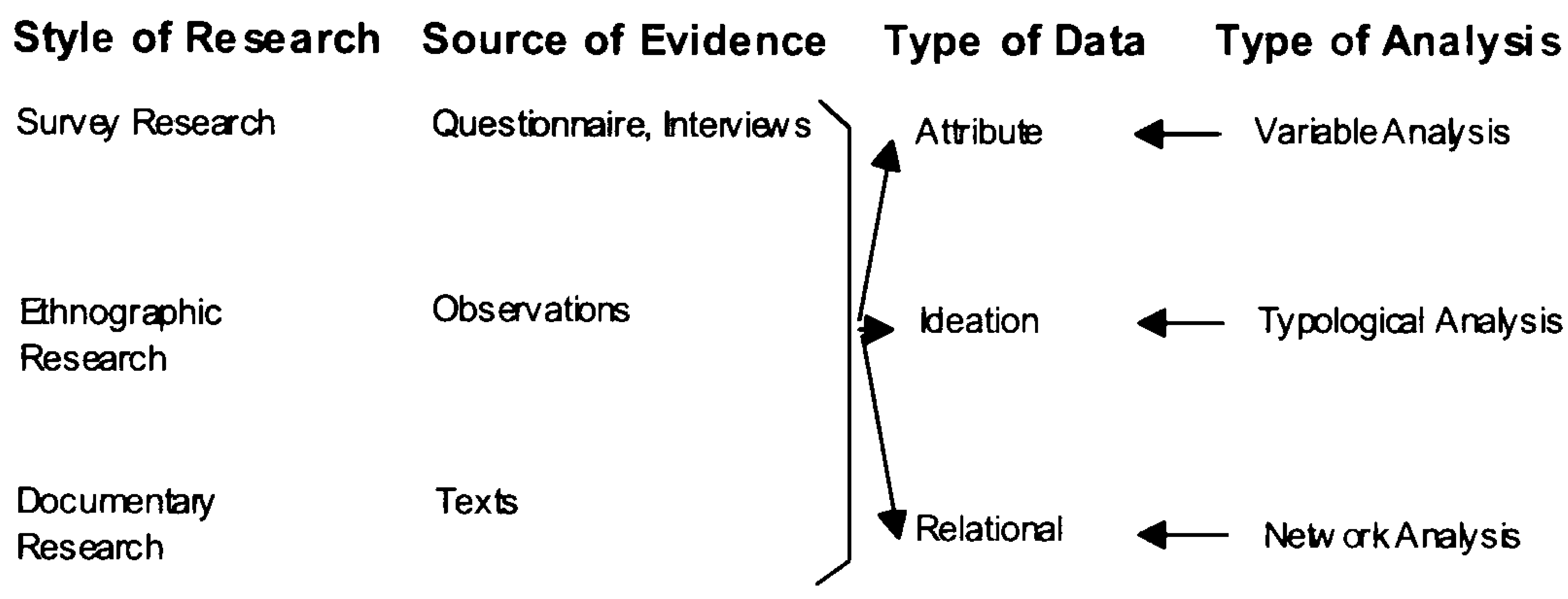

Figure 7.4 Types of Data Analysis. **Source: Scott (2005).**

Scott (2005) also identifies a third type of data called 'ideational'. This type is used to describe the meanings, motives, definitions and typifications themselves. However, techniques for the analysis of this data type are less well developed.

So, consideration must be give to the type of data needed in defining the order flow organizational network. 'attribute' data is not relevant. The mapping process needs to identify business unit ownership and control of the order flow process components. The attitudes and motives of the individuals at this stage are not relevant. Also, if variable analysis was to be conducted, the size of the organization to be surveyed would be approximately between 300 to 400 people. There is an interesting limit referred to as the '150 Rule' or 'Dunbar's Number' (Dunbar, 1993) which talks about a limiting factor of 150 members who can be included in the analysis. This limit stems from evolutionary psychology that states that this number may be a limit of average human ability to recognise members and track emotional facts about all members in a group. Apart from this limitation, in order to get a clear and accurate picture of the network the survey response would need to be almost 100%. This would be very difficult to achieve within a changing and high workload intensive organization.

Relational data and network analysis looks more closely at the links between members or groups with the organization. This is what is needed in order to provide an organizational overlay of the process, and, therefore, network analysis using relational data will be used.

In order to build the network diagram, data will be collected primarily by observation and documentation review. By reviewing existing IBM ISC organizational charts and on-line department operating manuals, the optimisation team used IDEF0 process mapping to identify and link specific business units, under each functional unit (Fulfilment, Supply/Demand, Manufacturing, Distribution etc), that directly interact with the order flow process. Internal documentation relating to the business mission and function of each department within IBM was also referenced via the on-line Quality Management System (QMX) to ensure each department identified was correctly represented in the mapping process. For the few departments where further clarification was needed the researcher was able to directly contact the department manager. The Table 7.2 outlines the main sources of data in building the network map.

Data Sources	**Data Extracted**	
IDEF0 Process Map	Provides an end-to-end description of the order flow process.	***What's involved?***
Organizational Hierarchy Charts	Provides a functional representation of which departments belong to the ISC Business Functions.	***Who's involved?***
QMX Database (Quality Management Database)	Provides details outlining each departments role, responsibilities, and mission	***How are they involved?***
Observation / Optimisation Team review	Is data providing a true reflection of what's actually happening? Is data from the above still current?	***Is what we're being told matching up to what's actually happening?***

Table 7.2 Data collection for mapping exercise. **Source: Developed for research.**

This approach to collecting data was also supported by Rice & Aydin (1991) as a suitable means of gathering information on network connectivity. It is important to note that the researcher does not intend to use SNA to determine the strength of relationships between the different business units, or the information directional flows. To do so would require taking the analysis and mapping process done to an individual employee level that is outside the scope of this research. Instead, SNA mapping tools would only be used to identify which business units played an active part in the order flow process.

In order to help determine the relationships between the different business units the UCINET social Network Analysis software application was used. This is a freely available application that has been developed by Borgatti *et al* (2002).

7.4.2 Identifying the Process Owners and Operators.

Through the data gathering exercise outlined in section 7.4.1 the researcher identified 45 different departments that have some impact on the order flow process. Not all of these departments would have an impact on order flow performance even though they existed as part of the overall supply chain function. In order to determine which departments actually impacted on the order flow performance the researcher devised and employed the following selection criteria.

1. *Select the department if its operational role clearly identifies it as having operational ownership of any part of the process that touches orders as they pass through the process.*
2. *Select the department if its operational role clearly identifies it as having operational ownership of any part of the process that can directly or indirectly impact orders in real time as they pass through the process.*
3. *Select the department even if its operational role does not identify it as having operational ownership of any part of the process but where practical experience shows the department to be involved in a direct or indirect way which impacts order flow in real time.*

Using these criteria the list of departments involved now reduces to a list of 35. Table 7.3 shows the list of identified departments. This Table effectively forms the 'incidence' matrix for the organizational network. The four columns to the right of the 'Department' column identify in what key milestone, or milestones, the department has influence; a '1' representing influence and a '0' representing no influence. The final column on the right hand side is the node number that appears in the network diagram.

Department	OR-OE	OE-OD	OD-OS	OS-ODEL	Node Ref
Regional CF North	1	0	0	0	1
Regional CF West	1	0	0	0	2
Regional CF South	1	0	0	0	3
Regional CF Central	1	0	0	0	4
Customer Fulfilment (CF) Support/BC	1	0	0	0	5
CF Back Office Central	1	0	0	0	6
CF Back Office Nordics	1	0	0	0	7
CF Back Office CEMA	1	0	0	0	8
CF Process	1	1	0	0	9
CF Claims/Claims/Billing and Disputes	0	0	0	0	10
CF Business Partner Support	1	0	0	0	11
Thinkcentre Supply/Demand Ops	0	1	1	0	12
Thinkpad Supply/Demand Ops	0	1	1	0	13
XSeries Supply/Demand Ops	0	1	1	0	14
HVEC 'Topseller' Scheduling	0	1	1	0	15
Supply/Demand Business Controls	0	1	0	0	16
Logistics Centre Options Supply.	0	1	1	1	17
Logistics Centre Operations.	0	1	1	1	18
CP Business Partner Reporting	0	0	0	0	19
CP Serviceability	0	0	0	0	20
CP Business Controls	0	0	0	0	21
CP Post Sales Support	1	1	1	1	22
CP Pre Sales Support	0	0	0	0	23
CP Global Accounts Support	1	1	1	1	24
CP IITC (S/W Configuration)	0	0	1	0	25
Ops and Procurement Business Controls	0	0	0	0	26
X Series Operations (Hungary)	0	0	1	0	27
Thinkcentre Operations (GNK/Hungary)	0	0	1	0	28
Thinkpad Operations (IIPC)	0	0	1	0	29
X Series Material Planning.	0	0	1	0	30
Distribution Ops Nordics	0	0	0	1	31
Distribution Ops Mainland Europe	0	0	0	1	32
Distribution and Logistics	0	0	0	1	33
Systems/Strategy and Customer Compliance	0	0	0	1	34
Global Logistics (Ireland)	0	0	0	1	35
Global Logistics (UK)	0	0	0	1	36
Global Logistics (Special Projects)	0	0	0	1	37
Strategic Outsourcing Support	1	1	1	1	38
EMEA Integration (Re-Engineering)	0	0	0	0	39
Scheduling Optimisation	1	1	1	0	40
Business Process Architecture	1	1	1	1	41
Business Information	0	0	0	0	42
Re-Engineering and Deployment	1	1	1	1	43
Project Office	0	0	0	0	44
Business Information	0	0	0	0	45

Table 7.3 Departments involved with the Order Flow Process. Source: Developed for research.

This information can be visualised by way of a Sociogram as shown in Figure 7.5.

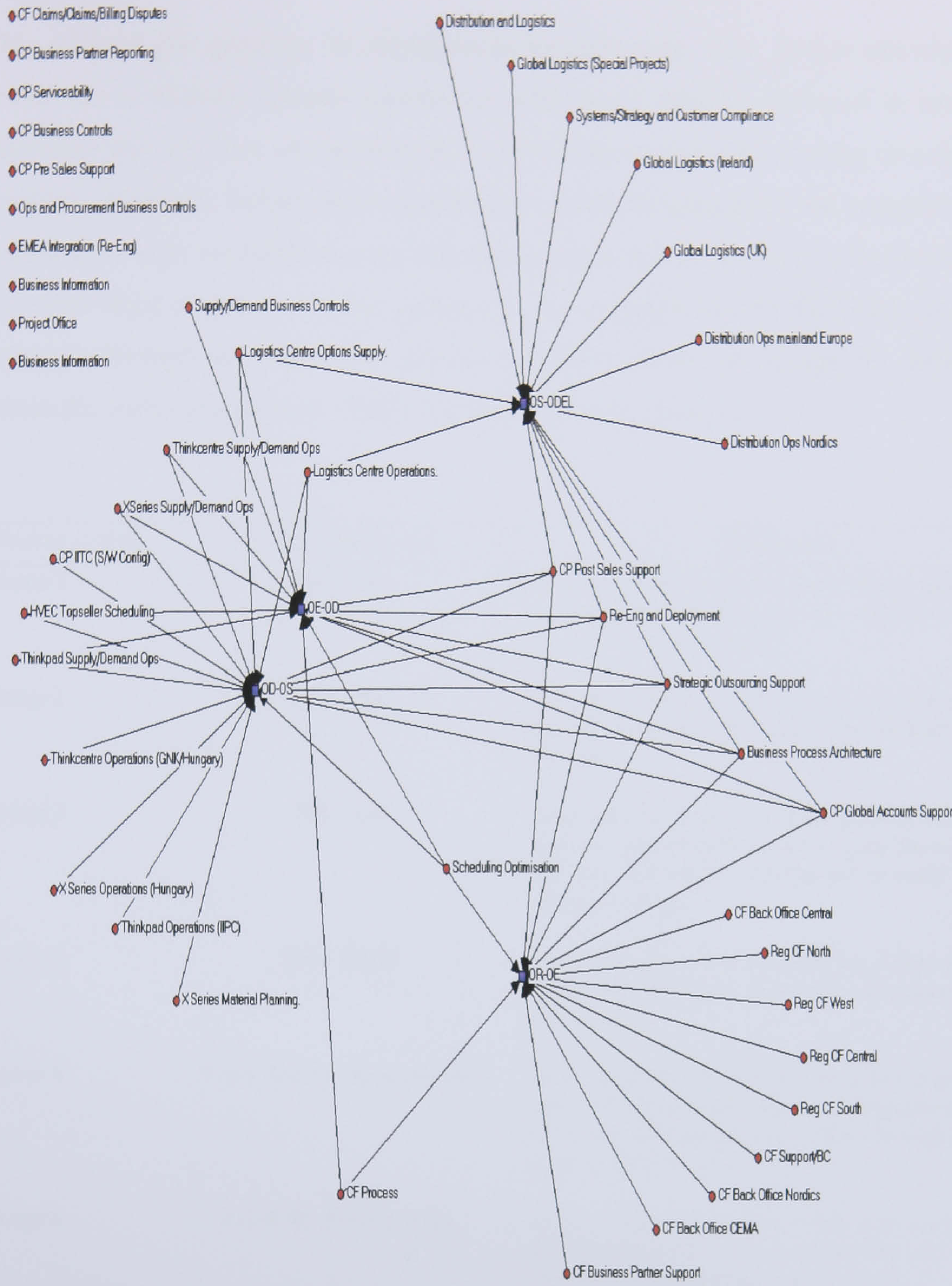

Figure 7.5 Order Flow Sociogram. **Source: Developed for research.**

The top left hand side of the Sociogram lists the ten departments that were deemed as having no real influence on the operation of the order flow process. The rest of the sociogram shows which milestone the departments with influence connect into.

This allowed the grouping of departments by milestone, thus further allowing the researcher to identify sample populations who could then be surveyed in order to determine the existence of the barriers to performance-related knowledge transfer and creation. However, before all the departments could be grouped it was important that departments were not listed in more than one group as this could cause individuals to be surveyed twice or more. Further analysis of the departments and their main areas of influence through the order flow process identified seven key groups for surveying across the order flow process. Table 7.4 identifies these groups.

Survey Group	Area of Influence	Description
Group 1	**OR – OE**	*Primarily responsible for order receipt and loading activities, and ensuring customer orders are valid prior to loading.*
Group 2	**OE – OD**	*Primarily responsible for supply availability against order forecast/expectation, and demand planning.*
Group 3	**OD – OS**	*Primarily responsible for order build scheduling, and ensuring manufacturing is ready from a material and resource perspective to build customer orders.*
Group 4	**OS – ODel**	*Primarily responsible for ensuring orders enter the distribution phase as soon as manufacturing is complete.*
Group 5	**E-2-E Order Management**	*Made up of departments that have E2E customer responsibility of order within ISC organization, but do not directly manage orders through any stage of the process.*
Group 6	**E-2-E Re-Engineering**	*Not responsible for actual orders in process, but are responsible for system availability and compliance with process requirements.*
Group 7	**E-2-E Administration**	*Support groups such as business controls departments that although do not directly process orders are responsible for business guidelines that in turn can impact the E2E process.*

Table 7.4 Survey Groups. **Source: Developed for research.**

Figure 7.6 shows the same Sociogram as Figure 7.5 but with the departments colour coded.

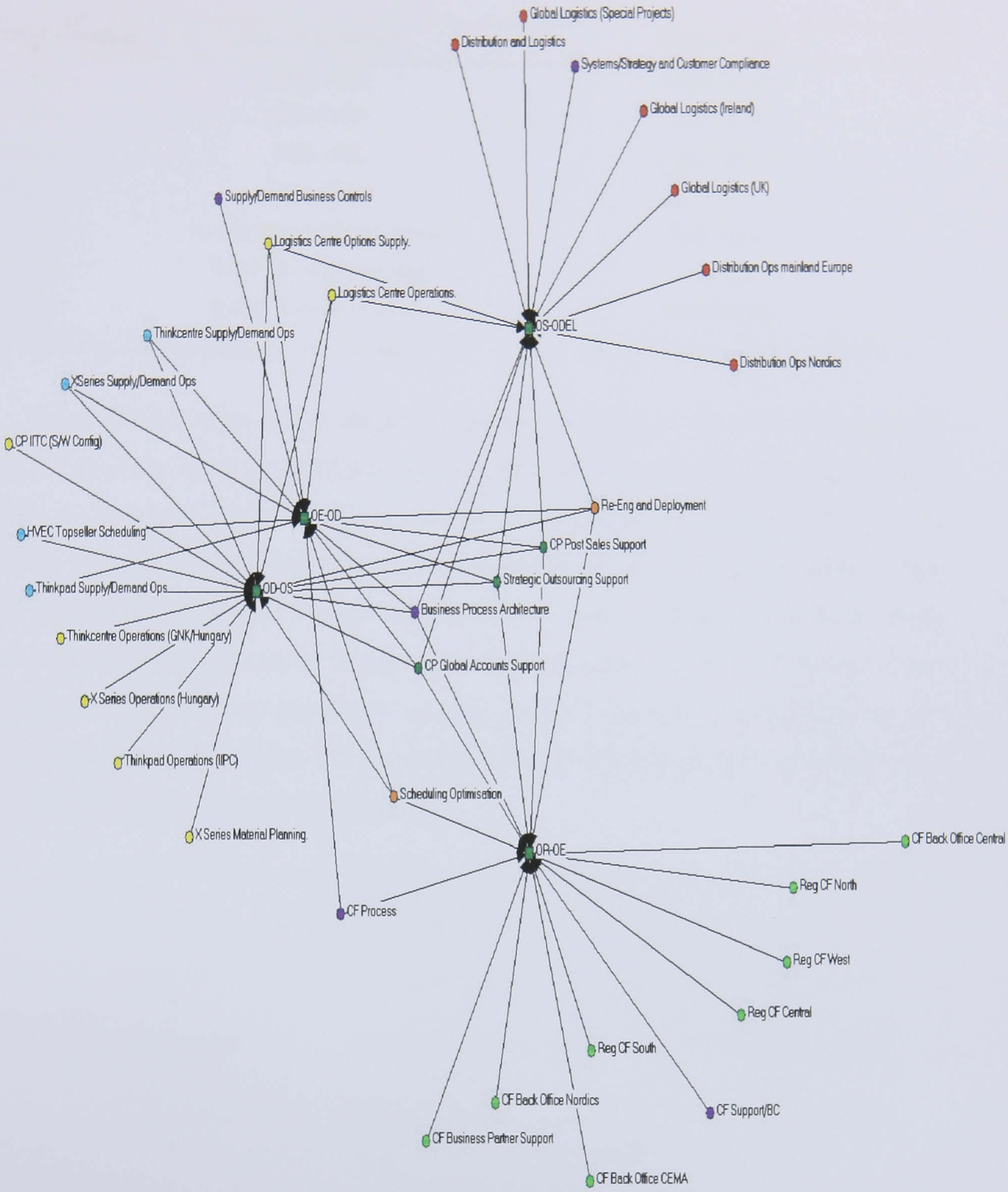

Figure 7.6 Departments by Group. **Source: Developed for research.**

The colours indicate the survey group to which the departments belong (as per Table 7.4). The groups are colour coded as follows.

Survey Group	Area of Influence	Colour Code
Group 1	**OR – OE**	Light Green
Group 2	**OE – OD**	Light Blue
Group 3	**OD – OS**	Light Yellow
Group 4	**OS – ODel**	Red
Group 5	**E-2-E Order Management**	Dark Green
Group 6	**E-2-E Re-Engineering**	Orange
Group 7	**E-2-E Administration**	Dark Purple

Table 7.5 Colour coded Survey Groups. Source: Developed for research.

There was an eighth group identified that was made up of the senior management team. This group is not included here as the senior management team were not included in the on-line questionnaire survey to the individuals within groups 1 to 7. The reason for this was that only non-management employees were included in the survey. This was because the researcher wanted the opinions of those employees directly involved with the order flow process or in support of the order flow process. However, senior management opinion was important and was captured separately through one to one interviews (Group 8). Figure 7.7 provides a graphic representation of the groups and their relationship to the order flow process.

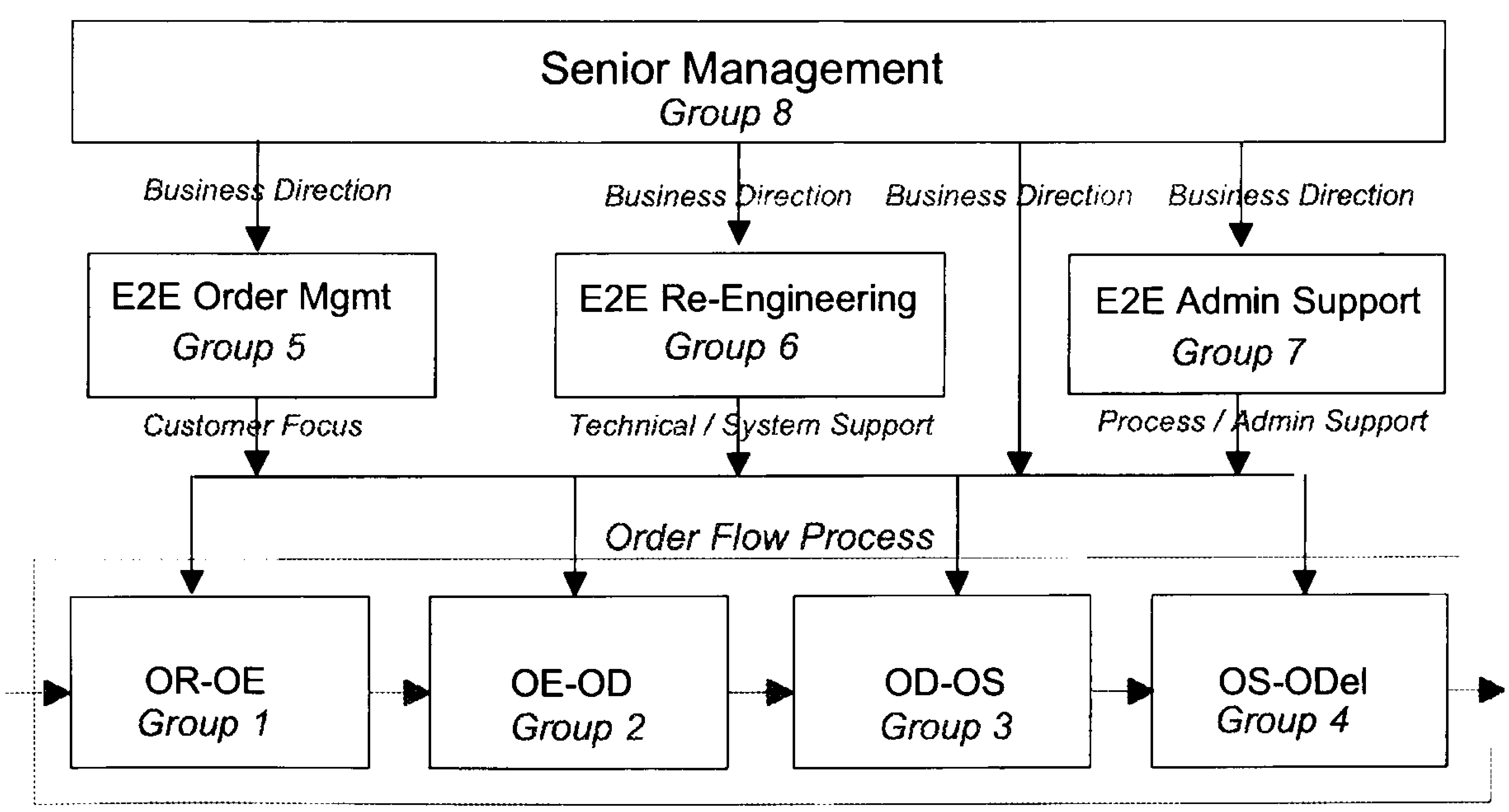

Figure 7.7 Identified Groups for Order Flow Process. Source: Developed for research.

7.5 Pre-testing the List of Barriers.

Prior to creating a questionnaire, based on the researcher's view of the spectrum of barriers that could potentially impact the process performance, the ISC optimisation team was used to review the list (Table 3.6 - *concise list of barriers*). The ISC optimisation team, which was made up of 12 -15 subject matter experts, were asked to review the list for omissions, and also provide a top level view as to how they felt the barriers existed across the four key process milestones (OR-OE, OE-OD, OD-OS, OS-ODel). A weighted view as to how the barriers impact across the different milestones is provided in Table 7.6. This shows how the optimisation team see the barriers appearing across the process, and whether the respective impact is high, medium, or low on performance within that milestone.

	Milestone 1			Milestone 2			Milestone 3			Milestone 4		
Cross Cat Barriers	No	Barrier	Impact	No	Barrier	Impact	No	Barrier	Impact	No	Barrier	Impact
	3	Arduous Relationship	H	3	Arduous Relationship	H	3	Arduous Relationship	H	3	Arduous Relationship	H
	4	Culture	M	4	Culture	M	1	Existing Resource	H	4	Culture	M
	2	Rewards	L	2	Rewards	L	4	Culture	M	2	Rewards	L
							2	Rewards	L			
Tech Barriers	No	Barrier	Impact	No	Barrier	Impact	No	Barrier	Impact	No	Barrier	Impact
				6	Legacy Systems	H	5	Available Technology	H			
Org Barriers	No	Barrier	Impact	No	Barrier	Impact	No	Barrier	Impact	No	Barrier	Impact
	8	Causal Ambiguity	H	7	K Strategy Imp	H	7	K Strategy Imp	H	8	Causal Ambiguity	H
	9	Poor Targeting	M	8	Causal Ambiguity	H	8	Causal Ambiguity	H	9	Poor Targeting	M
	14	Org Context	M	15	Info not perceived as reliable	H	15	Info not perceived as reliable	H	12	Distance	M
	16	Motivation (NIH)	M	9	Poor Targeting	M	9	Poor Targeting	M	15	Info not perceived as reliable	L
							12	Distance	M			
People Barriers	No	Barrier	Impact	No	Barrier	Impact	No	Barrier	Impact	No	Barrier	Impact
	24	Retentitive Capacity	H	24	Retentitive Capacity	H	24	Retentitive Capacity	H	24	Retentitive Capacity	H
	17	Internal Resistance	L	17	Internal Resistance	L	19	Trust	M	17	Internal Resistance	L
	22	Motivation (K is P)	L				20	Risk	M			
							17	Internal Resistance	L			

Table 7.6 Optimisation Team view of Barrier Impact across Process. **Source: Developed for research.**

As the optimisation team reviewed the list of barriers the feedback showed the team could relate to the existence of the barriers at different points through the process whilst also having different levels of impact on performance. The team were also asked to identify any additional barriers they felt were not covered by the proposed list (Table 3.6). After consideration it was felt that the proposed list covered all those barriers that were, and could, potentially impact the order flow process.

7.6 Pre-testing the Questionnaire.

The ISC organization was about to undergo a significant restructuring through the first half of 2005. Approximately 10,000 IBM ISC employees worldwide would be transferred to a new joint venture company called Lenovo. Therefore, the researcher had to ensure the questionnaire was sent out with enough time for the recipients to respond before internal preparations got underway for the smooth transfer of resources to Lenovo.

Prior to sending out the questionnaire to the identified groups, a test questionnaire was distributed via email to 10 employees within the ISC but not involved with the order flow process. The purpose of the test questionnaire was two-fold. The first purpose being to conduct a review of the actual questionnaire in line with Berger *et al* identified considerations (Berger *et al*, 1989, Benini, 2000, Puris, 1995). These included size, relevance, clarity, tone and content, layout, instructions, legal responsibilities, ethical consideration, and overall impression.

Once the review was complete the review team were then asked to complete the questionnaire. This would fulfil the second purpose by allowing the researcher to view the data and determine how suitable the response data would be in assessing the existence and impact barriers have within the surveyed groups. The main goals of the pilot test in effect were to determine the time to complete the questionnaire, to test the suitability of the research methods in gathering relevant data, to familiarise the researcher with the research environment, to give the researcher the opportunity to practice using SPSS in analysing the data, and to discover weaknesses, ambiguities, and problems prior to collecting the main data. Goals will vary from survey to survey but in general these goals follow the assessment of Oppenheim (1992), Sproull (1998), and Sarantakos (2005).

The time taken to complete the review and pilot survey took two weeks and resulted in five iterations of the questionnaire. A copy of the final questionnaire is contained within Appendix B.

7.7 Quantitative Data Gathering.

Once the relevant departments had been identified, the researcher needed to identify the individuals within each department to whom the questionnaire would be sent. Consideration would need to be given to ensure a suitable sampling method was used to reduce the effects of any sampling error on the findings from the questionnaire. Also, based on the format of the questions the researchers would need to ensure the correct quantitative techniques were employed to ensure the correct conclusions were drawn from the data.

7.7.1 Sampling.

The population to be questioned via on-line and one to one interviews had been identified by the researcher through their contact with the end-to-end order process. By accessing the on-line directory (Bluepages) and department and functional secretaries the researcher was able to get a comprehensive e-mail contact list for all personnel within the already identified departments. In order to try and maximise the number of responses the researcher sent a questionnaire to each non-management employee. In accordance with Diamantopoulos & Schlegelmilch's (1997) view on sampling methods the researcher would therefore, expect everyone polled to have the same opportunity to respond to the questionnaire. This in effect is the basis for a sampling probability method called Simple Random Sampling.

The level of responses received across the different groups is shown in Table 7.6.

Group	% of population responding	n	N
OR-OE	15.51%	38	245
OE-OD	25.00%	8	32
OD-OS	53.33%	16	30
OS-ODel	22.45%	11	49
E2E Management	20.59%	21	102
E2E Re-Engineering	26.00%	13	50
Administration	54.17%	13	24
Total	**22.56%**	**120**	**532**

n = Sample size. N = Population size.

Table 7.7 Level of response to On-line Questionnaire. Source: Developed for research.

From Table 7.7 it can be seen the overall level of response from the different groups identified for survey was 22.56%. The majority of responses were received within 2/3 days of the questionnaire being emailed out. It is believed by the researcher that the main reasons for the response level not being higher were:

1. *Excessive work load on employees as the organization prepared for segmentation, by which is meant the process of separating that part of the supply chain organization responsible for mobile and desktop computers in order to form the new Lenovo Company.*
2. *Employees taking holidays that were postponed during first quarter '05 due to a drive to improve product build and ship numbers prior to the segmentation of the organization.*
3. *Employees who had been identified as future Lenovo employees not wishing to take part in a questionnaire that was perceived to be supported by IBM.*

From Table 7.7 it can be seen that the number of responses varied significantly between the different departments. The level of response was related to the overall population of each department. As can also been seen the number of responses for group 1 (OR-OE) and group 2 (OE-OD) show a significant difference in their level. If the overall impact of the different barriers were to be understood across the end-to-end process, and within each group the researcher would need to ensure a suitable quantitative tool would be used.

The level of response from the senior management team was proportionally better. However, the sample size was significantly smaller as shown in Table 7.7.

Group	% of population responding	n	N
Senior Management	87.50%	7	8
Total	**87.50%**	**7**	**8**

n = Sample size. N = Population size.

Table 7.8 Level of Response to Senior Mgmt Interview. Source: Developed for research.

As the senior management team were asked the same questions during their one to one interviews, the responses were added to the overall feedback from the on-line questionnaire.

7.7.2 Testing Categorical Data.

The questions within the questionnaire are looking for answers that are not continuous but categorical. It is mainly for this reason the researcher has opted to use non-parametric testing (Miller, 2000; Siegel, 1956). The type of variable response, or answer, is very important in determining the type of testing to be used (Diamantopoulos *et al*, 1997; Miller, 2000). As part of the operational research plan, the researcher is looking to determine how the barriers are perceived to exist within each group relative to each other. The intent is not to determine a level of variance or frequency with which barriers appear across the end-to-end process. Because of this the questions have deliberately been structured to provide categorical, and in particular, ordinal, answers.

The actual type of non-parametric test to be used is further determined by the number of groups to be compared, and whether the groups will be tested independently, or dependently. In the case of this data analysis there will be eight group comparisons made. Also important to note is that each individual will only be questioned once as part of a predefined group; therefore, the groups will be 'independently' tested. Using these criteria the test to be used is the Kruskal – Wallis one-way ANOVA test (Diamantopoulos *et al*, 1997, Miller, 2000, Hinton, 2004).

In order to analyse the responses from the questionnaire, the data was entered into SPSS. As part of the analysis the following null hypothesis is assumed.

***H_0*: the impact the barriers have within the groups is uniform across the different groups.**

The alternative or test hypothesis is therefore as follows:

***H_1*: the barriers impact or ranking between the different groups is not uniform.**

If this null hypothesis is to be tested then a significance level must also be assumed. For the purpose of this experiment the significance level of $\alpha = 0.05$ will be set. If the Kruskal-Wallis (K-W) test provides a significance level $p \leq 0.05$ then the result will be seen as being significant with a high probability that the null hypothesis is not proved, thus allowing its rejection in favour of the alternative hypothesis (H_1).

7.8 Kruskal-Wallis Test Results.

Separate K-W tests were run against each question within the questionnaire for each of the 8 groups identified as having some impact on the end-to-end order flow process. Table 7.9 shows the significance level for each question asked through the on-line and senior management questionnaires.

Although all the barriers will appear to a greater or lesser extent across the organization, what the Kruskal-Wallis analysis (as shown in bold in Table 7.9) tells us is that not all barriers act uniformly across the organization. From the significance levels reported the following barriers reject the null hypothesis and, therefore, are perceived to impact knowledge creation and sharing differently across the 8 groups.

- Arduous Relationships
- Available Technology
- Legacy Systems
- Knowledge Implementation Strategy
- Causal Ambiguity
- Knowledge Cost
- Distance
- Unprovenness
- Trust

- Risk
- Fear of Contamination

As the remaining barriers do not reject the null hypothesis their impact is assumed to be uniform across all groups.

Q	Question	Barrier	*p*	*p*	*p*	*p*	*p*	*p* ($\alpha = 0.05$)
1	*Lack of financial*	Existing Resource.	1.000	1.000	1.000	1.000	1.000	1.000
2	*Reward.*	Rewards for sharing /creating knowledge.	0.584					
3	*Need for effective email*	Arduous Relationship.	1.000	**0.024**	**0.024**	0.1045	0.208	0.448
4	*Culture*	Culture (Knowledge Strategy).	0.120					
5	*IT Support*	Available Technology.	**0.008**					
6	*Legacy Systems*	Legacy Systems.	**0.000**					
7	*Knowledge Value*	Knowledge Strategy Implementation.	**0.000**					
8	*Impact of Knowledge*	Causal Ambiguity.	**0.016**					
9	*Knowledge Seeking*	Poor Targeting of Knowledge.	0.280					
10	*Financial Cost*	Knowledge Cost.	**0.000**					
11	*Knowledge Sharing*	Proprietary Knowledge.	0.392					
12	*Distance*	Distance.	**0.008**					
13	*Knowledge Usefulness*	Unprovenness.	**0.000**					
14	*Organization*	Organizational Context.	0.304					
15	*Knowledge Reliability*	Info perceived as reliable.	0.168					
15a	*Knowledge Reliability*	% of Info perceived as reliable.	0.200					
16	*Personal Knowledge*	Lack of Motivation (Not Invented Here).	0.120					
17	*Protecting interests of*	Internal Resistance.	0.224	0.352	0.848			
18	*External Sharing of*	Self Interest.	0.760					
19	*Trust*	Trust.	**0.024**					
20	*Risk of Penalty Payment.*	Risk.	0.384	**0.000**	**0.000**			
21	*Knowledge Reciprocity*	Fear of Exploitation.	0.072					
22	*Physical Distance*	Lack of Motivation (Knowledge as Power).	0.736	0.112	0.304			
23	*Knowledge*	Fear of Contamination.	**0.048**					
24	*Knowledge Capture*	Lack of Retentive Capacity.	0.696					
25	*Beneficial Knowledge*	Lack of Absorptive Capacity	0.720					

n = 125
N = 540

Table 7.9 Kruskal-Wallis Analysis.

Source: Developed for research.

7.9 Barriers that Support the Test Hypothesis (H_1): $p \le 0.05$.

The Kruskal-Wallis analysis showed that eleven of the barriers impacted the eight groups tested to different degrees. It is important that the different groups are therefore compared to see where these differences lie.

7.9.1 Arduous Relationships.

Figure 7.8 shows how the eight groups differ in their view of two components that contribute to arduous relations across the organization.

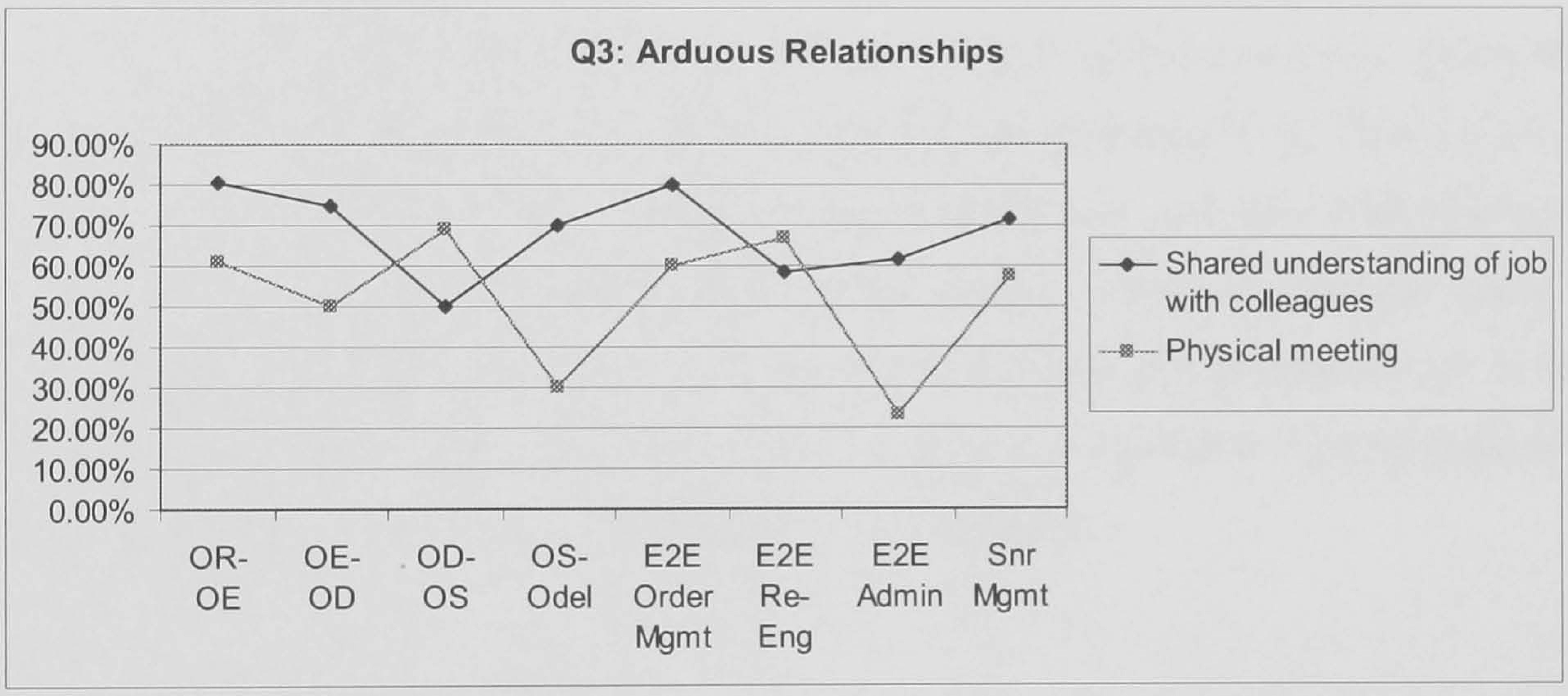

Figure 7.8 Arduous Relationships. **Source: Developed for research.**

From the graph it can be seen that six of the groups rate having a shared understanding of the job with colleagues higher than having physical meetings with fellow employees. From comments received by employees across the groups surveyed there is a feeling that the main contributor to the existence of arduous relationships is a failure to understand what people are trying to achieve through their jobs. It is felt that if employees had a better understanding of other employee's jobs, information and knowledge sharing would improve. The implication here is that this barrier has possible influencing effects on other barriers such as trust and causal ambiguity.

The fact that physical contact is also an important aspect of information and knowledge sharing shows the work force is not totally dependant on codified systems for successful business performance.

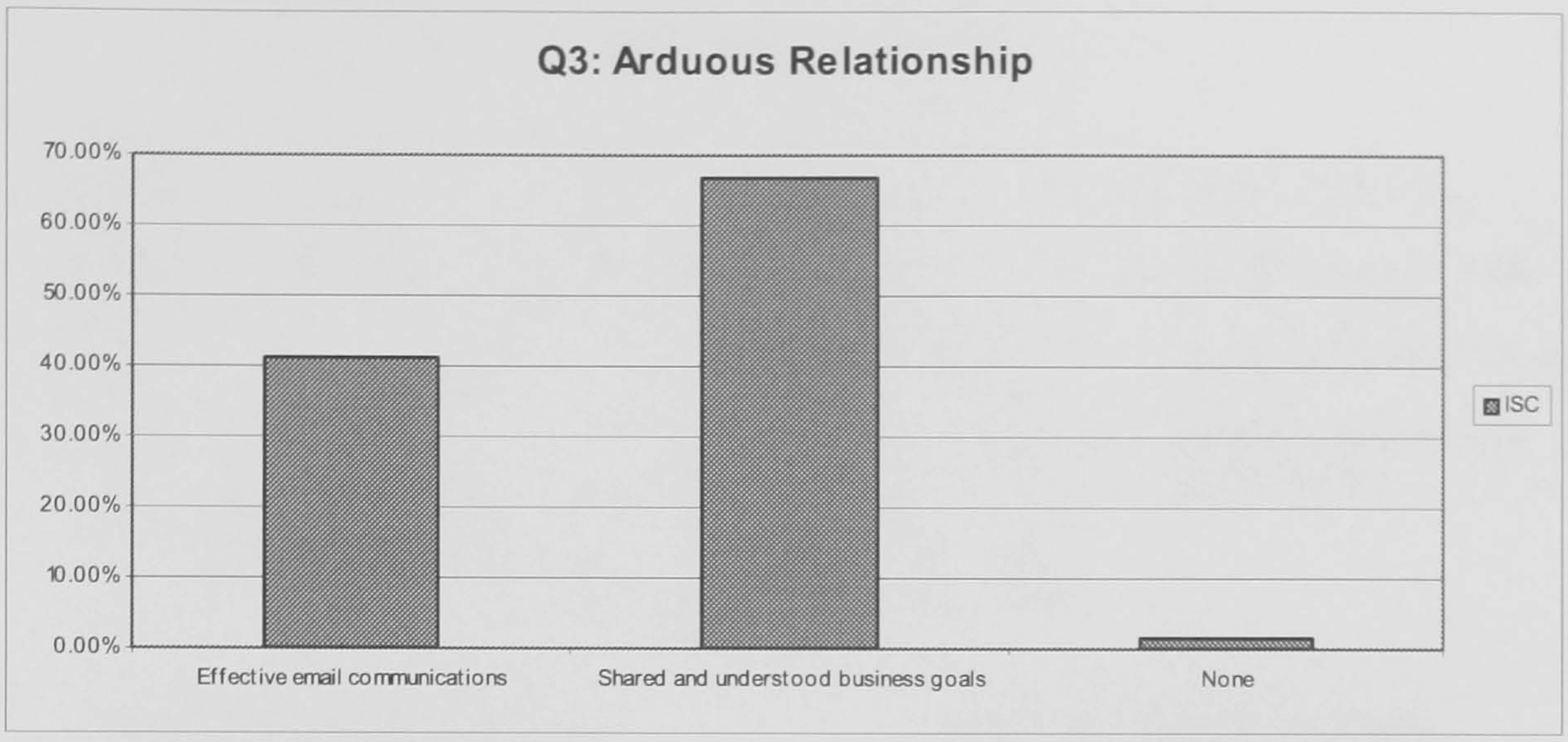

Figure 7.9 Arduous Relationship 2. **Source: Developed for research**

Also worth noting is that across the eight groups the employee response shows that a shared understanding of business goals is also important (Figure 7.9). This failure to share a common business goal, which can be translated into common work practices, prevents smooth sharing of information and knowledge. Although effective email is highlighted its percentage selection is relatively low across the groups; except in the case of group 4(OS-ODel) and group 7 (E2E Admin) who view this as being more of a barrier then regular physical meetings with other employees.

7.9.2 Available Technology.

This barrier refers to how technology is seen to support or restrict the flow of information. To simply ask if technology supported the sharing of information would be likely to elicit a vague and subjective response. In order to understand how technology impacts information flow and knowledge sharing the manner in which technology matches the needs of the user in creating, accessing, and sharing information would need to be identified. This would provide a more objective view as to the impact of technology as a barrier to knowledge creation and sharing.

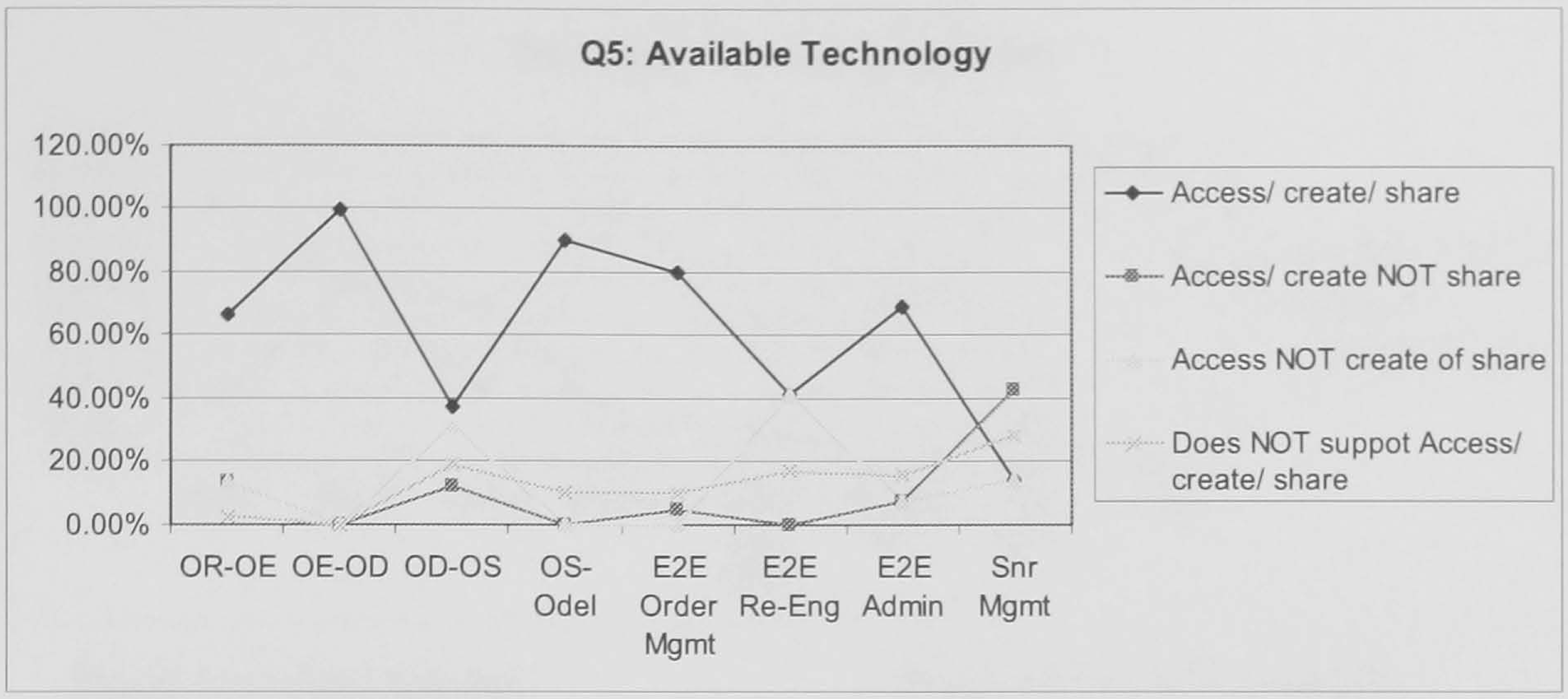

Figure 7.10 Available Technology. **Source: Developed for research.**

The response across the eight groups is shown in Figure 7.10. Across the order flow process the main view is that the current technology allows the access, creation, and sharing of information. However, group 4 (OD-OS) and group 6 (E2E Re-Engineering) show the equally strong view that technology only really supports the accessing, and not the creation and sharing of information.

The view of the senior management team should also be highlighted. This is the only group that believes technology is not sufficiently supporting the creation and sharing of information. After this view the second strongest view is that the current technology even fails to properly support the accessing of information. This is an important finding as it shows the senior management team do not believe they have the necessary ability to access and disseminate information across the organization. This inability to manage information can have significant impact on their ability to make decisions in a timely manner.

7.9.3 Legacy Systems.

This barrier refers to how new technology is integrated into existing systems across the organization. In particular, this barrier looks at how the integration of new and existing technology affects the work of the employees. Figure 7.11 shows the response provided by the polled employees.

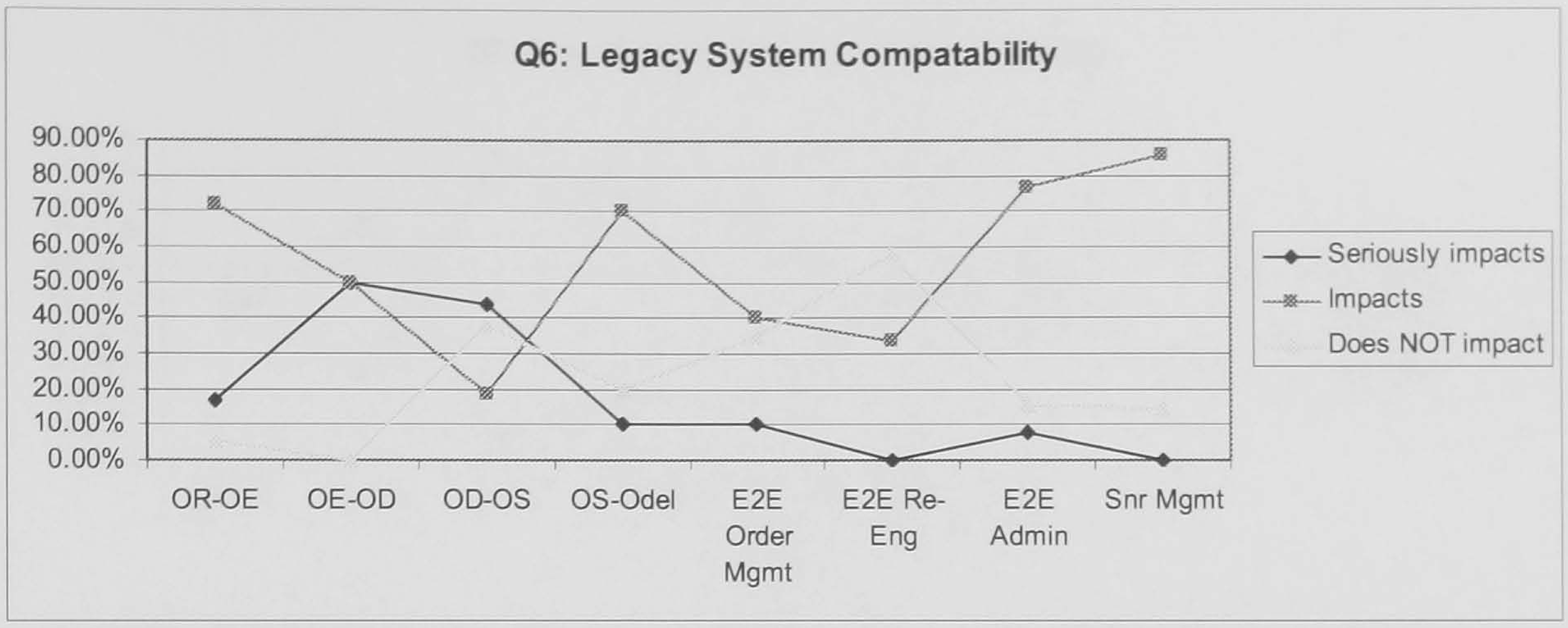

Figure 7.11 Legacy Systems. Source: Developed for research.

Across the organization the general consensus is that the integration of new technology with older existing systems is having an impact on how the different parts of the organization work. The exception is the E2E Re-Engineering group. This is not unexpected as this is the group that is responsible for the integration of new and legacy systems. However, this may point to a failure, on the part of Re-Engineering, to understand the system needs of the other groups.

7.9.4 Knowledge Implementation Strategy.

This barrier refers to how the employees look to facilitate the creation and sharing of knowledge throughout their part of the organization. Do employees look to do this through the predominant use of IT systems (codified approach), or through the development of personal networks via personal contact (personalised approach) (Tiwana, 2000; Hansen *et al*, 1999)?

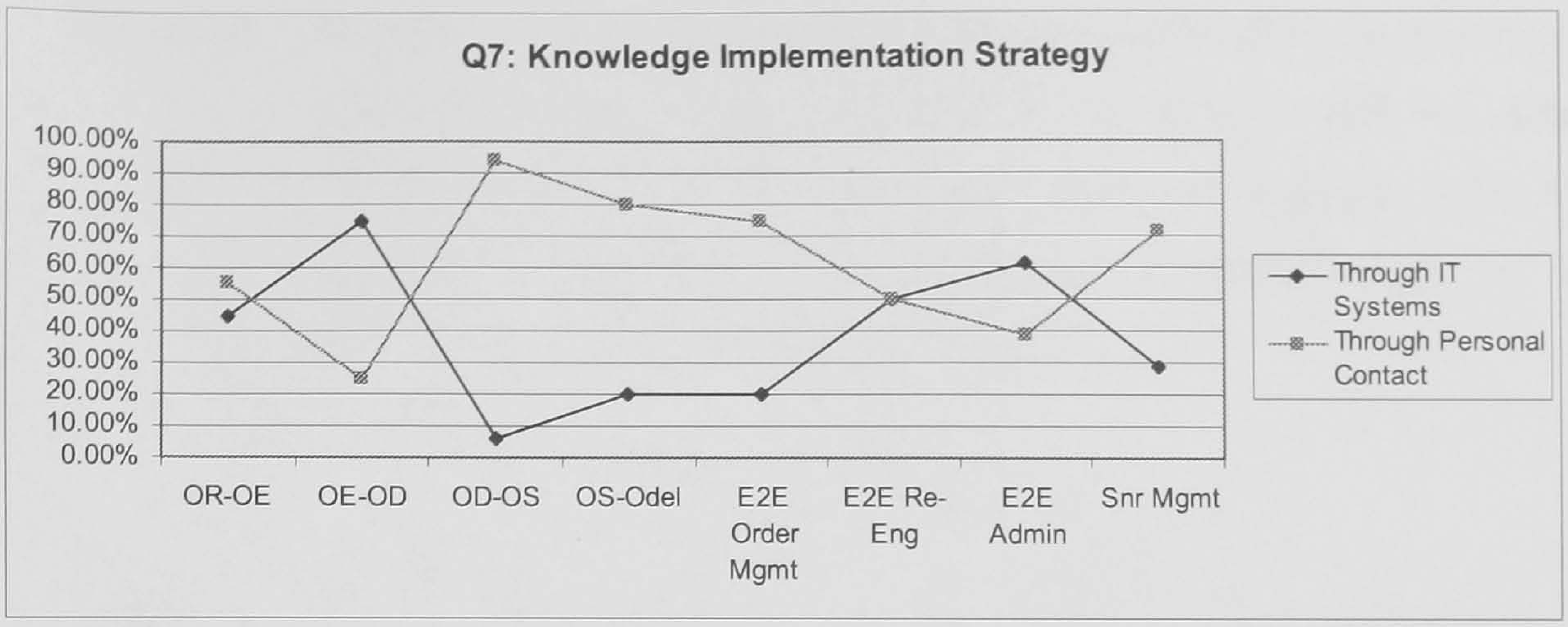

Figure 7.12 Knowledge Implementation Strategy. Source: Developed for research.

When implementing a knowledge strategy the practice is not to implement one approach to the exclusion of the other (Tiwana, 2000, Hansen *et al*, 1999), but to have a dominant strategy. However, when organizations talk about knowledge strategies the implication is to deploy the chosen strategy across the entire organization or business unit (Hansen *et al*, 1999). Where this approach begins to fail is in complex organizations that have different information and knowledge sharing practices across the organization; practices which may not cause problems in vertically aligned structures, but will cause information and knowledge loss at business unit boundaries in horizontally aligned organizations such as a supply chain. When we look at supply chains we need to look across organizations and business units. The response in Figure 7.12 from the employees across the order flow process shows a difference in preference for codified and personalised knowledge strategies across the different groups.

For an organization dependant on technology the consensus for the different groups, with the exception of the OE-OD group, Re-Engineering group, and E2E Administration group, is for knowledge creation and sharing through personal contact.

7.9.5 Causal Ambiguity.

This barrier refers to how knowledge is shared or properly identified as being of value. It is not fully understood how different parts of the organization may value the knowledge, or perceive it differently. Although not the main focus of the research the existence of causal ambiguity in organizations can be linked to the complexity of the organization. The more complex the organization the more difficult it can become for employees to understand the knowledge and information needs at different points throughout the organization. Figure 7.13 show how employees throughout the ISC order flow process drive information and knowledge to different parts of the organization that lie outside their area of business expertise.

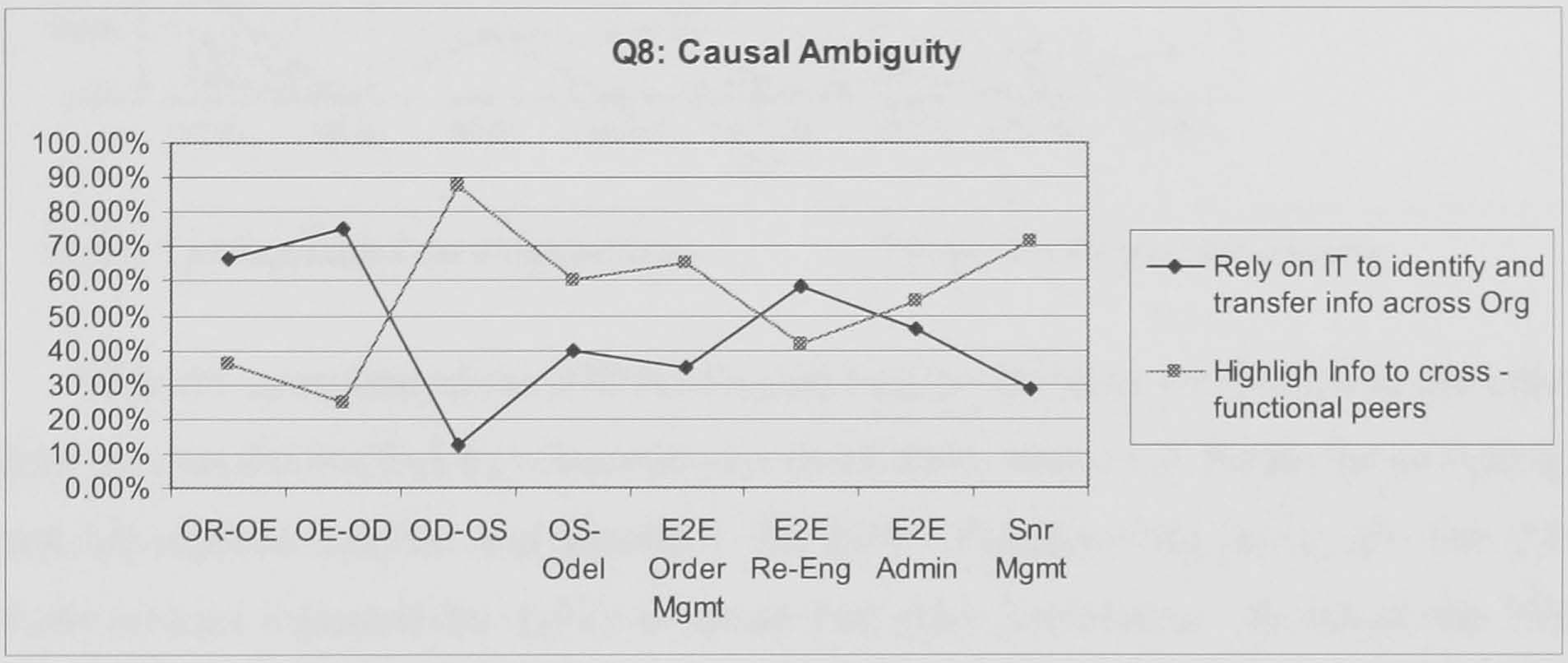

Figure 7.13 Causal Ambiguity. **Source: Developed for research.**

Groups 1, 2 and 6 (OR-OE, OE-OD, and E2E Re-Engineering) mainly rely on IT systems to identify and transfer information to the different interested parties throughout the organization. However, the remaining groups rely on their own understanding of the information or knowledge as being of value and look to share this information / knowledge at cross-functional / business unit peer reviews.

An interesting component of being able to identify other locations within the organization, which may value similar information, is a shared understanding of the different business units, and what they are trying to achieve. It is also important to note that the existence of causal ambiguity can impact the organization's ability to be innovative (Argote, 2004; Cohen & Levinthal 1990).

7.9.6 Knowledge Cost.

This barrier refers to how knowledge creation and sharing initiatives can be perceived by employees to be restricted through financial cost controls. Figure 7.14 outlines the response to this question as put to the eight groups.

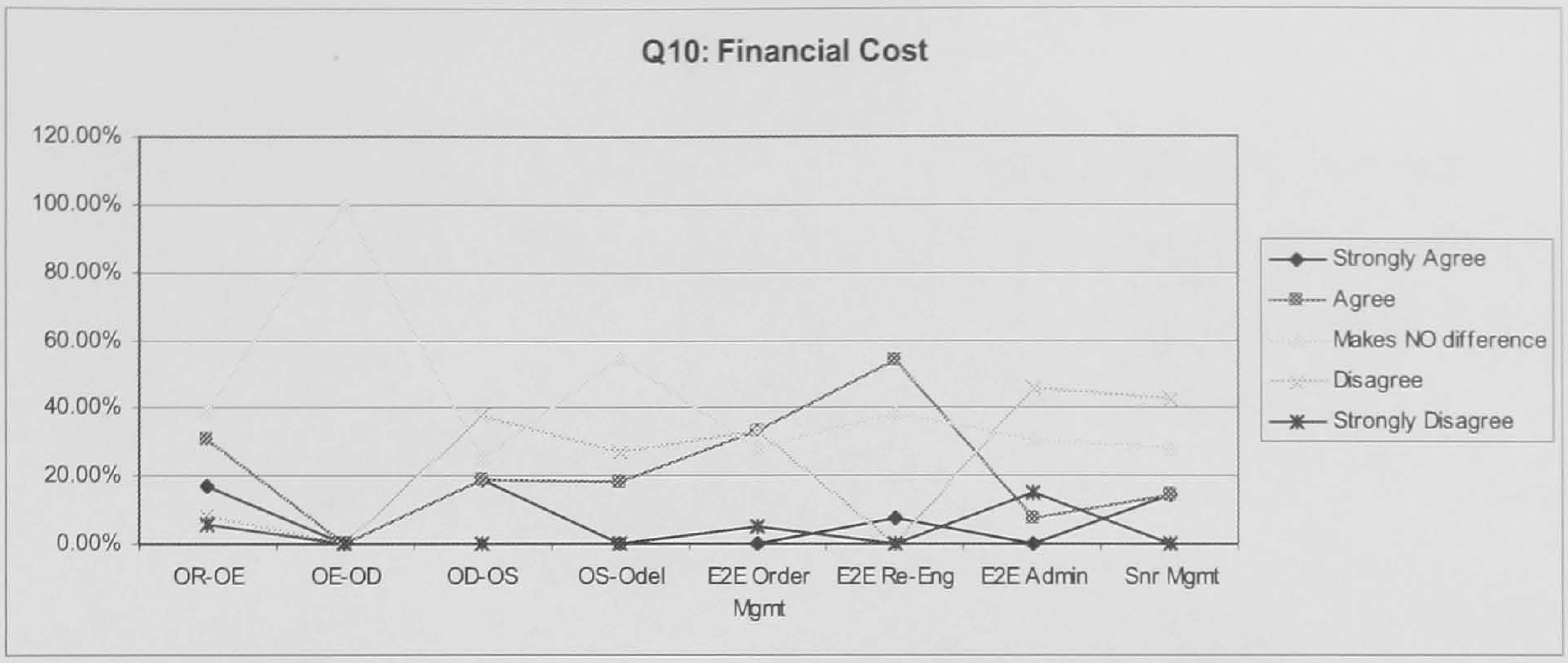

Figure 7.14 Financial Cost of Knowledge. **Source: Developed for research.**

With the exception of the E2E Re-Engineering group those involved with the order flow process did not feel that financial cost restrictions were a key barrier to knowledge and information creation and sharing. The E2E Re-Engineering group did feel that financial cost impacted the ability to create and share knowledge. However, the E2E Re-Engineering group are responsible for facilitating the knowledge and information needs of the other groups. It is Re-Engineering's responsibility to finance as well as implement technology changes. Therefore, the belief that Financial costs impact knowledge creation and sharing is based on E2E Re-Engineering group's sole responsibility for financing system changes.

7.9.7 Distance.

This barrier refers to how physical, cultural, or language distance between employees can effect the way information and knowledge is shared. Figure 7.15 graphs the responses from the employees across the eight groups regarding the impact of this barrier.

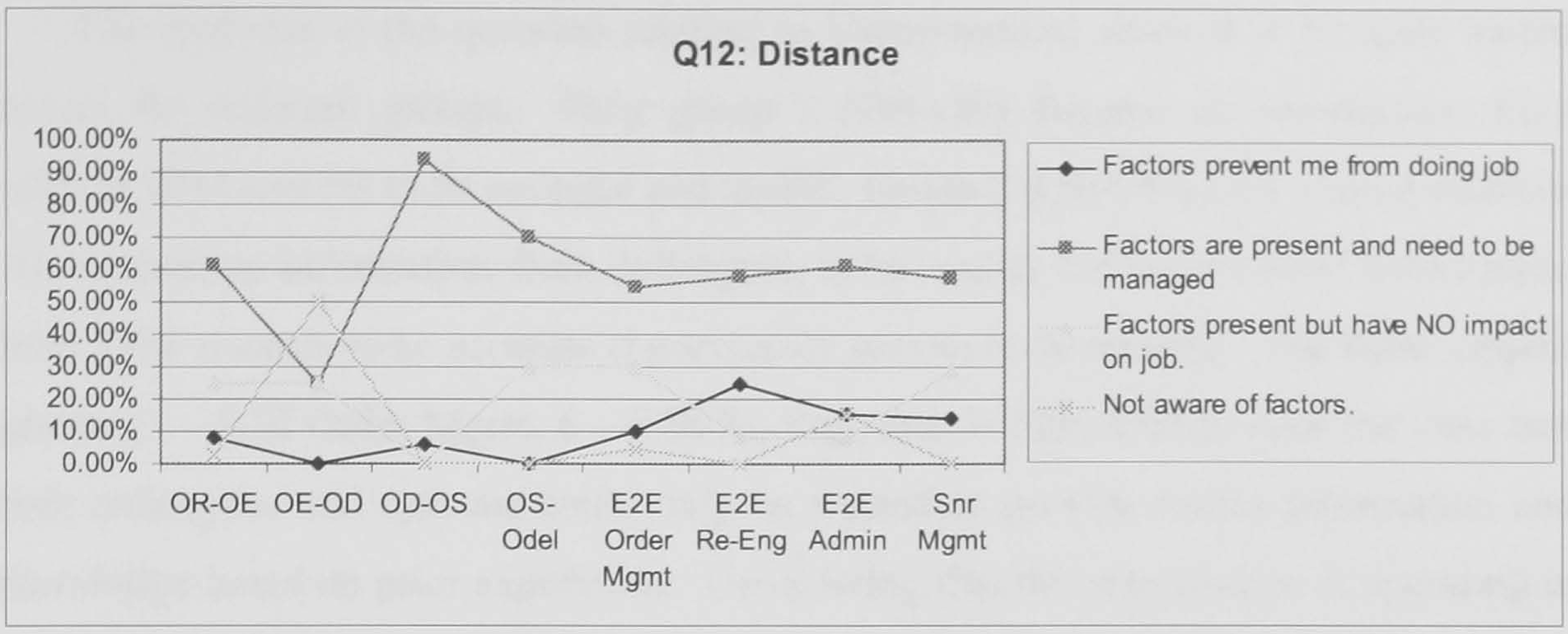

Figure 7.15 Distance. **Source: Developed for research.**

Across the eight groups there is awareness that physical/cultural/linguistic barriers exist and need to be managed. However, none of the employees believe the factors actually prevent them from completing their work. Of all the groups identified, group 2 (OE-OD) has the least awareness of Distance being a barrier to knowledge and information creation and sharing.

7.9.8 Unprovenness.

Unprovenness refers to how employees gauge information or knowledge as being of relevance to them. In gauging relevance the employees were asked to consider information sourced from people and also the systems to be considered. Figure 7.16 graphs the responses received via the questionnaire.

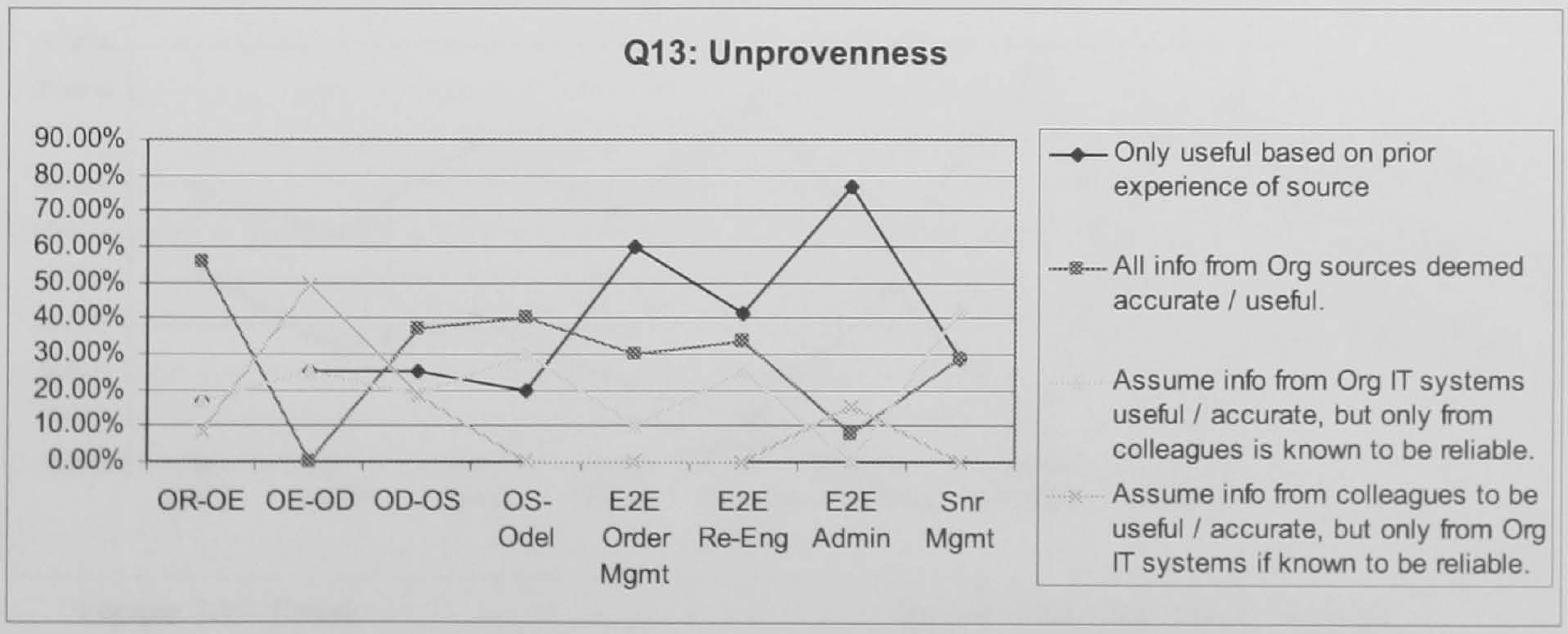

Figure 7.16 Unprovenness. **Source: Developed for research.**

The response to the question relating to Unprovenness showed to be quite varied across the different groups. Only group 1 (OR-OE) deemed all information from internal IBM sources to be accurate and useful. Group 2 (OE-OD) took a more cautious view assuming information from colleagues to be useful, but only trusted information from IBM systems to be accurate if previously proven to be reliable. The three support groups (5 – E2E Order Mgmt, 6 – E2E Re-Eng, and 7- E2E Admin) took the view that both colleagues and systems could only be trusted to provide useful information and knowledge based on prior experience. Considering that the organization is operating in a dynamic business environment, this cautious approach may impact these groups' ability to respond to new information. The view of group 8 (Senior Management) shows an almost three-way split between believing all IBM sourced data, only believing sources based on prior experience of the source, or believing information sourced from systems, but remaining cautious about information sourced from colleagues.

7.9.9 Trust.

This barrier is concerned with how an employee trusts a recipient of their information or knowledge to correctly use that information. By this the researcher means is there a belief that the information will be used and analysed in the same context in which it was provided. Figure 7.17 graphs the responses from the eight groups.

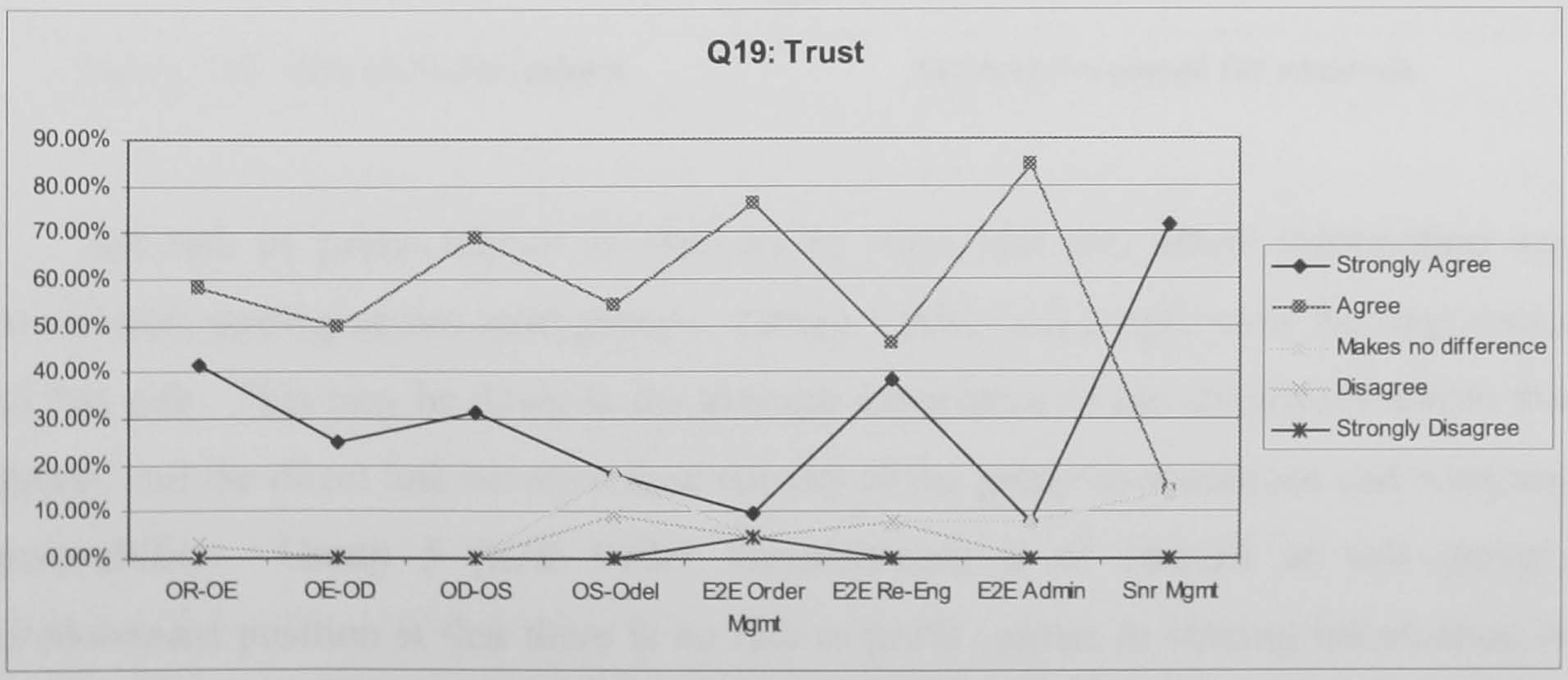

Figure 7.17 Trust. **Source: Developed for research.**

From the responses provided, the employees either 'agreed' or 'strongly agreed' with the belief that trusting recipients to use your information or knowledge correctly was a key consideration when determining the quality and quantity of information passed on.

7.9.10 Risk.

The employees were asked to comment on three risk issues; risk of profit impact, risk of customer dissatisfaction, and risk of incurred penalty payments. These were seen as the main tangible risks facing the organization should sensitive information or data pass outside the respective business units or organization. It would be the thought of realising one of these risks that would or could influence an employee's willingness to share information or knowledge with other business partners and customers.

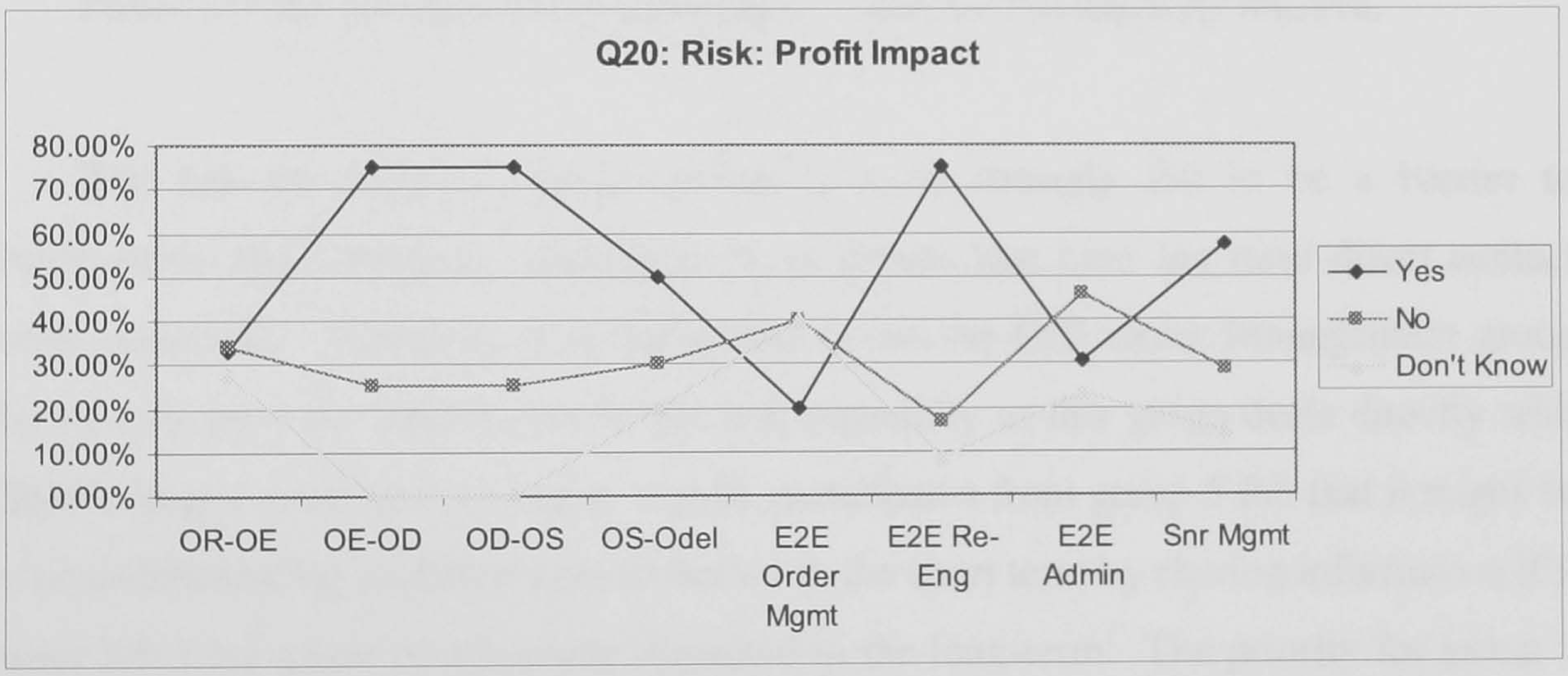

Figure 7.18 Risk of Profit Impact. **Source: Developed for research.**

The risk of profit impact is seen as an issue that can affect information and knowledge sharing across most groups. Group 1 (OR-OE) is split over the importance of this risk. This may be down to the average experience of the employees within this group, and the direct link between their (or any of the group's) operations and company profitability. Group 5 (E2E Order Management) is of interest as this group's predominant position is that there is no risk to profit impact in sharing information or knowledge. Part of the reason for this can be attributed to the belief that an open and honest relationship with a customer builds a longer and more secure relationship for the future. As group 5 have a direct relationship with customers who have been chosen by IBM for the purpose of developing long-term partnership arrangements, a lot of the E2E Order Management team felt that giving information that might impact short-term profit was preferable to holding back and adversely impacting any trust that had been developed.

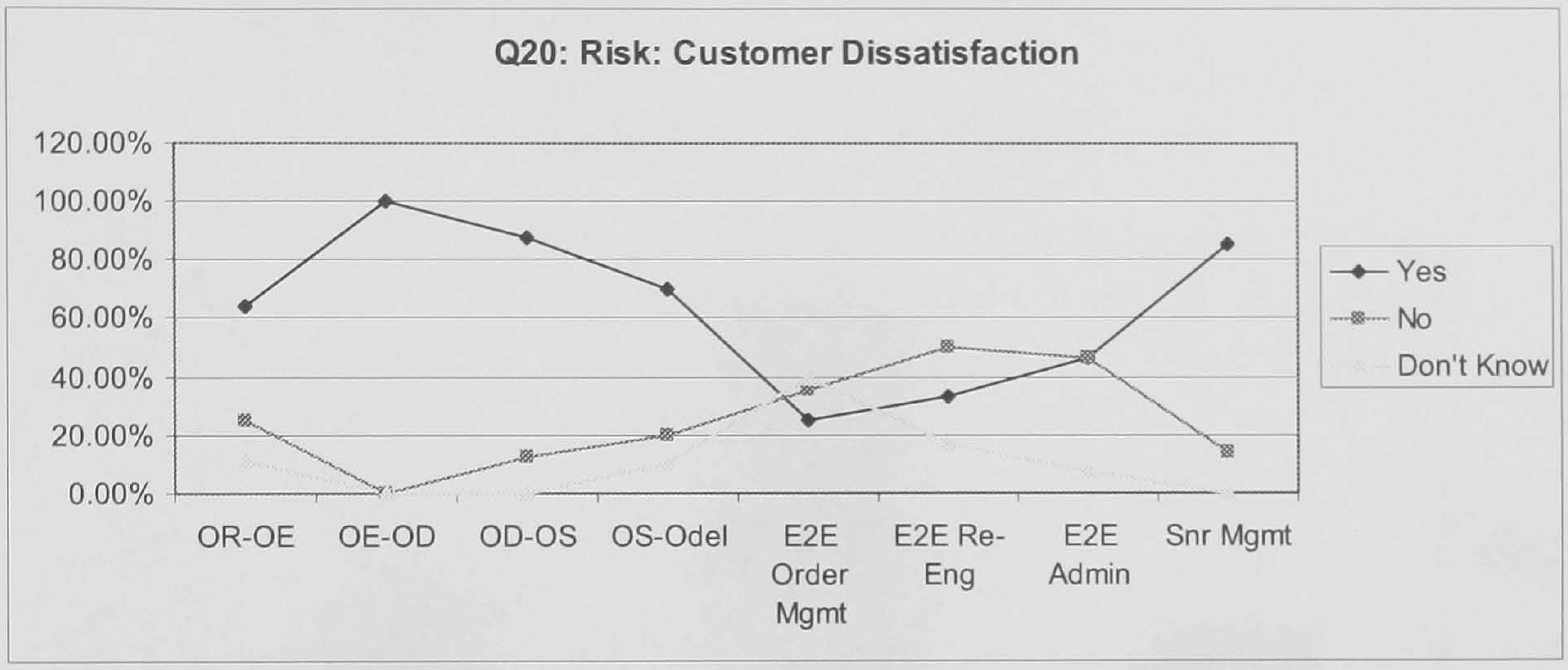

Figure 7.19 Risk of Customer Dissatisfaction. Source: Developed for research.

The risk of customer dissatisfaction is more strongly felt to be a barrier to information and knowledge sharing in those groups that have the most direct contact with customers. However, it is interesting to see the E2E Order Management group being split over the importance of this risk especially as this group deals directly with IBM's large enterprise customers. Again, participants from group 5 felt that it might be worthwhile risking customer dissatisfaction in the short term by sharing information if it were felt trust might be adversely impacted in the long-term. The priority for group 5 was the development of an open and sharing relationship. If the customer believed information, good or bad, were being held back the relationship would suffer. That said, bad information would never be provided to customers without first understanding the downstream impact, and then it would be managed by the order management team in order to reduce any long term after effects.

Figure 7.20 shows the response across the different groups to the risk of incurred penalty payments. The predominant view is that this does not impact the way employees share information and knowledge with customers or business partners. However, almost 25% of the organization believes this does impact information and knowledge sharing. The Kruskal-Wallis test says that with a significance of p=0.384 this result cannot be viewed on a group-by-group basis for comparison. However, it is the researcher's belief that the individuals who think this risk to be of importance would include those directly involved with customer and partner contract negotiation and account management. Of the eight groups involved this would certainly contain group 5 (E2E Order Management) and group 8 (Senior Management).

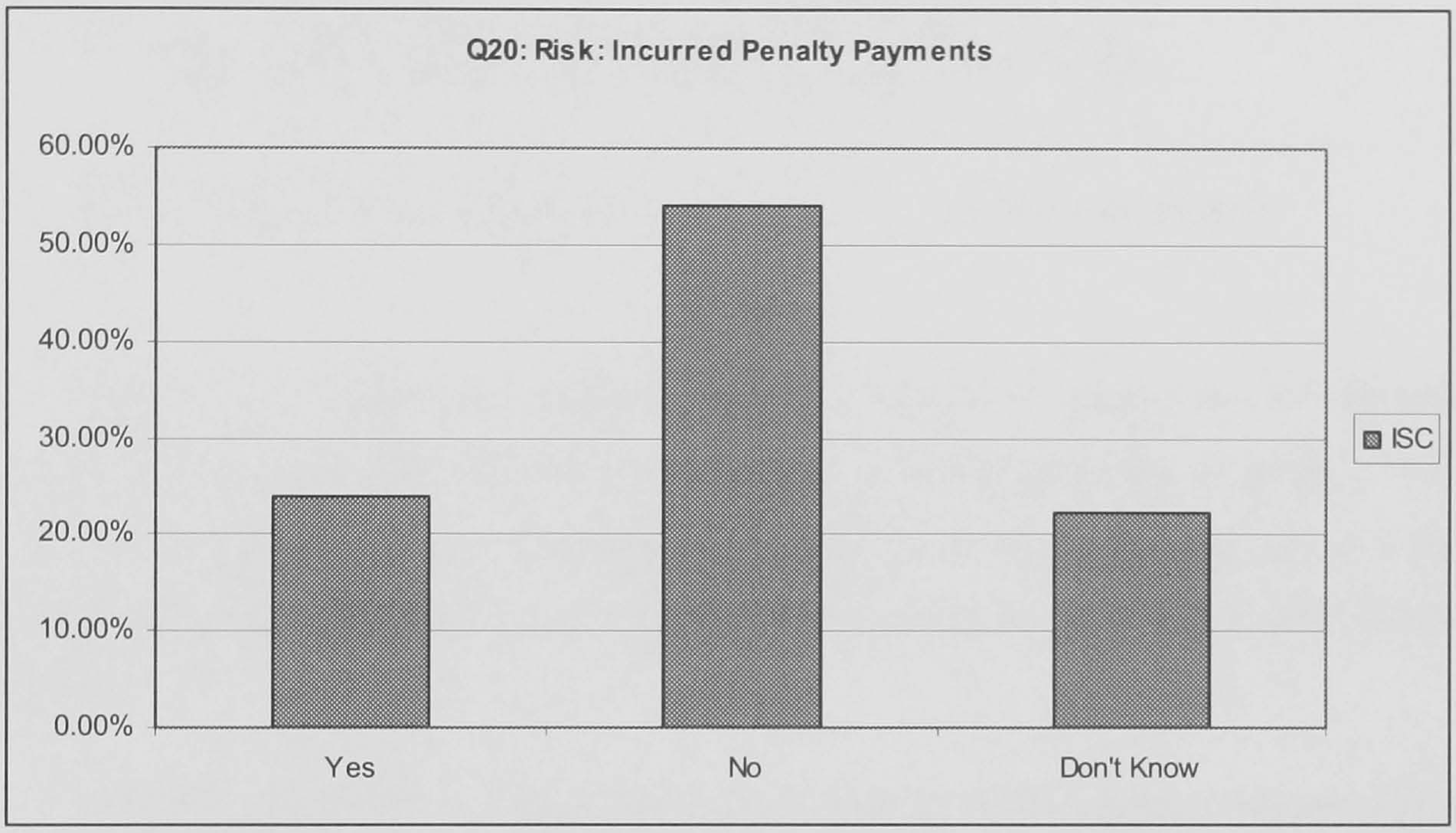

Figure 7.20 Risk of Penalty Payments. Source: Developed for research.

7.9.11 Fear of Contamination.

This barrier refers to how an employee would be disposed to sharing information or knowledge with a business partner if the business partner were of the same or similar professional level. The question asked of the different groups was 'does the level of collaboration have any correlation to the level of professionalism of the recipient within the business partner organization?'

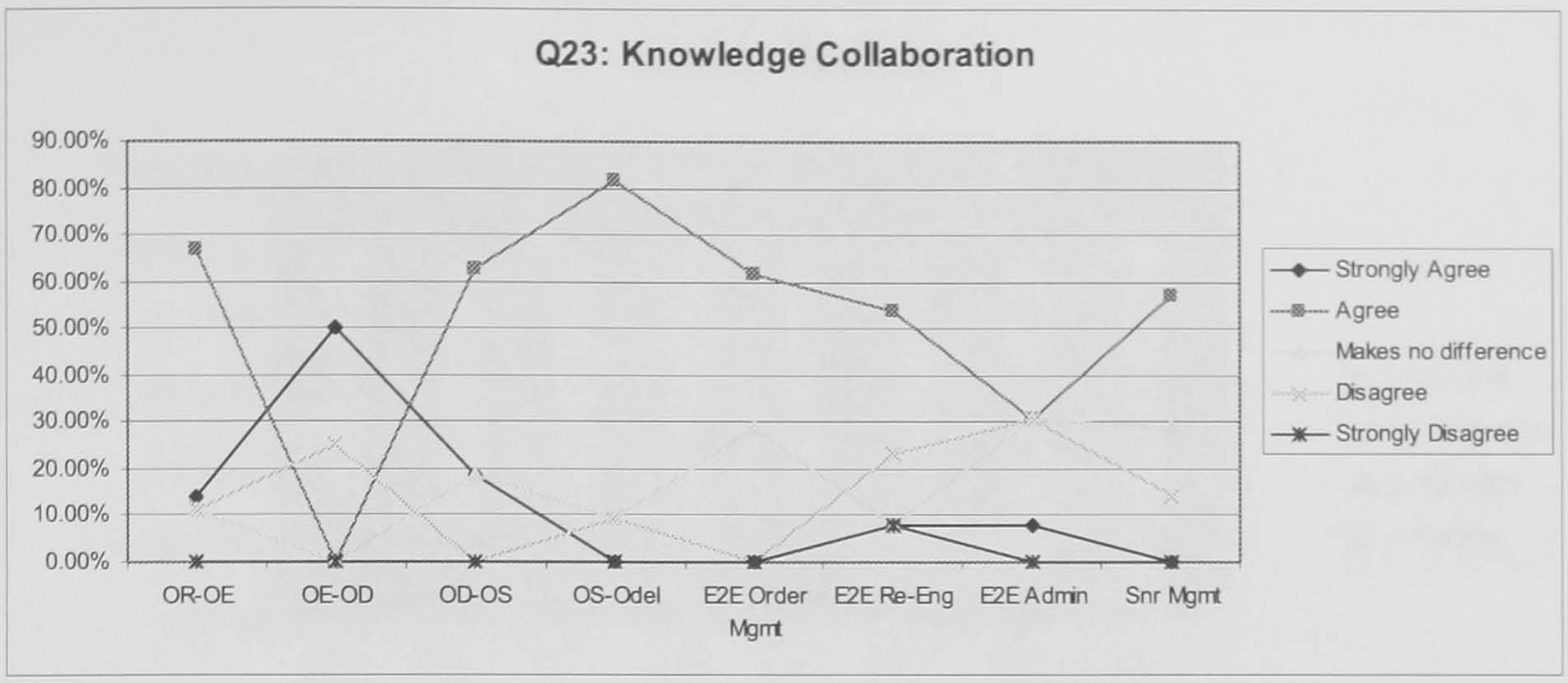

Figure 7.21 Knowledge Collaboration. **Developed for research.**

Figure 7.21 shows the response from the different groups to the question concerning collaboration. Across all the groups, with the exception of group 7 (E2E Admin) the feeling is that an equally perceived level of professionalism is a key component in an employee's desire to share information or knowledge with business partners.

It can be inferred from this result that in order for inter-company partnerships to improve information and knowledge sharing collaboration, individuals must know who the recipient of the information or knowledge is, and their level of professional competence. Once again it can be seen that there are possible links between fear of contamination and other barriers such as risk, trust, arduous relationships, and existing resources.

7.9.12 Time in current role and IBM.

Although time served is not one of the 25 barriers to information and knowledge sharing, the researcher believes it provides a good indication of an individual's experience within their respective role, and as part of the organization as a whole.

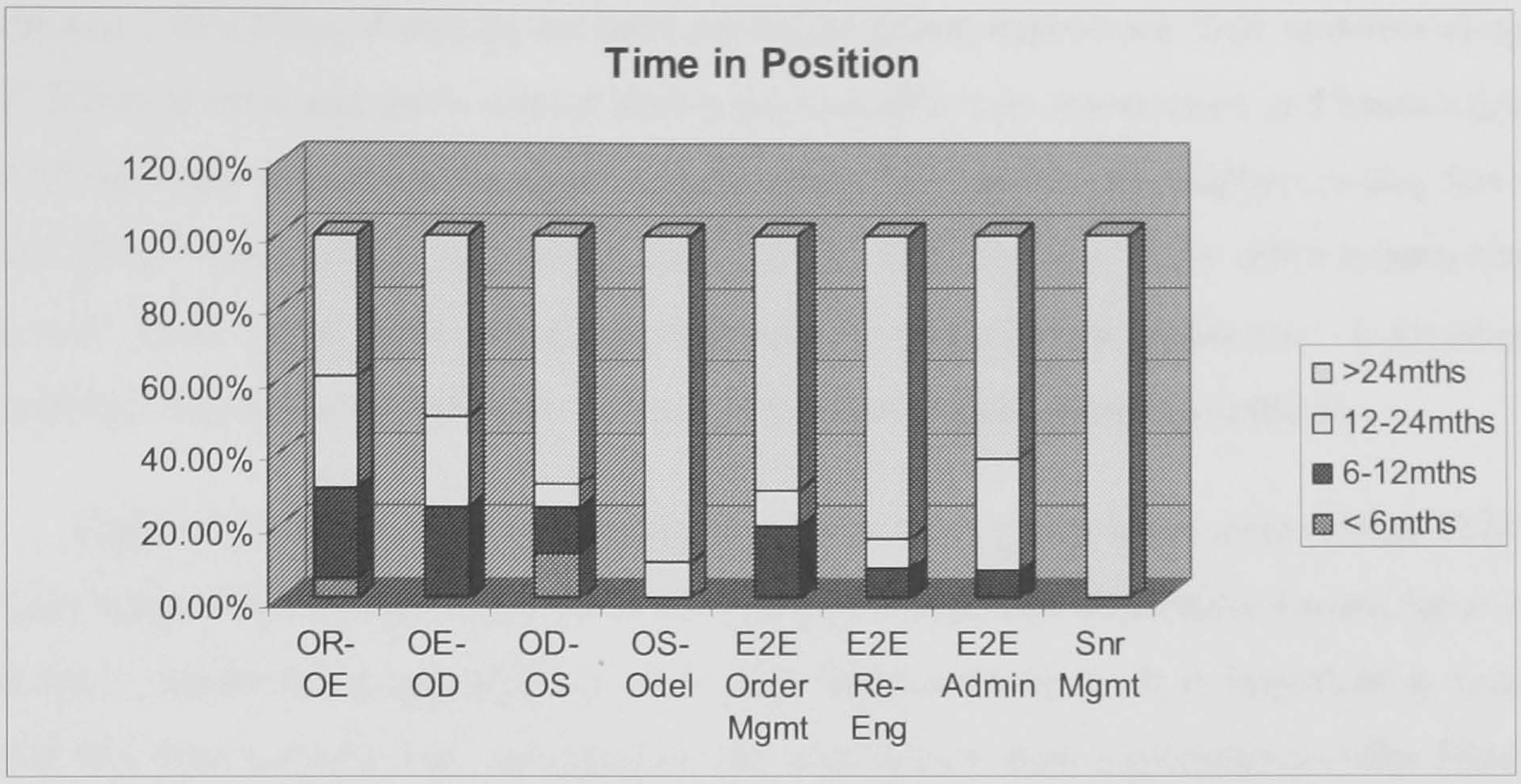

Figure 7.22 Time in Current Position. **Source: Developed for research.**

Figure 7.22 shows the time employees have spent in their current roles within the ISC, and more specifically within the different groups. Group 1 (OR-OE) has the least experienced work force with nearly 60% under 2 years experience. At the other end, group 8 (Senior Management) has the most experienced employees with all of them having over 2 years experience in their current role.

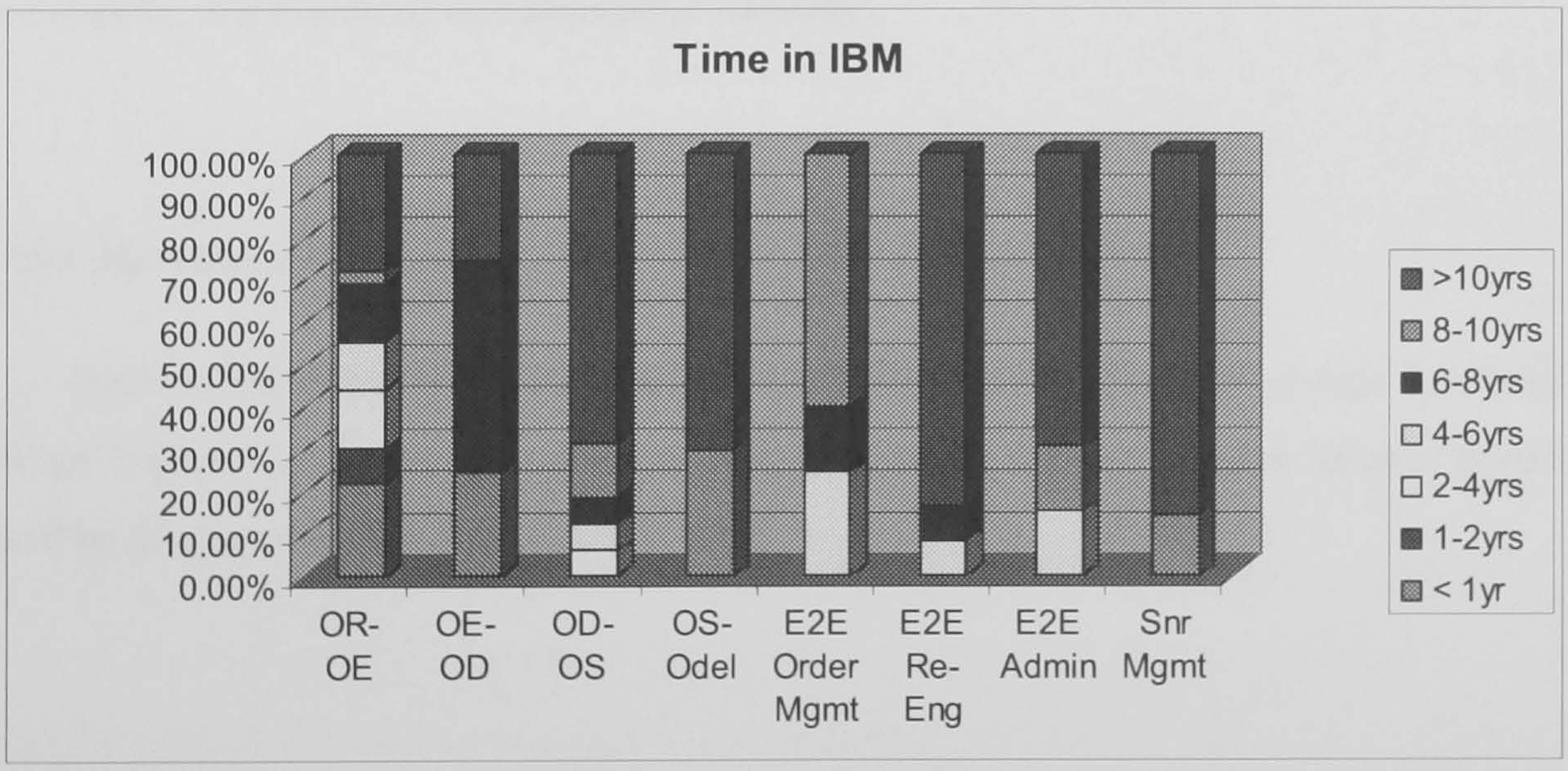

Figure 7.23 Time in IBM. **Source: Developed for research.**

However, as already identified, a shared understanding of roles and business goals is felt by many employees to be important to improved information and knowledge sharing. Therefore, if employees have cross-functional experience their understanding of different roles and goals should have a positive effect on information and knowledge sharing across the vertically aligned organization. So, whilst some employees may have less than 2 years experience within their current role they may have other experience gained from other parts of the organization; organizational awareness, leadership qualities, understanding of business goals, customer insight, planning skills etc.

Figure 7.23 shows how long employees from each group have spent within IBM. Once again from an IBM perspective the group with the least experienced work force is group 1, whilst the group with the most experience is group 8. It is important to note that this does not take into consideration an employee's work experience outside IBM. However, external hiring has been limited due to cost restructuring and the desire to fill positions by internal employees. Therefore, although external hires cannot be ruled out, the researcher believes that their impact is negligible across the eight groups tested. It is important to note though that organizations that rely on a temporary work force will have to contend with the fact that these employees will not have any in-depth understanding of the organization's goals, or the different roles that support key horizontal business processes. This in turn can have a significant impact on the existence of the key barriers such as arduous relationship, existing resources, causal ambiguity, and retentive and absorptive capacity.

7.10 Barriers which support the Null Hypothesis (*Ho*): p>0.05

Each of these barriers was assessed for impact across the eight groups surveyed. What follows is a breakdown of the remaining barriers. Specific impact for each barrier will be discussed as follows.

7.10.1 Existing Resources.

This is a cross category barrier that looks at those general aspects of the work environment that employees feel impact the way they create and share information and knowledge with colleagues.

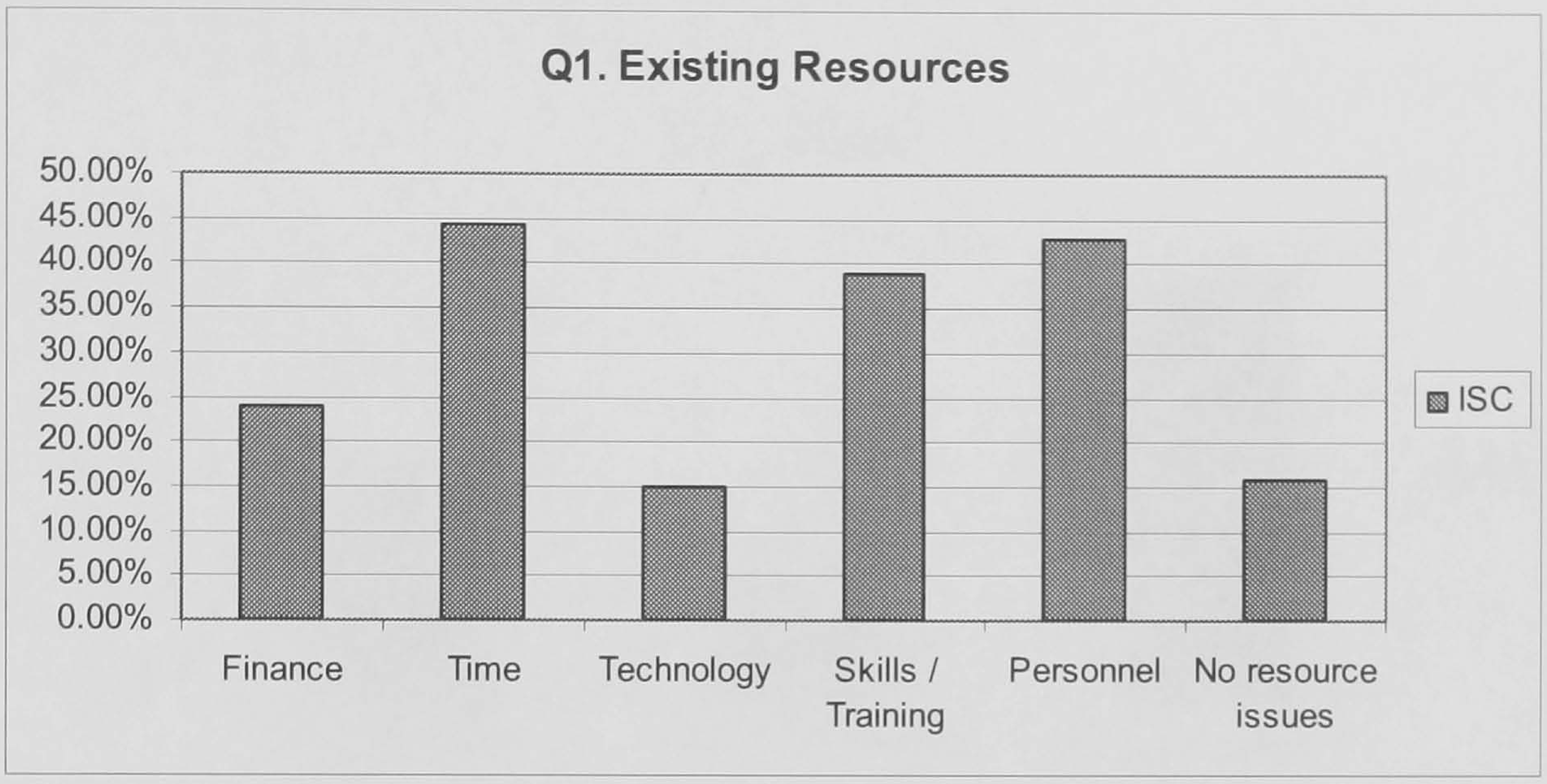

Figure 7.24 Existing Resources. **Source: Developed for research.**

From Figure 7.24 the main environmental issues are time, lack of personnel, and skills and training. From the comments received from the employees involved in the survey the three areas of impact are linked (Appendix E). There was a definite feeling of time pressure to complete work that was being compounded by lack of training and skill on new systems (SAP, i2 etc). The problem was aggravated further by a high turnover of agency staff.

Across the board, technology is only seen as being an issue in 15% of the responses. However, the skills and training issues relate in no small way to using the new and existing technology. In effect the technology issues refer to explicit-to-explicit transfer, whilst the skills / training issue refer largely to tacit-to-explicit and explicit-to-tacit transfer issues.

7.10.2 Rewards.

This barrier refers to how the existing reward structure within a complex organization supports information and knowledge sharing. The employees across the group were asked if the existing reward systems encouraged them to work as part of a team, or to concentrate harder on excelling as an individual.

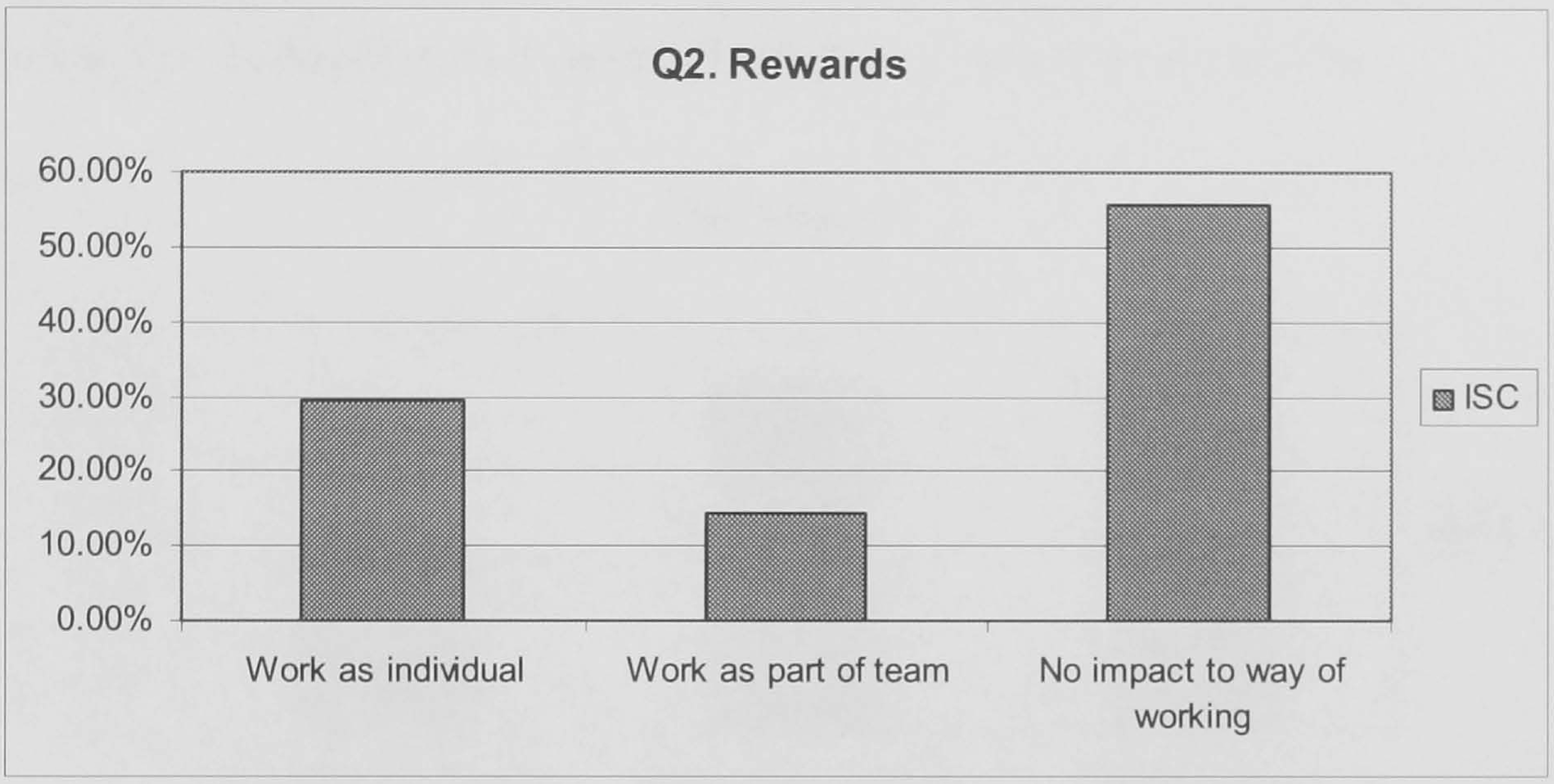

Figure 7.25 Rewards. **Source: Developed for research.**

From the responses received (Figure 7.25) only 14.29% said the reward systems encouraged them to work as part of a team. As teamwork is seen to be more conducive to better innovation and knowledge sharing (von Krogh *et al*, 2000; Nonaka *et al*, 1995) it is desirable that this response should be the highest. 29.37% returned the response that the reward system encourages them to act and work as an individual, and 55.56% say the reward systems does not influence the way they work. This points to the fact that a high proportion (55.56%) of the population does not believe that the reward system works and that they will be rewarded irrespective of how they perform, whilst the next highest proportion (29.37%) believe the system is working to develop a culture counter to that which it wishes to achieve. In effect it could be said that the existing reward system is failing, and is a significant barrier to information and knowledge creation and sharing.

7.10.3 Culture.

This barrier refers to the type of culture organizations develop for information and knowledge transfer and retrieval. In effect what is trying to be determined is whether the culture is an information / knowledge 'push' or 'pull' culture (Kluge *et al*, 2001). This is an important consideration in any knowledge environment as it underlines the subtle difference between pushing information to employees and developing a desire within your employees to seek out the information or knowledge themselves.

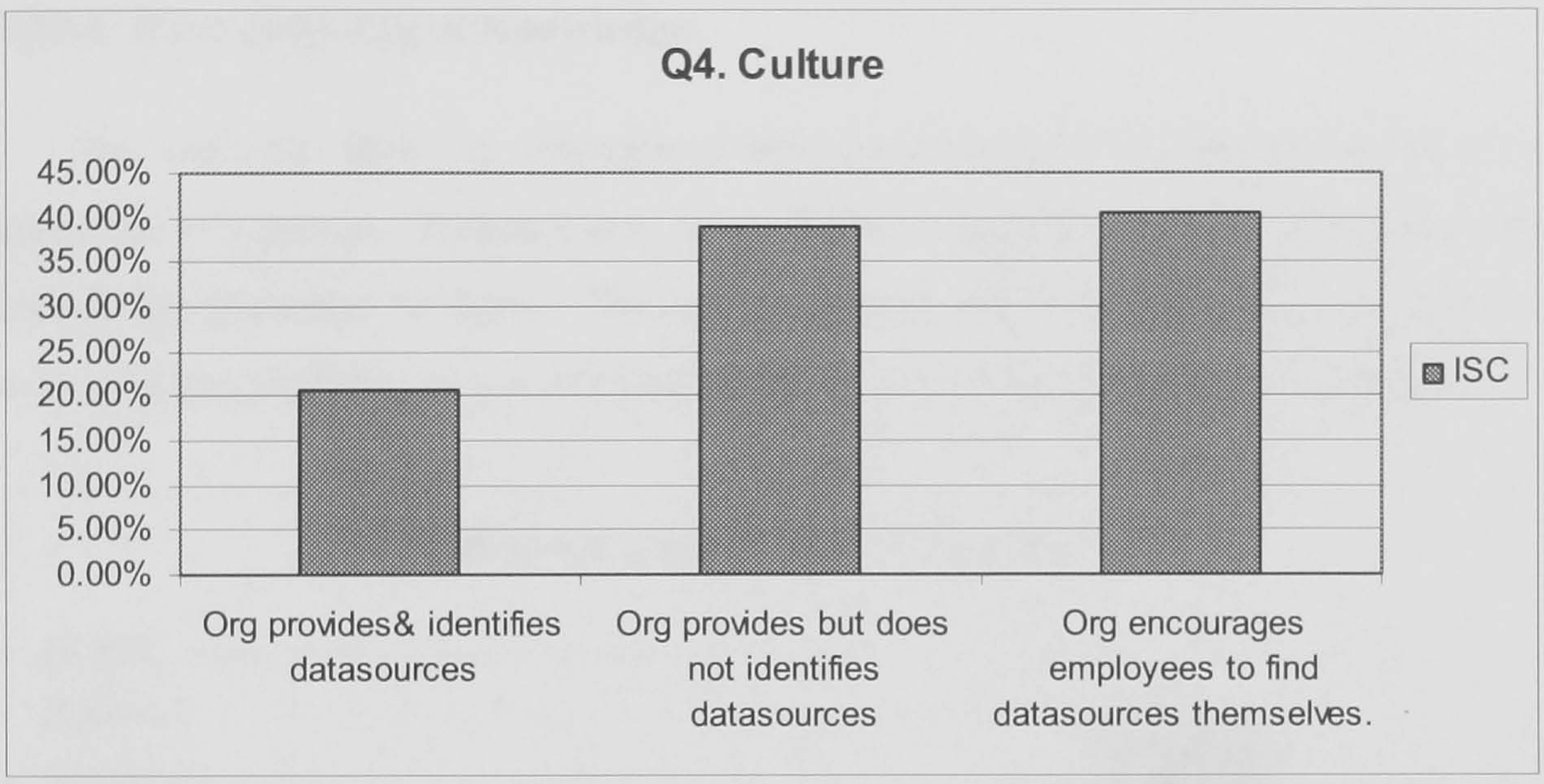

Figure 7.26 Knowledge Culture. **Source: Developed for research.**

From Figure 7.26, 40.48% of the population believes that the organization positively encourages individuals to seek out information for themselves whilst 37.89% see the organization as providing the information but not necessary encouraging them to seek it out. However, 20.63% believe the organization provides and identifies all the data sources they need. What this tells the researcher is that 40.48% work within a 'pull' information and knowledge culture, whilst 20.63% are happy to work within a 'push' culture. The 37.89% are aware that information pertinent to their jobs lies in data repositories that may or may not be known to them. As they feel the organization does not encourage them to look to these data sources for information it cannot be assumed they do so. What can be assumed from the result is that the dominant culture is 'pull'. However, there is still a significant 'push' element expected by the workforce. This may be expected, as there will always be a degree of expectation on the part of the employee for the organization to provide the necessary data to complete the job. Although this gives an overview of the culture across the organization it would be very interesting to see how the push / pull expectation changes across the organization. To what degree is it dependant on experience and time served? How do employees 'push' or 'pull' information based on the knowledge strategy being used i.e. codified or personalised?

7.10.4 Poor Targeting of Knowledge.

The outcome from the response to this question does not directly indicate the existence of a barrier. It does show, however, how employees access information and knowledge important to them. The question asked was how employees, when faced with a unique problem, access information that will help them resolve the problem.

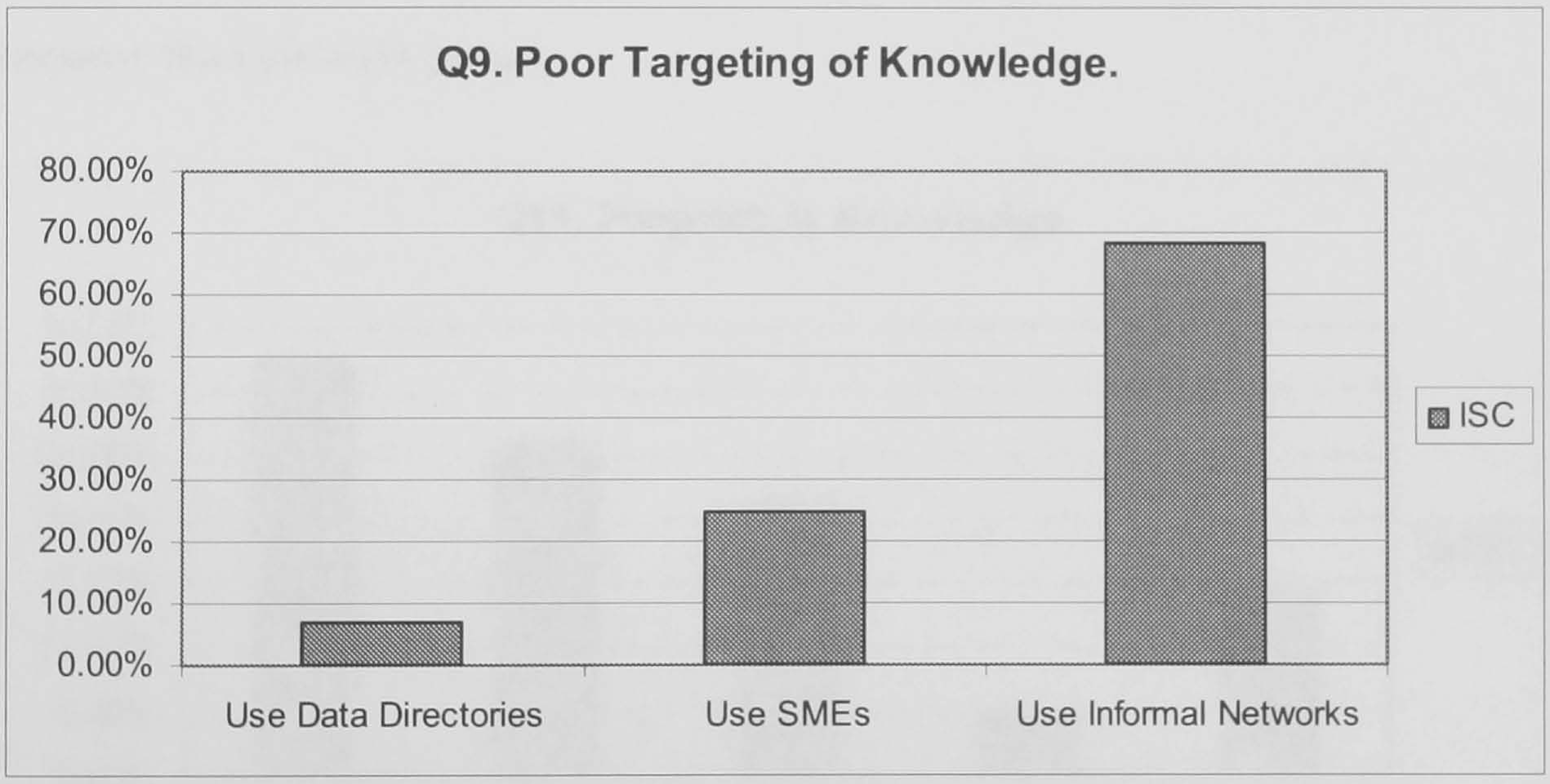

Figure 7.27 Knowledge Targeting. **Source: Developed for research.**

Figure 7.27 shows the responses for the eight groups surveyed. It is interesting to see that 67.25% of those polled rely on informal networks with 24.6% using designated department subject matter experts. However, in remarks provided by employees a lot of them felt that the use of SMEs would be a good idea if they knew who the SMEs were. Only 7.14% relied on existing data directories to help resolve unique problems. This response shows a willingness on the part of the employee to seek information and knowledge from information and knowledge sources that are not specifically identified by the organization. This lends further support to the existence of a 'pull' information and knowledge culture. The response also points to the fact that the existing codified data repositories are not very flexible when employees need information that in any way deviates from the standard format. This in itself may become a barrier to knowledge and information transfer in a dynamic business environment such as the one IBM is currently in.

It is also worth remembering that although employees are not averse to using informal networks, they may still be limited in their success in acquiring the necessary data to answer their specific queries.

7.10.5 Proprietary Knowledge.

This barrier refers to how employees share information or knowledge developed within their own work environment with other employees. Figure 7.28 shows the response from the eight groups.

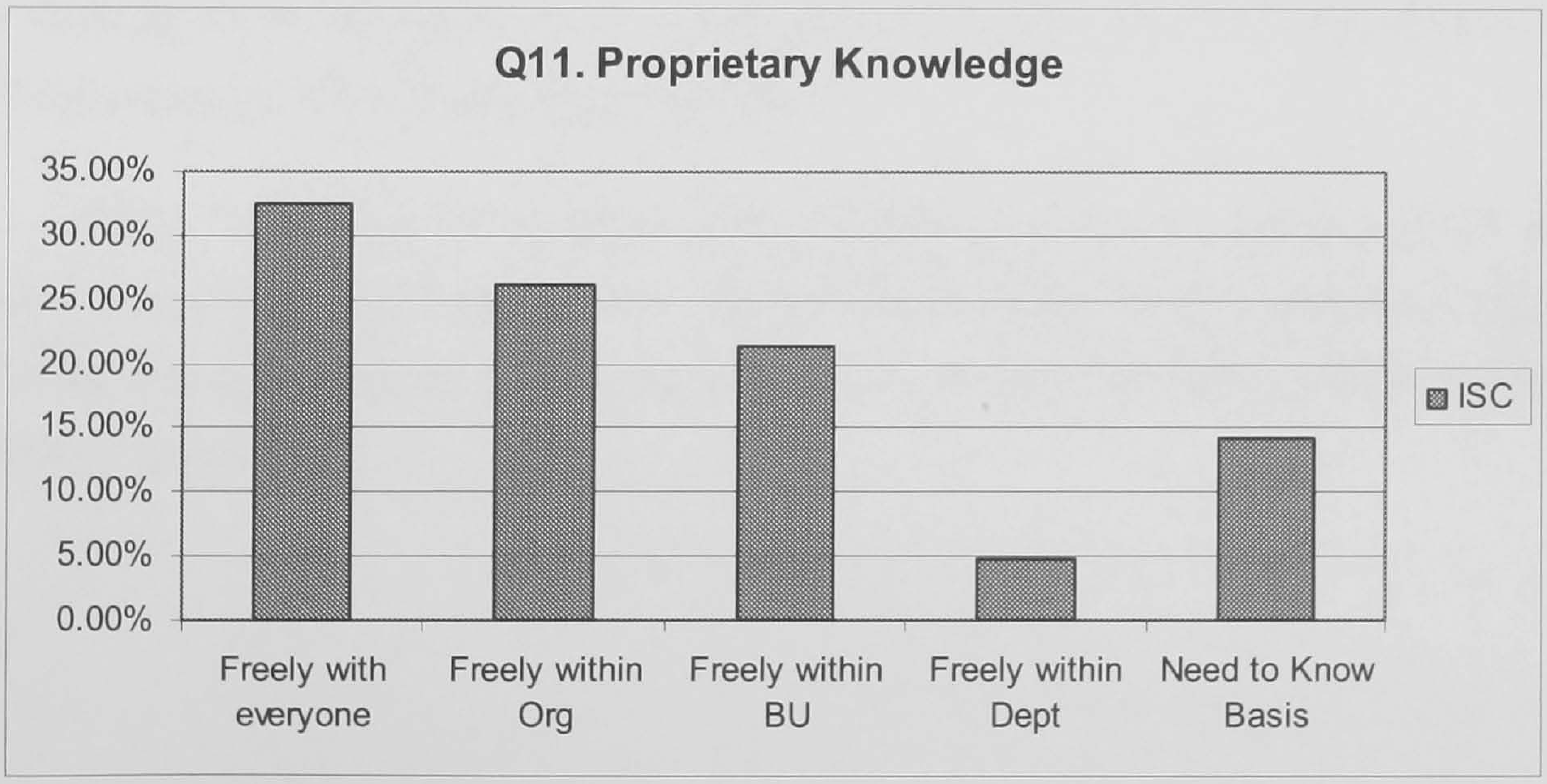

Figure 7.28 Proprietary Knowledge. **Source: Developed for research.**

The general consensus is one of openness regarding the sharing of proprietary knowledge, certainly down to business unit level. In effect 80.16% of the polled employees believed that proprietary knowledge or information should be shared openly and freely with everyone at least within the same business function. For the purposes of this question the business function refers to the ISC 'order flow' process. Only 14.29%

of the employees polled believe that proprietary knowledge or information should be shared on a 'need to know' basis.

However, this shows that people will share their proprietary information or knowledge and not just on the basis of whether the recipient is internal or external to their organization or group. From the response given it would appear that people would also take into consideration the proximity of the recipient from an organizational linkage perspective. This may also tie in with an employee's desire to minimise risk of contamination, risk of incurred penalties, or trust in the recipients to use the information / knowledge correctly.

7.10.6 Organizational Context.

This barrier looks at how well employees believe the organization is structured to support the creation and sharing of information and knowledge. The question does not distinguish between codified or personalised approaches to managing information and knowledge flows, but instead looks to understand the employee's overall perception of the organization's ability to manage these flows.

Figure 7.29 shows the response from the groups surveyed. The population is almost equally divided between those who believe the organization's structure is right for the way information and knowledge needs to be created and shared, with those who believe it does not.

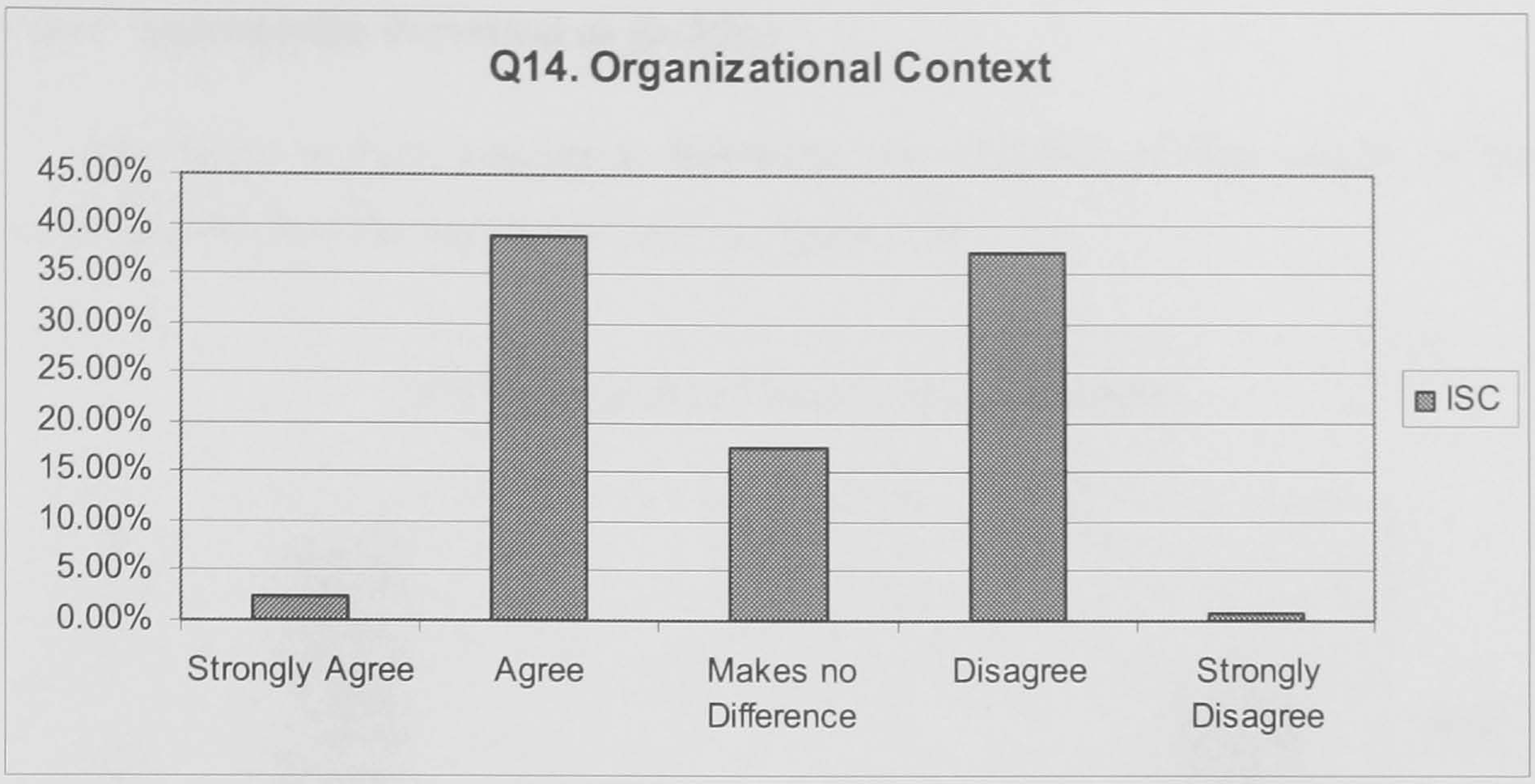

Figure 7.29 Organizational Context. **Source: Developed for research.**

However, the graph also tells us that only 41.27% believe that the structure is conducive to information and knowledge creation and sharing. 57.73% believe that the structure does not enhance creation and sharing. Therefore, some concern exists as to whether the current organizational structure is right for the new information and knowledge needs of the organization.

Comments provided by the employees point to a potential problem area that is also recognised as a barrier to improved supply chain performance (Hammer *et al*, 1993; van Weele, 2002). In analysing feedback from employees the researcher was able to pick out the current hierarchical organizational structure as an area of discontent. A lot of employees believe the vertical structure, or functional alignment, impacts sharing in that there is a perception that 'information sharing is political'. Also the vertical structure allows for the misalignment of business goals that can further impact information and knowledge creation and sharing.

7.10.7 Information Perceived as Reliable.

This looks at how employees determine the reliability of the sources of data available to them. The results are show in Figure 7.30.

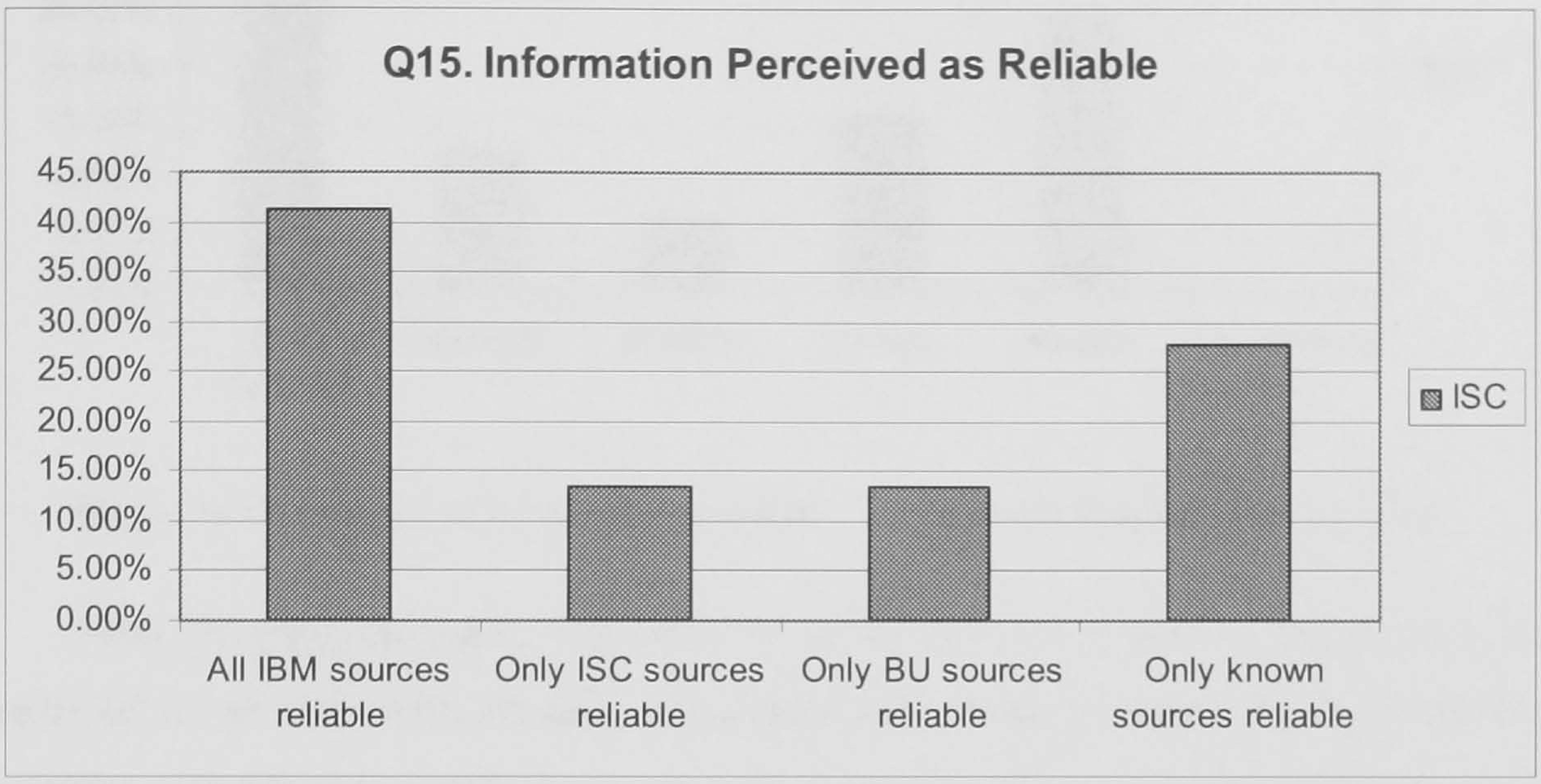

Figure 7.30 Reliable Information. Source: Developed for research.

It is interesting that the view concerning perceived information reliability is as shown. 41.27% believe that all IBM sources of information are reliable, 13.49% are only prepared to rate IBM ISC sources as reliable, 13.49% are only prepared to trust information sources within their functional or vertical business unit, whilst 27.78% will only trust information that they personally know.

The comments received during the survey help clarify the position somewhat further. There is a feeling that information received via systems is not always reliable. This may be for a number of reasons, such as that the information is not relevant, is not accurate due to system time delays or that the recipient does not know where or how the information is being sourced.

An additional question was asked to try to gauge the percentage of reliable information employees perceived they received during the course of their work. The response is provided in Figure 7.31.

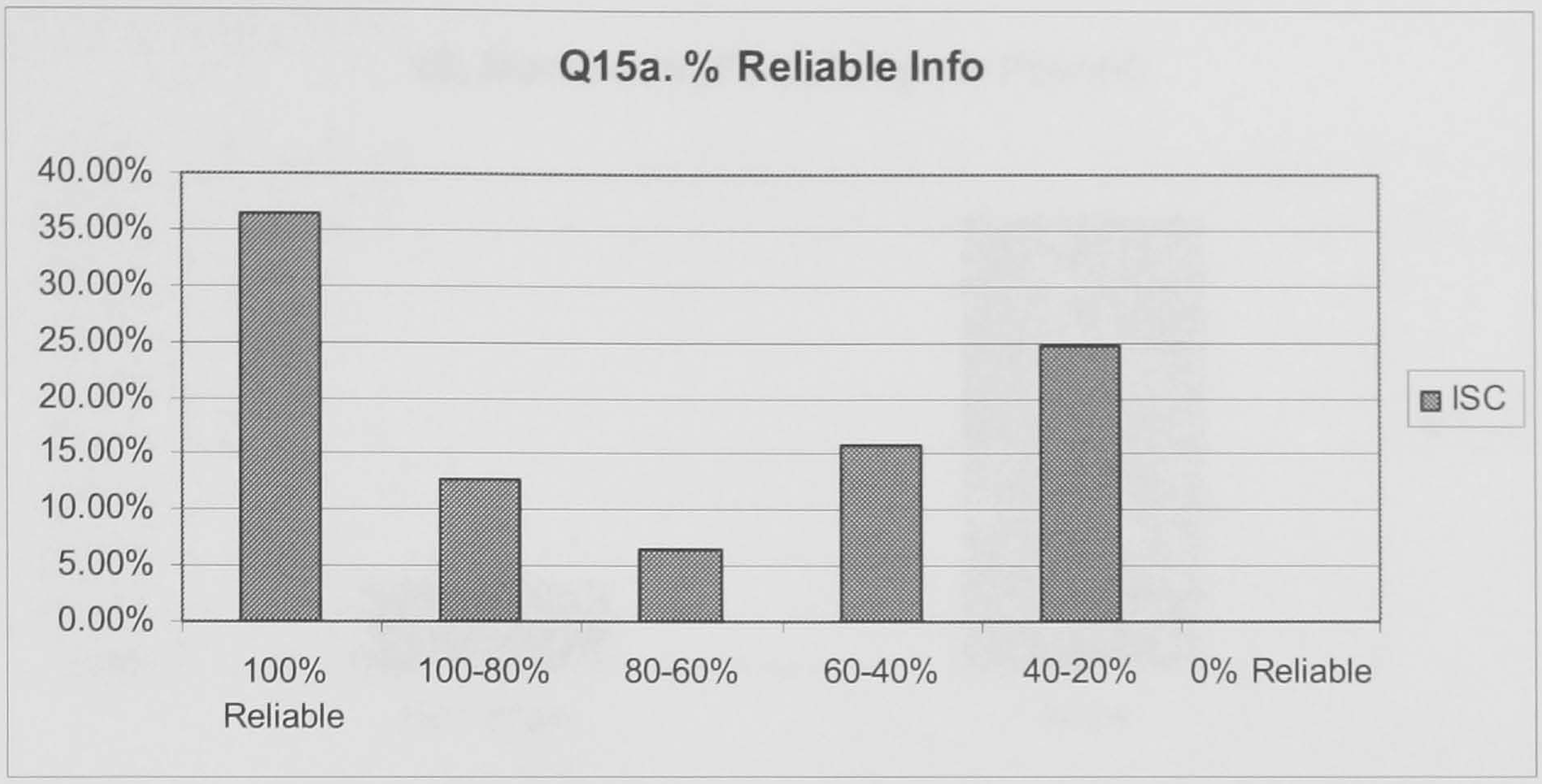

Figure 7.31 Percentage of Reliable Information. Source: Developed for research.

From the graph in Figure 7.31, 40.07% of the population believe that information received is less than 60% reliable. Considering the large investment IBM (and other complex organizations) invests in systems support, this is not a good result. It is important to understand what drives this lack of confidence. Once again looking at responses from employees, a main concern is how data is updated and kept current on the systems. There are multiple systems that provide different levels of the same data, which in turn can provide confusion – in this case too much data can cloud the picture and cause errors in the correct evaluation of that data.

7.10.8 Motivation (Knowledge is Power).

This barrier looks at how individuals share information based on the premise that knowledge is power. Figure 7.32 shows how the employees polled responded to this question.

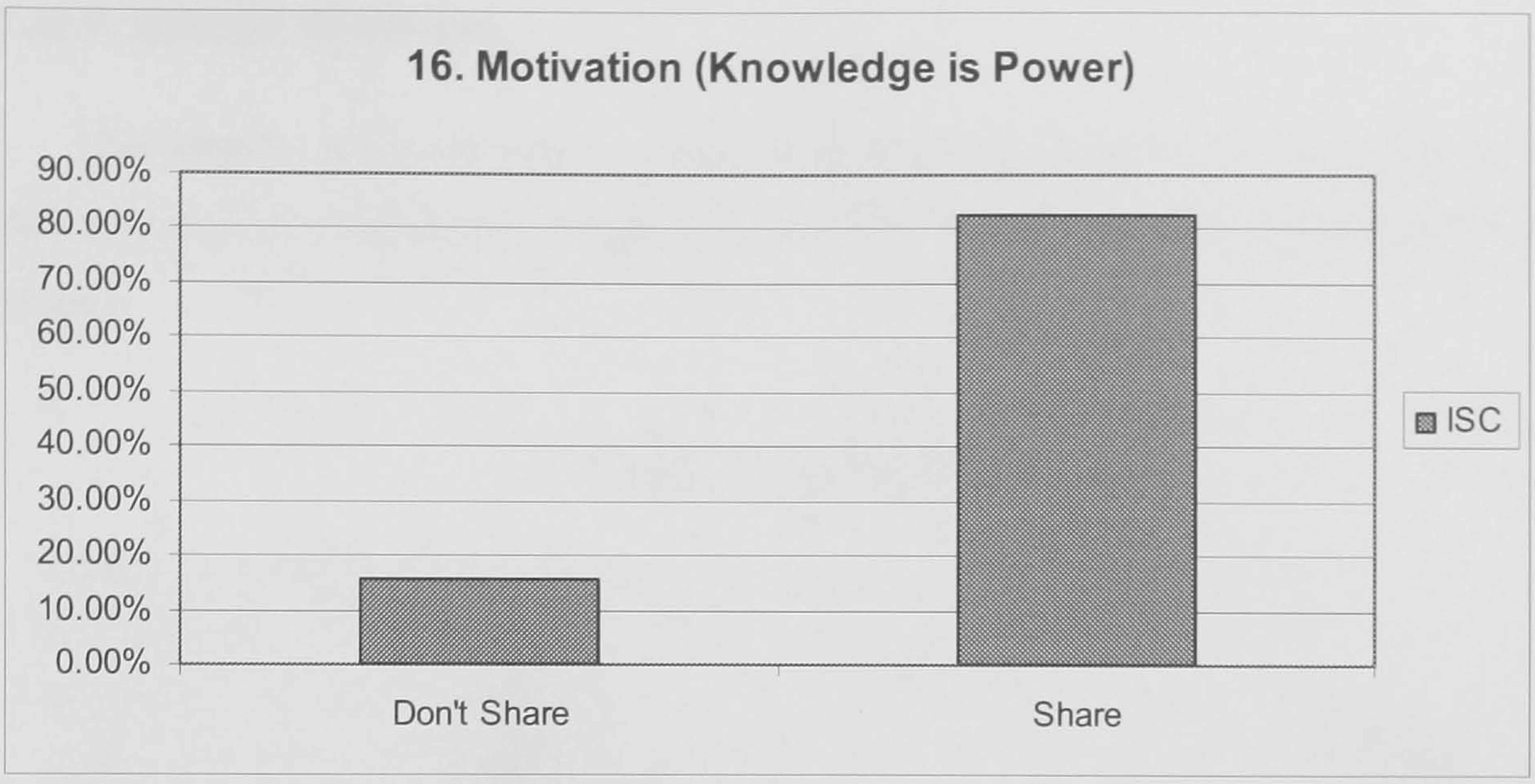

Figure 7.32 Motivation (Knowledge is Power). Source: Developed for research.

The response showed a desire to share knowledge as opposed to hoard knowledge for individual gain. What is interesting about this result is the belief that their sharing of information and knowledge enhances an individual's worth to the organization. Considering the overall response concerning rewards, where it was not felt that the reward system was driving a 'team' culture, is something else at work within the organization which is driving this level of cooperation? Some employees alluded to a reason for this being the need to develop as a generalist within their respective work groups. It was felt that to do so would allow greater job flexibility and security. Therefore, in order to acquire new knowledge one must be prepared to share knowledge. This was an interesting shift from a view that employees can make themselves more valuable to the organization by hoarding information and knowledge. In an environment where business is constantly changing focus and direction, new skills are constantly in demand. Employees, to improve their job security, need to pick up and constantly develop new skills.

This desire, or need, to redefine who they are and their value to the organization is eclipsing the need to develop themselves as unique knowledge brokers within specialized work domains.

7.10.9 Internal Resistance.

This barrier refers to how a desire to protect the interests of the department, business unit, or organization might impact on the way information or knowledge is shared.

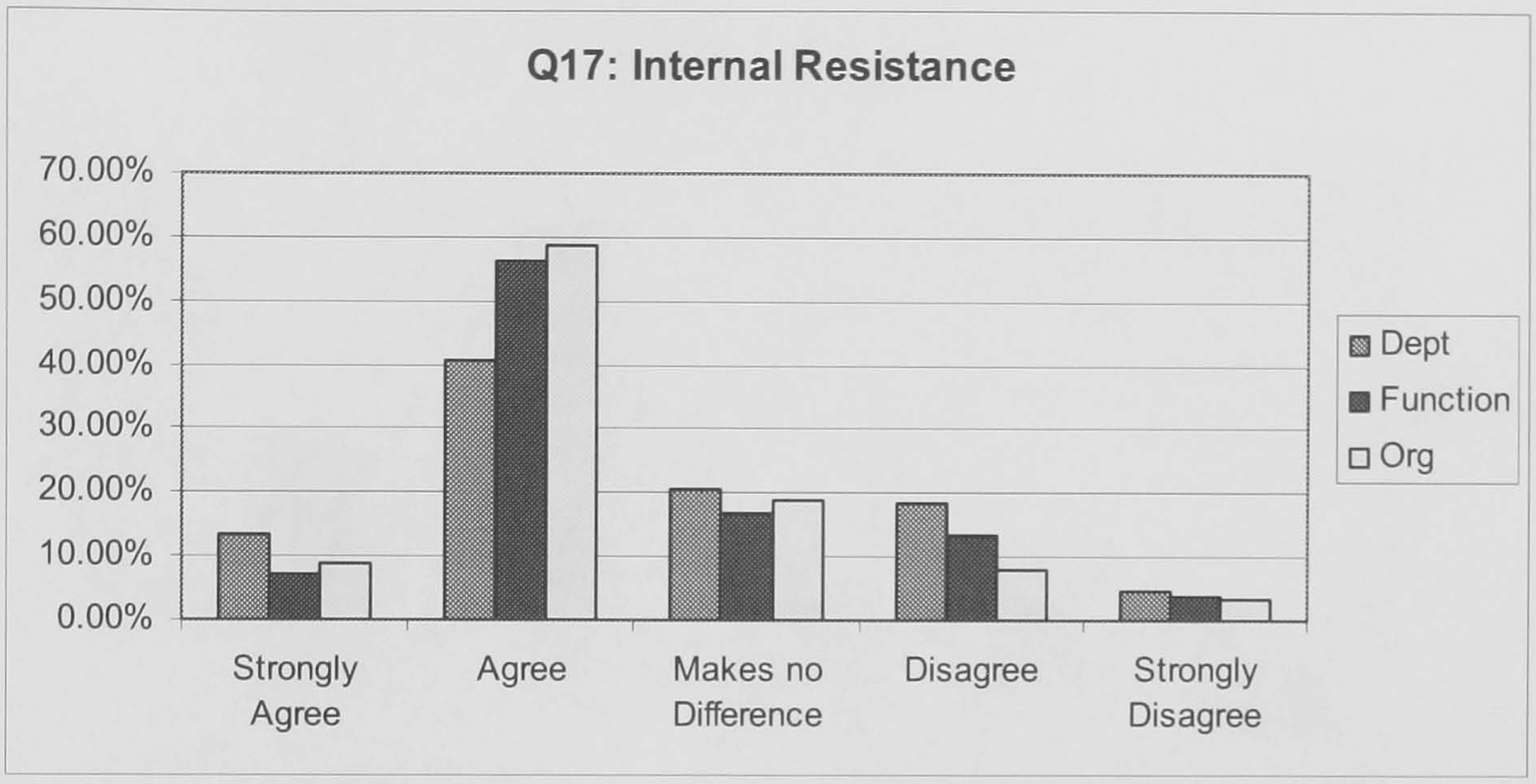

Figure 7.33 Internal Resistance. **Source: Developed for research.**

From the responses shown in Figure 7.33 employees certainly view this as an issue when considering who to share information and knowledge with. From the graph the employees are firstly concerned with protecting the interests of the organization, then the functional business unit, and then their respective departments.

The results in Figure 7.33 are supported by the comments received from employees when asked about the internal resistance barrier. Some employees had experienced internal resistance between functions and departments. It was generally felt that the problem was not necessarily down to people hoarding information as per the 'Motivation' (knowledge is power) barrier, but more to do with misalignment of business goals and functional business unit objectives.

7.10.10 Self Interest.

This barrier refers to the way employees may censor information to be shared with business partners and suppliers. The primary driver for this behaviour is to prevent sensitive information passing on to competitors.

Figure 7.34 Self Interest. **Source: Developed for research.**

Figure 7.34 shows the response from the groups surveyed. An overwhelming 87.88% are in agreement that self-interest is a main consideration when sharing information and knowledge with suppliers and business partners. This is an important barrier to be aware of considering the trend within supply chain organizations to develop out-sourced and strategic alliances with third parties. If the individuals within the organization do not trust the third party to use the information in a confidential manner then the information and knowledge sharing will not be optimised.

7.10.11 Collaboration.

This barrier refers to how individuals regulate the amount of information they share with how much they receive in return. Figure 7.35 shows a graph outlining the responses provided from the eight groups surveyed.

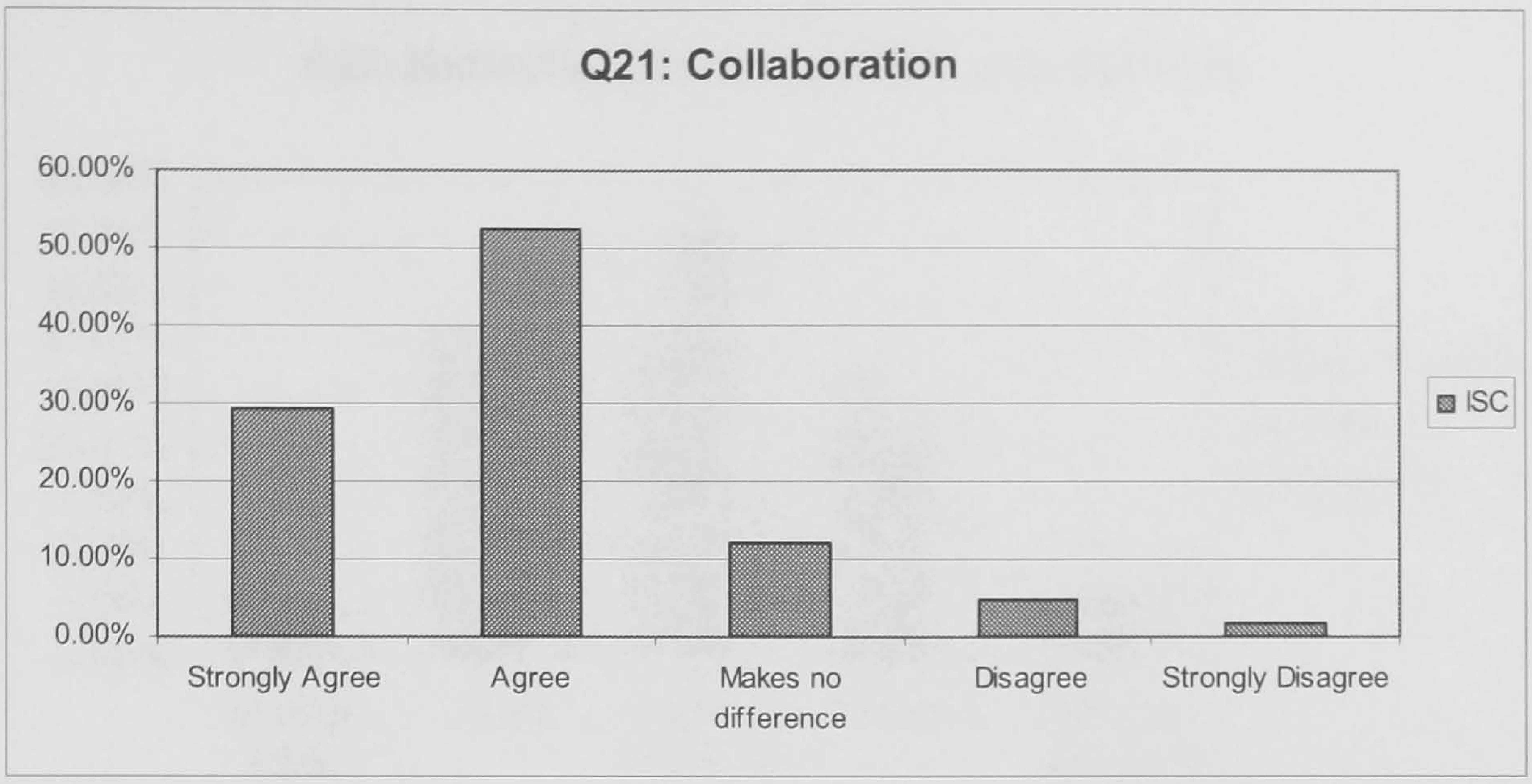

Figure 7.35 Collaboration. **Source: Developed for research.**

Whilst 11.90% said reciprocity of information did not matter, 81.75% said it did. In open information sharing organizations this may not cause a problem assuming the person seeking the information or knowledge has some information or knowledge of their own with which to 'trade'. However, this may not be always the case. From comments received and discussions with employees concerning collaboration 'two way transfer of information' is important if a 'successful relationship' is to be established. Incidental requests for information and knowledge may be impacted by the 'Internal Interest' barrier as already discussed. Employees see this barrier as being more an issue when individuals need to work together on a regular basis but one individual looks to acquire information rather than share information. In effect this barrier may be produced, as a result of an individual's desire not to share; such as in the case of the 'Motivation' (knowledge is power) barrier, 'Knowledge Cultural' barrier, and 'Distance' barrier.

7.10.12 Motivation (Not Invented Here).

This looks at an individual's resistance to using information or knowledge that has not been developed locally. Figure 7.36 shows the collective response from the eight groups when asked if they felt resistance from other groups to use their information based on geographical separation, cultural difference, or language.

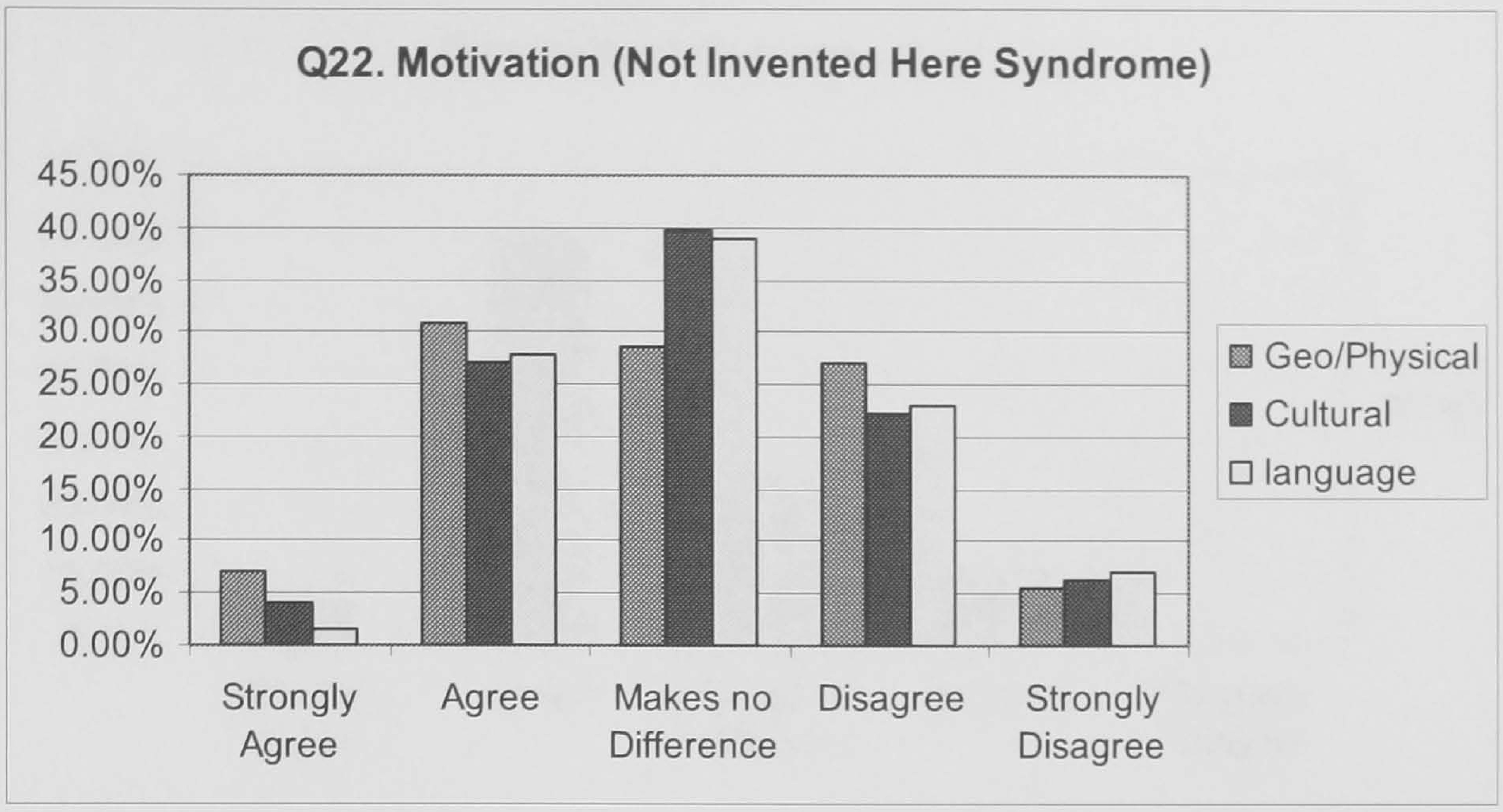

Figure 7.36 Motivation (NIH). **Source: Developed for research.**

From the graph it can be seen the majority of respondents 'strongly disagreed', 'disagreed', or felt this barrier 'makes no difference' to sharing information and knowledge. Of those that 'agreed' and 'strongly agreed' that they experienced resistance from fellow employees to use information and knowledge that they had developed, motivation based on geographical separation was felt to be the most common reason (39.09%). This was followed closely by cultural differences (30.95%) and language differences (29.37%).

Once again they are possible links between this barrier and other barriers such as 'Trust', 'Knowledge Unprovenness', and 'Reliability'.

7.10.13 Lack of Retentive Capacity.

This barrier refers to how information or knowledge that has been created as part of the organizational learning cycle can be captured in order to allow its re-use and dissemination throughout the organization. In order to gauge if this barrier is present the questionnaire's recipients were asked if they felt the existing IT systems allowed them to store and implement their new knowledge or information if in a format which differs from the required data formats for the existing systems. Figure 7.37 graphs the responses received.

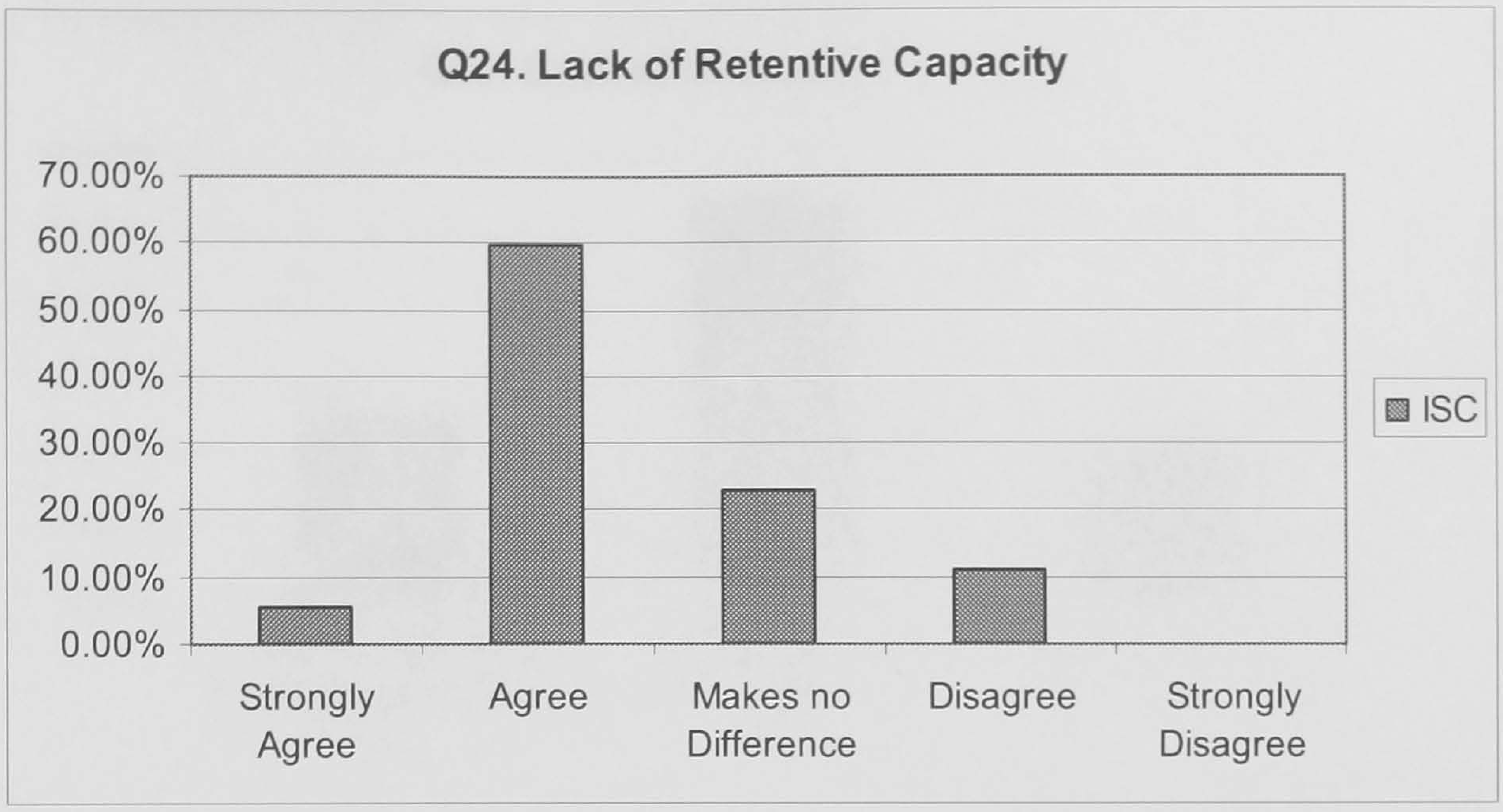

Figure 7.37 Retentive Capacity. **Source: Developed for research.**

From the graph in Figure 7.37 it can be seen that a significant proportion of the population polled believes the current systems are not capable of storing new information or knowledge in a format that differs from the existing data format. This becomes an issue when employees want to provide information on problems that they have encountered and solutions they may have implemented. In effect this is seen by 66.08% of the polled population as being a barrier that prevents the organization from capturing and sharing new knowledge that can help improve processes.

7.10.14 Lack of Absorptive Capacity.

This barrier impacts the ability of an individual or organization to identify information and knowledge that is of relevance to their business needs and objectives. In effect by identifying if this barrier exists one must look to see how individuals within an organization not only separate syntactic from semantic information but also identify and use information sources not necessarily directly related to their job. Those polled across the eight groups were asked how they identified information useful to them from the large amounts of data presented to them on a daily basis. Figure 7.38 graphs the responses received.

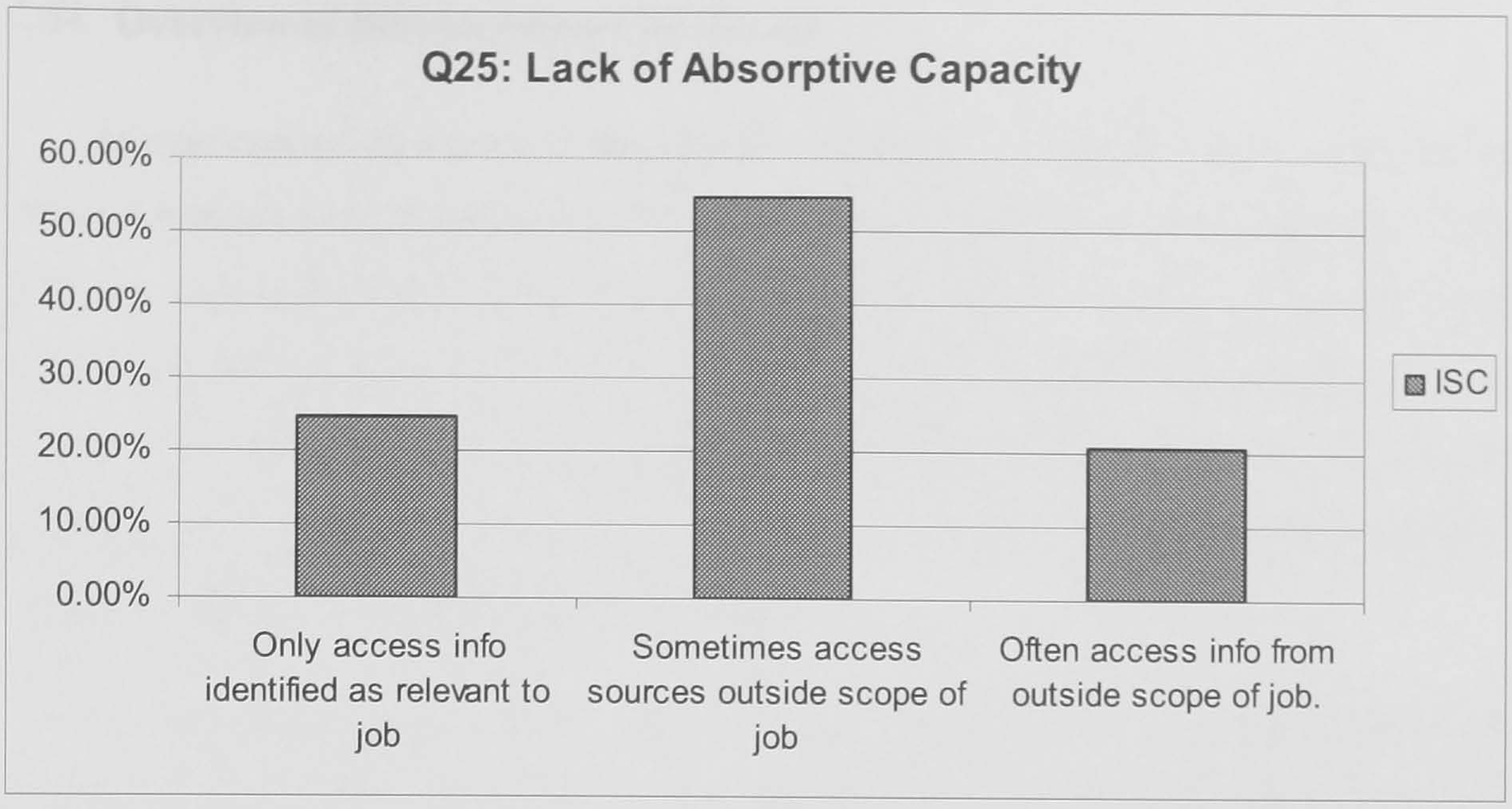

Figure 7.38 Absorptive Capacity. **Source: Developed for research.**

This barrier is quite similar to the 'Knowledge Culture' barrier already discussed. However, the difference between the two is that absorptive capacity looks at how the individual sources and accesses useful information, whereas 'Knowledge Culture' looks at how the organization tries to establish either a 'push' or 'pull' information environment.

From the response shown in Figure 7.38 54.76% of employees sometimes access information from sources outside the scope of their job, whilst 20.63% regularly access information from outside the scope of their job. This shows that 75.39% of the employees are prepared to actively look out with the scope of their jobs, and any identified data sources for information that will help them with their respective jobs. Although 24.69% of those employees polled will only access information from previously identified data sources, this does not in itself point to a lack of absorptive capacity. However, this inability to seek new relevant information from different information repositories may impact an individual's absorptive capacity more so than the individual who actively seeks information.

7.11 Overview of Barrier impact by Group.

The existence and impact of the identified barriers is varied across the eight groups. What is important to the research at this stage is not merely the existence of barriers, but how they are perceived to differ in impact across the different groups. From the results of the Kruskal-Wallis analysis we now know that the barriers are impacting the groups in different ways, and as such are affecting the information and knowledge creating and sharing behaviour of the employees in these groups. Table 7.10 gives a summary of the barriers' impact across the different groups.

It is also important to note that the barriers exist to greater or lesser extents across the organization. The notion of a barrier simply existing or not existing is not valid. Through the questionnaire and observations and interviews the barriers also appear to link into, and influence other barriers.

Barriers by Category	Gp1	Gp2	Gp3	Gp4	Gp5	Gp6	Gp7	Gp8
Cross Category Barriers								
Existing Resources	Key resources impacting are Time, Personnel, and Training	>>	>>	>>	>>	>>	>>	>>
Rewards	14.29% believe current reward system encourages team working.	>>	>>	>>	>>	>>	>>	>>
Arduous Relationship	Understanding on job / Shared understanding of goals	Understanding on job / shared understanding of goals	Need face to face contact / shared understanding of goals	Understanding on job / shared understanding of goals	Understanding on job / shared understanding of goals	Need face to face contact / understanding on job / shared understanding of goals	Understanding on job / shared understanding of goals	Understanding on job / shared understanding of goals
Culture (Knwledge Strategy)	Dominant culture is encouraging information 'pull'.	>>	>>	>>	>>	>>	>>	>>
Technology Barriers								
Available Technology	Allows Access, Create and Share	Allows Access, Create and Share	Allows Access NOT Create and Share	Allows Access, Create and Share	Allows Access, Create and Share	Allows Access NOT Create and Share	Allows Access, Create and Share	Allows Access, Create, NOT Share.
Legacy Systems	Impacts information transfer between IT systems.	Impacts / Seriously Impacts information transfer between IT systems.	Seriously Impacts information transfer between IT systems.	Impacts information transfer between IT systems.	No impact on information transfer between IT systems.	No impact on information transfer between IT systems.	Impacts information transfer between IT systems.	Impacts information transfer between IT systems.
Organizational Barriers								
Knowledge Strategy Implementation	Determine value of information through IT / Personal contact	Determine value of information through IT	Determine value of information through Personal contact	Determine value of information through Personal contact	Determine value of information through Personal contact	Determine value of information through IT / Personal contact	Determine value of information through IT	Determine value of information through Personal contact
Causal Ambiguity	Rely on IT to identify important info through org.	Rely on IT to identify important info through org.	Rely on personal contact to identify important info through org.	Rely on personal contact to identify important info through org.	Rely on personal contact to identify important info through org.	Rely on IT to identify important info through org.	Rely on personal contact to identify important info through org.	Rely on personal contact to identify important info through org.
Poor Targeting of Knowledge	Strong use of personal networks across organization to solve unique problems.	>>	>>	>>	>>	>>	>>	>>

Knowledge Cost	No perceived impact	>>	>>	>>	>>	>>	>>	>>
Proprietary knowledge	80% believe in sharing information freely at least down to BU level. Approx 5% only prepared to share at Dept level, and 15% on a need to know basis.	>>	>>	>>	>>	>>	>>	>>
Distance	Factors are present and need to be managed, but do not effect way employees do their job.	>>	>>	>>	>>	>>	>>	>>
Unprovenness	Assume all Org info sources reliable.	Assume peer sources reliable, but IT sources need to prove reliability	Assume all Org info sources reliable.	Assume all Org info sources reliable.	Assumes all Org info sources unreliable until proved otherwise.	Assumes all Org info sources unreliable until proved otherwise.	Assumes all Org info sources unreliable until proved otherwise.	Assume IT sources reliable, but peer sources need to prove reliability
Organizational Context	Opinion split as to whether org structure supports the creation and sharing of information / knowledge.	>>	>>	>>	>>	>>	>>	>>
Info not perceived as reliable	Only approx 40% see all IBM information as being reliable	>>	>>	>>	>>	>>	>>	>>
Motivation (NIH Syndrome)								
Physical Distance from Peers makes them less inclined to use your info/knowledge?	Majority 'Don't know' to 'Strongly disagree'. 39.09% say barrier exists.	>>	>>	>>	>>	>>	>>	>>
Does different work Culture make your peers inclined to use your info/knowledge?	Majority 'Don't know' to 'Strongly disagree'. 30.95% say barrier exists.	>>	>>	>>	>>	>>	>>	>>
Does the use of different Languages make your peers less inclined to use your info/knowledge?	Majority 'Don't know' to 'Strongly disagree'. 29.37% say barrier exists.	>>	>>	>>	>>	>>	>>	>>

People Barriers								
Internal Resistance								
Dept / Functional / Organizational level	Agree desire to protect interest effects sharing of info / knowledge.	>>	>>	>>	>>	>>	>>	>>
Self Interest (Sharing externally)	'Strongly agree' / 'Agree' in restricting info with Business Partners in case they pass it on to competitors.	>>	>>	>>	>>	>>	>>	>>
Trust	'Agree' that trusting recipients to use info correctly impacts sharing.	>>	>>	>>	>>	>>	>>	'Strongly agree' that trusting recipients to use info correctly impacts sharing.
Risk								
Risk of Penalty Payments impacts sharing.	23.81% Think this risk impacts sharing. 53.97% do not believe this risk impacts sharing, and 22.22% do not know.	>>	>>	>>	>>	>>	>>	>>
Risk of Profit Loss impacts sharing	Undecided	'Yes'	'Yes'	'Yes'	'No' / 'Don't know'	'Yes'	No Impact	'Yes'
Risk of Customer Dissatisfaction impacts sharing.	'Yes'	'Yes'	'Yes'	'Yes'	'No' / 'Don't know'	'No'	Undecided	'Yes'
Fear of Exploitation	'Strongly agree' / 'Agree' that reciprocity is important.	>>	>>	>>	>>	>>	>>	>>
Fear of Contamination	'Agree' that a shared professionalism needs to exist with partners for knowledge transfer to occur.	'Strongly agree' that a shared professionalism needs to exist with partners for knowledge transfer to occur.	'Agree' that a shared professionalism needs to exist with partners for knowledge transfer to occur.	>>	>>	>>	Mixed between 'Agree' / 'Don't know' / 'Disagree'.	'Agree' that a shared professionalism needs to exist with Partners for knowledge transfer to occur

Lack of Retentive Capacity	'Agree' IT systems are not flexible at capturing info in new formats.	>>	>>	>>	>>	>>	>>	>>
Lack of Absorptive Capacity	75.39% of employees polled actively look to capture and use new information / knowledge from different sources.	>>	>>	>>	>>	>>	>>	>>
Motivation (K is P syndrome)	Approx 80% say they are prepared to share information to improve their worth to the organization	>>	>>	>>	>>	>>	>>	>>

Table 7.10 Barrier Assessment by Group. **Source: Developed for research.**

Note: '>>' appears where impact/effect is the same as that noted for Group in column to the left.

For Table 7.10 the existence of all 25 barriers is confirmed, with only 'Knowledge Cost' as being perceived as having no real impact across the organization. Of the eleven barriers identified through the Kruskal-Wallis test, six showed a significant difference in barrier perception across the eight groups surveyed. The implication of this difference in perceived barrier impact is outlined in Table 7.11.

Barrier	Barrier Type	Implication.
Available Technology	Technology	*Across the groups, current technology is seen to allow access, creation, and sharing of information and knowledge to different degrees. So, where common technology supports one vertical business unit, it does not support another.*
Legacy Systems	Technology	*Once again the way common systems exchange information with legacy systems is seen to work well by some groups, but is seen to impact information transfer by others.*
Knowledge Implementation Strategy	Organizational	*Responses from the different groups showed that individuals determined the value of information differently. Some determined the value through IT systems, some through personal contact. Only one group valued information equally from both personal and IT sources.*
Causal Ambiguity	Organizational	*Of the eight groups, three rely on the existing IT systems to drive relevant information around the organization. However, the feeling amongst the remaining groups is that important information / knowledge needs to be identified by people as opposed to IT systems and then the individual should ensure the information / knowledge is fed out to the wider organization through peer-to-peer meetings (personal contact).* *In a business that relies heavily on IT the drive to ensure information is distributed effectively is seen as being a human function...not solely a systems one. It is also important to note that 'Causal Ambiguity' is seen as a key factor in innovative organizations. It follows therefore, that innovative organizations do not depend on systems for ideas, but people.*
Unprovenness	Organizational	*A varied response across the organization. Some groups see all information sources as unreliable until proved otherwise. Other groups assume all sources are reliable. Depending on the type of job / task individuals are involved with will determine how they view the systems they use. Therefore, as job structures differ significantly across a complex organization individual views as to how IT should be used to support tasks will vary.*
Risk	Personal	*View of risk was seen to differ across the groups. Risk was seen to exist for most groups. Those who felt risk didn't impact information / knowledge sharing were the furthest removed from actual customers. The exception being the Order Management (Group 5) who felt openness and honesty more important to the development of a lasting customer relationship. However, if this relationship was itself at risk then information / knowledge sharing would be restricted.*

Table 7.11 Barrier Differences. **Source: Developed for research.**

From Table 7.11 it can be seen that the groups value IT and its contribution to information and knowledge sharing differently. The impact these barriers may have on an organization's ability to improve the performance of any vertically aligned process must be taken into consideration.

7.12 Identifying Relational Links between Barriers.

From the original definition of the 25 identified barriers to information and knowledge creation and sharing (Chapter 3), it can be seen that there are similarities between some of the barriers. Similarities that may cause certain barriers to be more likely to exist based on the existence of other barriers.

After looking at the results provided from the questionnaire, and further discussion with employees the researcher has developed an adjacency matrix which shows where barriers have been identified as having an effect on other barriers (Appendix F). For the purpose of this matrix all effects are seen to have a negative impact in that their existence on a barrier does not negate the existence of another barrier. The barrier either has no effect at all on other barriers, or it helps bring into existence other barriers.

Due to the need to understand which barriers may impact other barriers a directed graph was developed from the adjacency matrix. An undirected graph was not considered appropriate as the relationship between barriers was not considered to always be reciprocal. Figure 7.39 shows the directed graph that was produced as a result of the matrix in Appendix F using the Ucinet 6 social network analysis mapping software tool.

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Figure 7.39 shows the directed relationships between barriers that have been identified through the research. The barriers on the graph have been colour coded and assigned different shapes based on whether they are cross category, technology, organizational, or people barriers. The Table below outlines which colours and symbols match up to the different categories.

Barrier Category	**Colour**	**Shape**
Cross Category Barriers	Blue	Circle
Technology Barriers	Green	Square
Organizational Barriers	Red	Triangle
People Barriers	Purple	Diamond

Table 7.12 Barrier Category Identification. Source: Developed for research.

The physical length of each line between identified barriers is not relevant, nor is the way the barriers have been laid out on the directed graph. What is important is the 'multiplicity', which is a basic measure of intensity between the different barriers. However, as this is a directed graph the direction of influence will not always be two-way. Therefore, when looking at the way barriers are connected in the graph the way barriers influence and are influenced by other barriers needs to be identified. Determining the 'outdegree' and 'indegree' values for each node or barrier does this. The outdegree is defined as the total number of other points (barriers) to which the point (barrier) in question directs lines, whilst the indegree of a point (barrier) is the total number of other points that have lines directed towards it (Scott, 2005).

Table 7.13 shows the outdegree and indegree of the different barriers.

Barrier	**Barrier Category**	**Indegree**	**Outdegree**	**Ego-centric Density**
Existing Resources	*CCB*	12	3	0.205
Rewards	*CCB*	6	0	0.333
Arduous Relationship	*CCB*	6	1	0.533
Culture (K Strategy)	*CCB*	4	4	0.238
Available Technology	*TB*	6	2	0.467
Legacy Systems	*TB*	3	3	0.600
K Strategy Implementation	*OB*	3	3	0.400
Causal Ambiguity	*OB*	0	8	0.536
Poor Targeting of K	*OB*	2	2	0.333

Knowledge Cost	*OB*	1	1	1.000
Proprietary Knowledge	*OB*	1	7	0.500
Distance	*OB*	4	1	0.333
Unprovenness	*OB*	3	3	0.333
Organizational Context	*OB*	1	4	0.333
Info not perceived as reliable	*OB*	2	5	0.400
Motivation (NIH Syndrome)	*OB*	1	4	0.400
Internal Resistance	*PB*	3	5	0.571
Self Interest	*PB*	6	4	0.619
Trust	*PB*	10	3	0.489
Risk	*PB*	3	3	0.700
Fear of Exploitation	*PB*	5	7	0.311
Motivation (K is P syndrome)	*PB*	8	5	0.100
Fear of Contamination	*PB*	0	2	0.000
Lack of Retentive Capacity	*PB*	1	6	0.286
Lack of Absorptive Capacity	*PB*	0	5	0.400
No of Isolates		0		
No of Degrees		91	91	
No of Lines (Degrees/2)		45.5		

Table 7.13 Barrier Out/In Degrees. **Source: Developed for research.**

The Table also shows the egocentric density. This relates to the density of links surrounding the particular barriers. However, a more relevant measure is the density of the entire graph (Barnes, 1969, Scott, 2005). This is termed the socio-centric density. From the adjacency matrix the overall graph socio-centric density can be determined using the following formula:

Directed Graph Density = $l \,/\, n\,(n\text{-}1)$

Where l equals the number of lines present, which can be calculated as (No of Degrees/2). The variable n equals the number of connected nodes, or in this case the number of barriers. From the values provided in Table 7.13 this formula gives a graph density of 0.0757. This effectively means that of all the possible connections between barriers only 0.0758, or 7.58% of connections have been made. The implication here is that barrier connectivity is not total. It is worth noting that although the theoretical density can reach 1.0, or 100%, research conducted by Mayhew & Levinger (1976) suggests that the maximum density to be found in actual graphs is no more then 0.5, or 50%. However, because there are no isolates identified (unconnected barriers) there is some relationship between barriers. What can be identified from the directed graph are those barriers that have the greatest impact on other barriers (Indegree), and those barriers that in turn are impacted the most by other barriers (Outdegree).

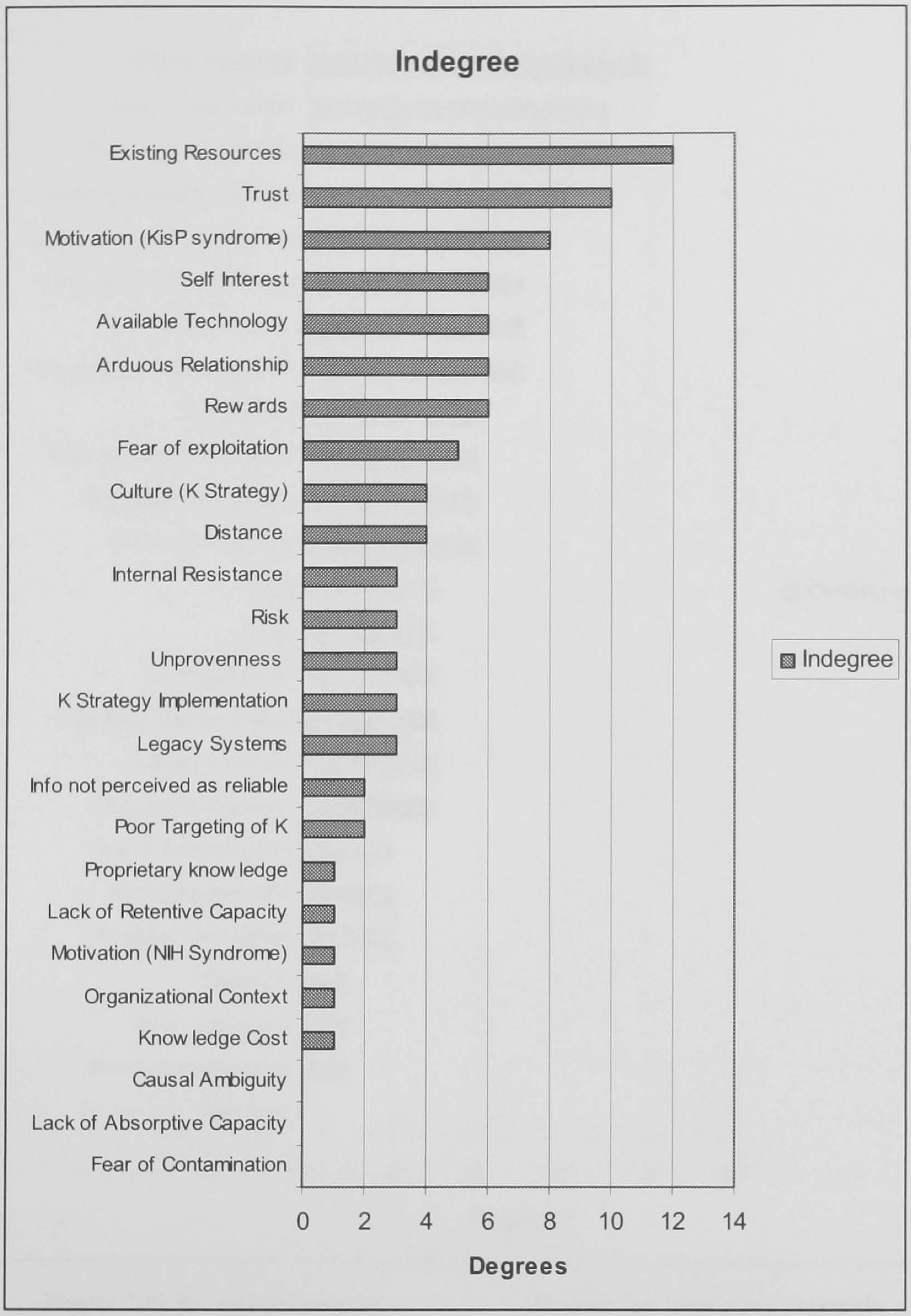

Figure 7.40 Barrier Indegree. **Source: Developed for research.**

Figure 7.40 shows the level of influence barriers have on other barriers. From the graph in Figure 7.40 it can be seen that the 'Existing Resources' barrier impacts the most number of barriers. This is followed by 'Trust' and 'Motivation' (Knowledge is Power).

From Figure 7.40 the barriers that are influenced the most by other barriers are shown in descending order of influence.

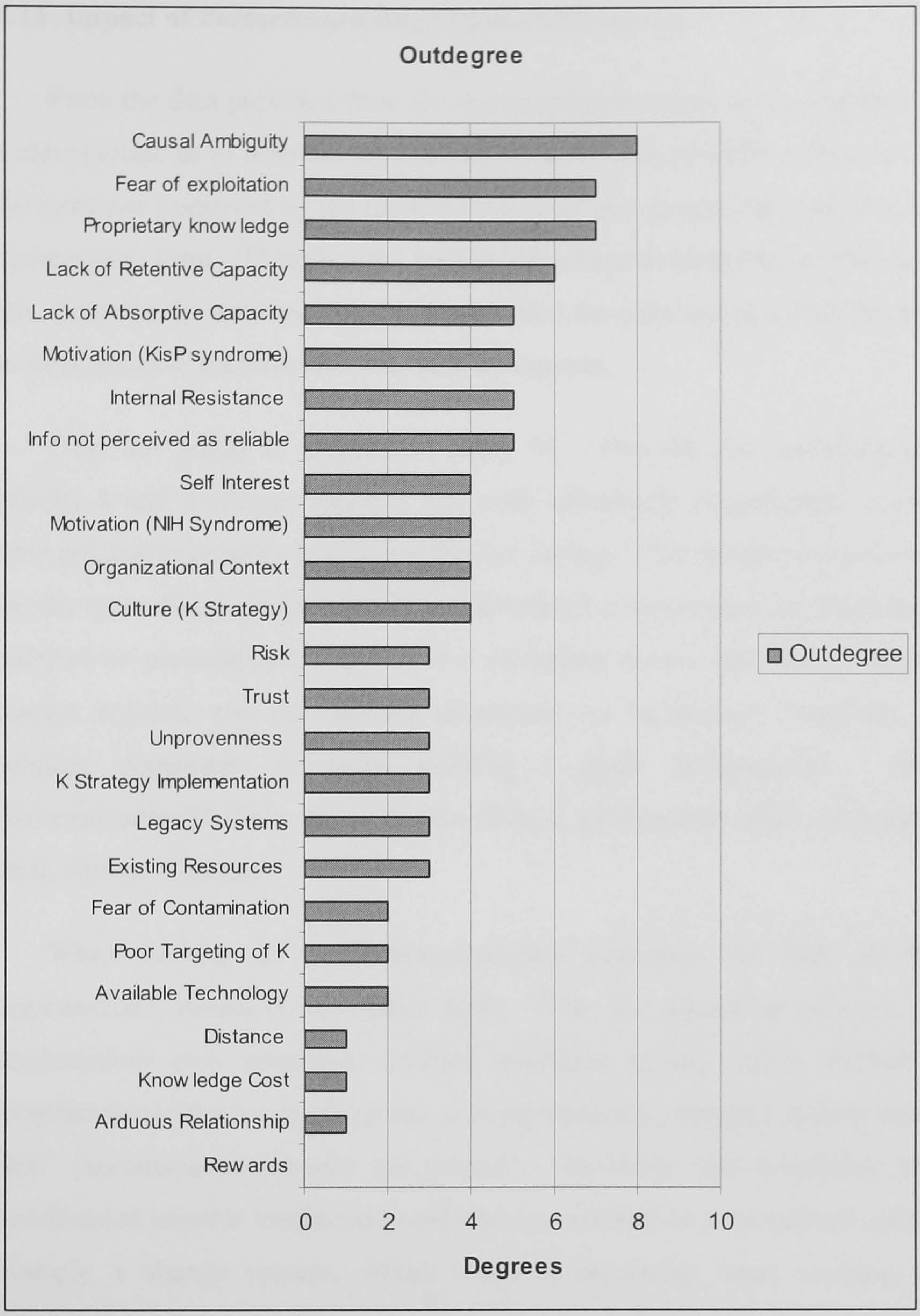

Figure 7.41 Barrier Outdegree. **Source: Developed for research.**

Form the outdegree graph (Figure 7.41) the barrier most influenced by other barriers is 'Causal Ambiguity'. 'Fear of Exploitation' follows this on down to 'Rewards'. By overlaying the directed graph with an assessment of the actual impact and existence of barriers within the ISC a view of those barriers that are key main influencers and influenced can be determined.

7.13 Impact of Performance Improvement Measures.

From the data provided from the documentation search and questionnaire feedback a clear picture as to how the barriers appear across the order flow process has emerged. Performance improved by the implementation of key change requests (CRs) through the optimisation team. Therefore the researcher is keen to understand what link there is, if any, between the existence of the barriers and the subsequent improvement initiatives, as through these performance was seen to improve.

Over the period of assessment (May 04 – Dec 04) the researcher identified 90 priority 1 and 2 change requests that were effectively implemented across the order flow process (Appendix D contains the full listing). The change requests were assessed for the type of knowledge transfer and whether the mechanism for implementation was codified or personalised. By this the researcher means that when implementing the change request, was the solution dependant on technology (codified), or was the solution dependant on team building / team development / team linking (personalisation)? This, the researcher feels is an important point and one not touched on in current literature.

When looking at codified/personalised strategies the link to the learning organizational model is not clearly made. This, the researcher believes, can mislead organizations into assuming codified strategies mainly equal 'explicit-to-explicit' (combination) transfer mechanisms, and personalised strategies mainly equal 'tacit-to-tacit' (socialisation) transfer mechanisms. However, the researcher noted that a socialisation transfer mechanism could have a codified or personalised component. For example a change request, which looks at improving team working through the development of communities of practice, is using a personalised approach to achieve a tacit to tacit transfer. However, a change request, which looks at improving communities of practice through the development and deployment of a web/ intranet solution, looks at using a codified approach to improving a tacit-to-tacit transfer. In essence, as each stage of the learning model has two components (tacit-to-tacit (T-T), tacit-to-explicit (T-E), explicit-to-explicit (E-E), explicit-to-tacit (E-T)) making changes or improvements within each area, the improvement can centre on either or both components. So, the researcher believes a change within the externalisation (T-E) quadrant can focus on the softer aspect of how an individual formats their information, including as much contextual information as possible, for input into a system. Or, the change can focus on how the system can be improved to capture relevant, context rich information from the user.

With this in mind the researcher reviewed each change request from a codified / personalised perspective. In effect, not only was each request looked at to see which transfer mechanism it best facilitated, but also which approach it used to achieve this transfer mechanism. In order to ensure a common approach was used for all change requests the researcher developed a criteria against which each change request would be assessed.

Table 7.14 shows the criteria used by the researcher in making this assessment.

Nonaka Learning Stages.	Approach	Description.
Socialisation (T->T)	*Codified*	Change requests that enable better face to face interaction through the use of technology and available systems.
	Personalised	Change requests that allow better face to face/ information sharing through formal/informal network development.
Externalisation (T->E)	*Codified*	Change requests that improve the capture of information through improved systems interfaces.
	Personalised	Change requests which improve an individual's ability to input valuable information into appropriate systems.
Combination (E->E)	*Codified*	Change requests that improve system-to-system data transfer.
	Personalised	Change requests that look to improve how information is manually pulled from systems, reformatted, and then re-entered to different systems.
Internalisation (E->T)	*Codified*	Change requests which look at improving the way systems present information in a format acceptable to the user.
	Personalised	Change requests that look to improve users contextual understand of the information on systems, and their ability to analyse the said information.

Table 7.14 A Codified / Personalised view of Org Leaning. Source: Developed for research.

Figure 7.42 shows how the change requests impact each of the learning stages as outlined by Nonaka (1995).

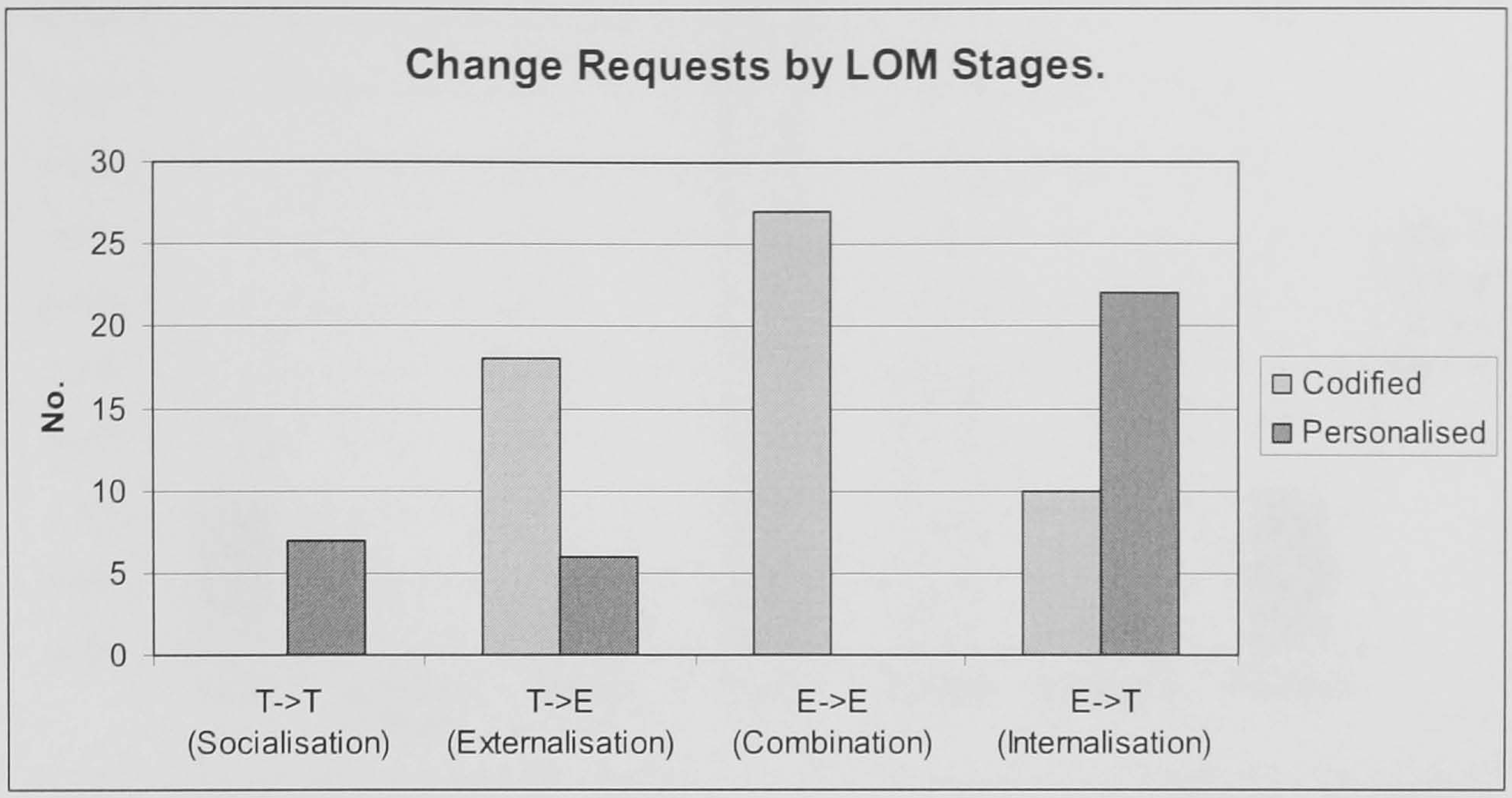

Figure 7.42 Change Request Impact by Learning Stage. Source: Developed for research.

It is interesting to note that there are no codified type changes within the socialisation (T-T) stage, or any personalised type changes within the combination (E-E) stage. The change requests, once categorised using the criteria in Table 7.14, were also mapped to seven key groups previously identified as having direct impact on the order flow process. The eighth group (Senior Management) is not included as none of the changes directly related to it.

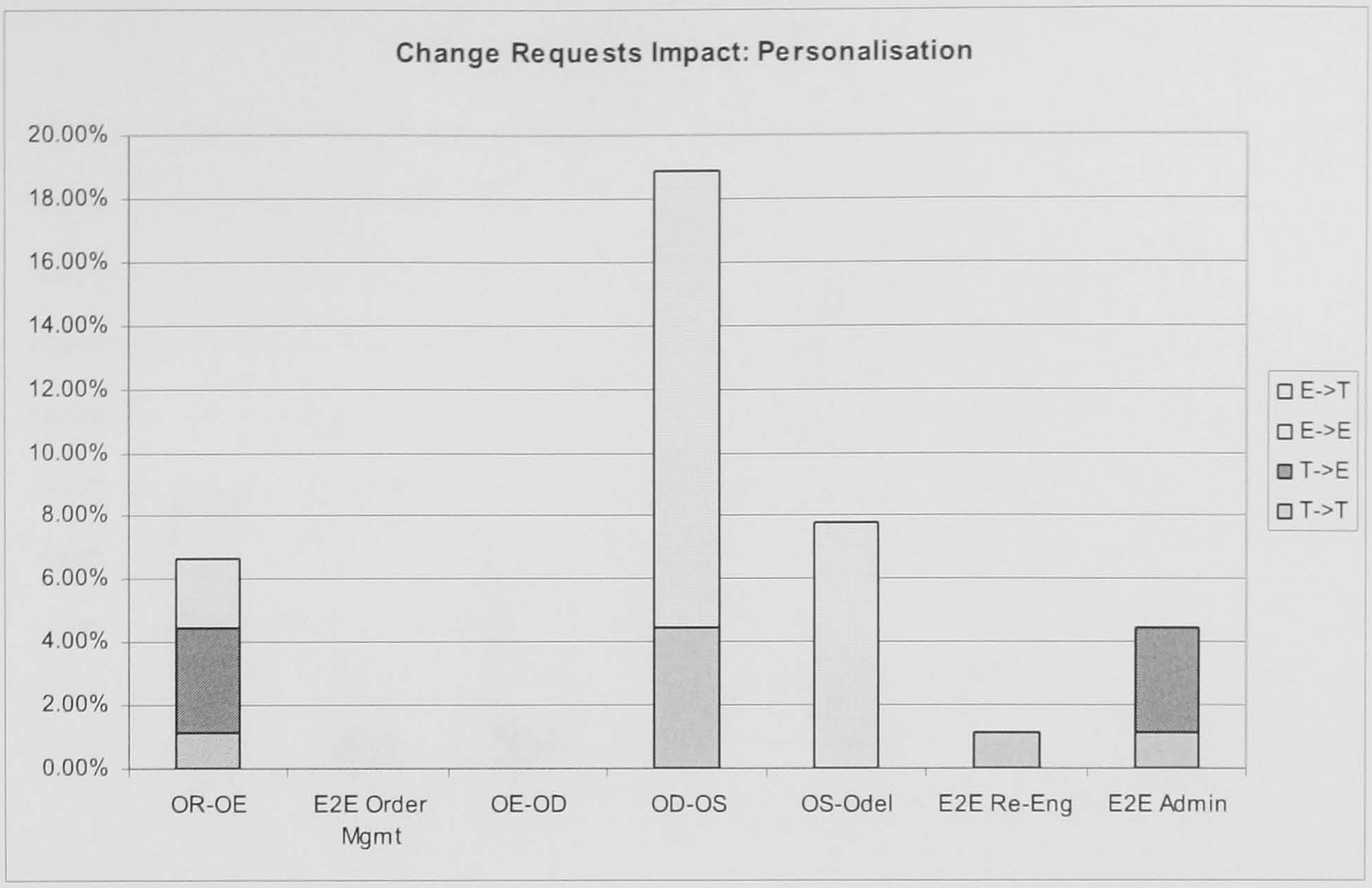

Figure 7.43 Personalised Change Requests. **Source: Developed for research.**

Figure 7.43 shows the change requests breakdown for each group from a personalisation perspective. It can be noted from the graph in Figure 7.43 that from a personalisation perspective there is no 'explicit-to-explicit' transfer change requests. Similarly, for Figure 7.44 there is no 'tacit-to-tacit' type change requests listed against the codified view.

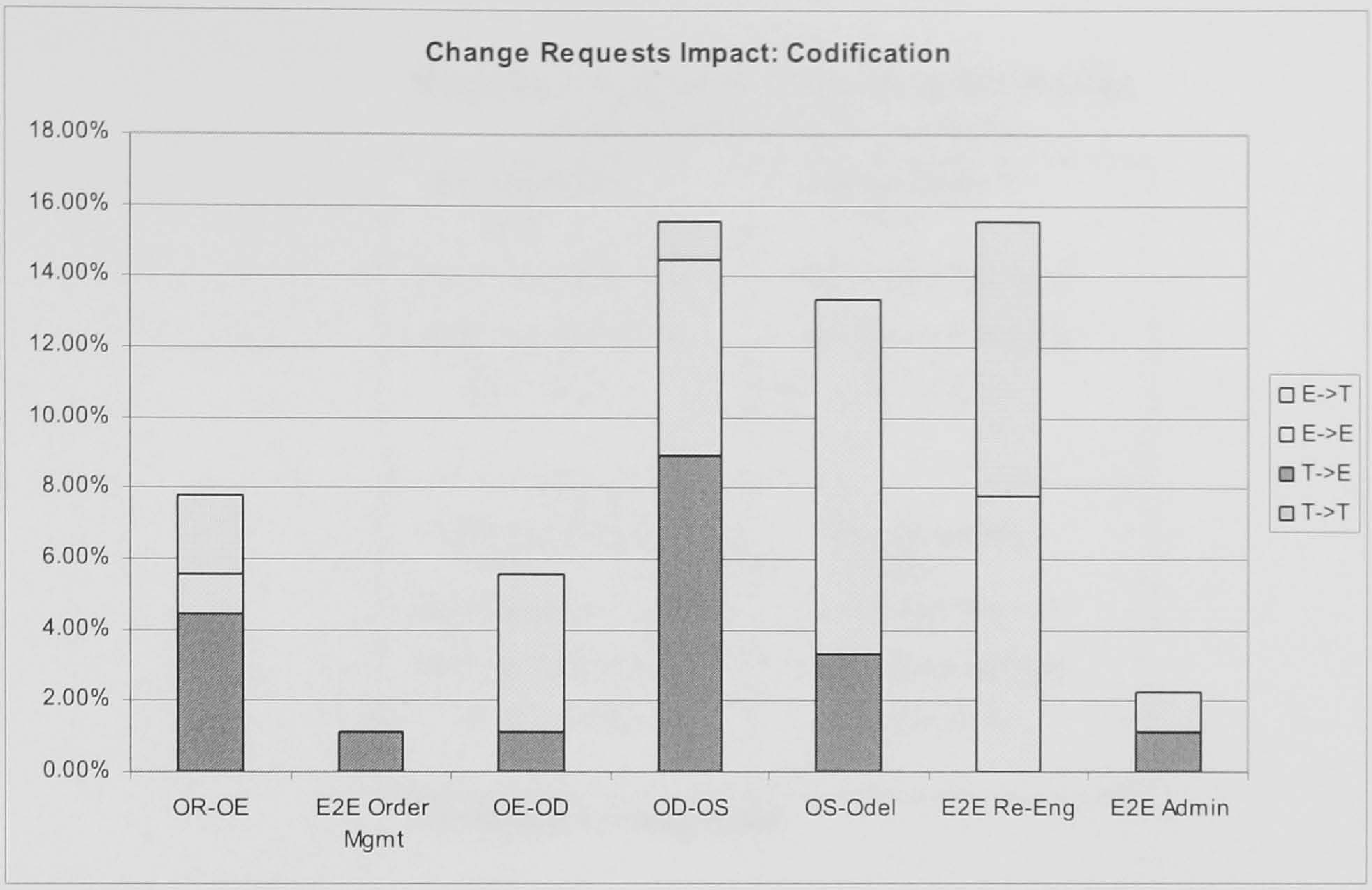

Figure 7.44 Codified Change Requests. **Source: Developed for research.**

However, it is important to understand how the change requests impacted the identified barriers, and what link exists if any.

7.14 Impact of Change Requests on Barriers.

It is worth restating that the ISC order flow performance improved through the identification and implementation of the change requests, therefore, it is important to know which barriers were addressed through this process. Although the change requests varied in their complexity, and were capable of impacting one or more barriers it is interesting to note the focus of the change requests across Nonaka's Learning Organization Model (Figure 7.45).

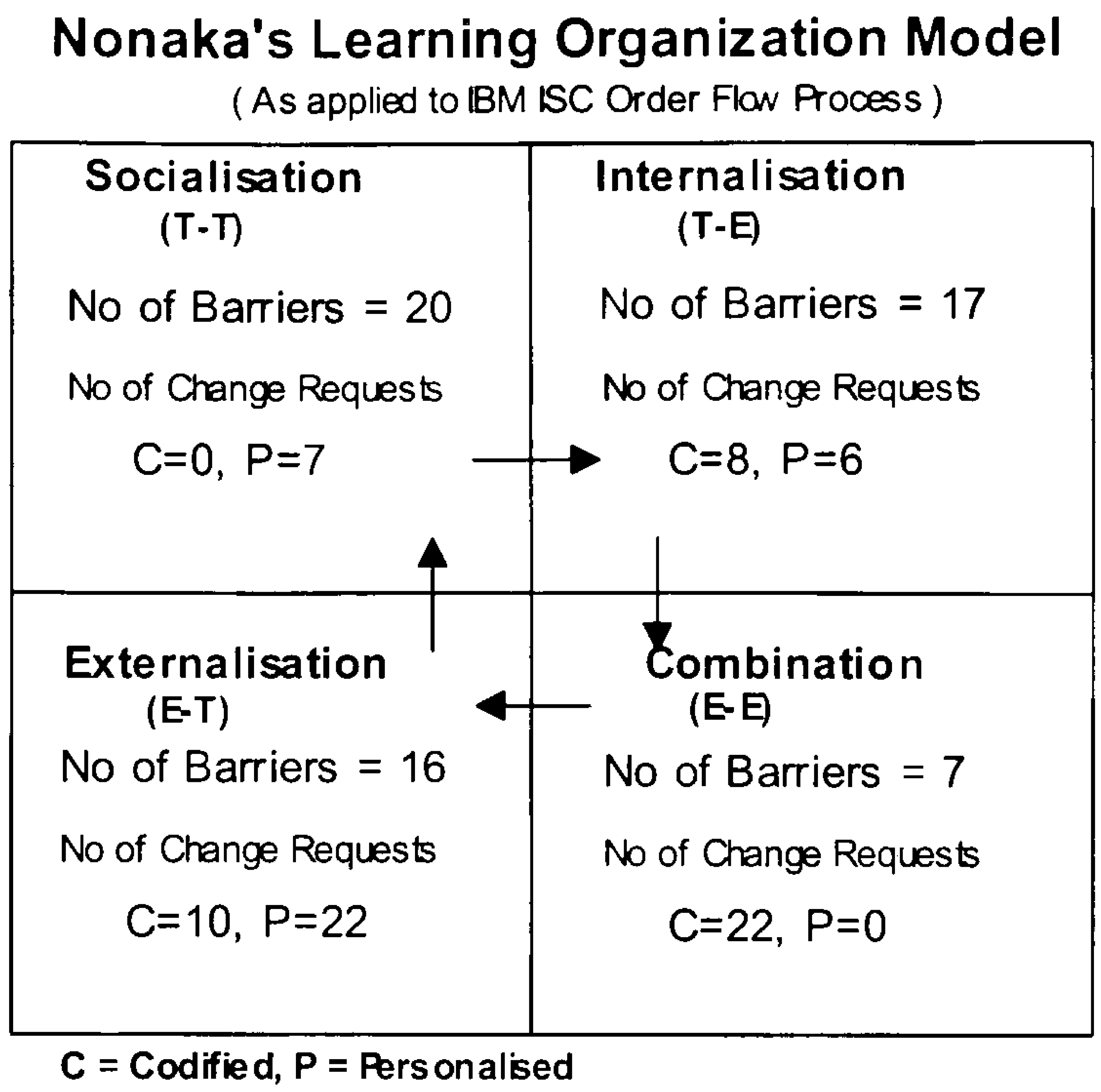

Figure 7.45 Change across the Learning Organization Model. Source: Developed for research.

Before looking more closely at the type of change and their direct correlation to the identified barriers it is interesting to note that 'socialisation', containing the most barriers, experiences the least amount of changes, whilst 'combination', containing the fewest number of barriers, has significantly more changes identified. In particular, the changes within the 'combination' quadrant are by far the most codified changes across the model.

Using the criteria developed and outlined by the researcher in Table 7.14 the diagram in Figure 7.45 can be re-drawn as shown in Figure 7.46.

Nonaka's Learning Organization Model

(As appled to IBM ISC Order Flow Process)

Socialsation **Primary Focus of Change.** *Change requests which allow better face to face / information sharing through formal / informal network development.*	Externalisation **Primary Focus of Change.** *Change requests that improve the capture of information through improved systems interfaces.* **Secondary Focus of Change.** *Individuals abilty to input valuable information into appropriate systems.*
Internalisation **Primary Focus of Change.** *Change requests that look to improve users contextural understanding of information on systems, and their ability ot analyse said information.* **Secondary Focus of Change.** *Change requests that look at improving the way systems present information in a format acceptable to the user.*	Combination **Primary Focus of Change.** *Change requests which improve system to system data transfer.*

Figure 7.46 ISC Types of Change. **Source: Developed for research**

Understanding how the change requests relate to the different transfer mechanisms (T-T, T-E, etc) and the different approaches to knowledge strategy (personalised and codified) is important as this helps to understand how the changes relate to the transfer of knowledge through the learning model as developed by Nonaka *et al* (1995).

Having also matched the barriers to the learning model (Figure 7.46) it is important to see how the change requests match up to, and impact the barriers. This research has provided a very good opportunity to see which barriers have been impacted by the changes that in turn have been responsible for significant performance improvement.

7.14.1 Mapping CRs to Barriers and the Learning Model.

A list of ninety implemented change requests was reviewed by the optimisation team with a view to determine what changes impacted the different barriers. The criteria were to look at the impact of the change and then identify and match the relevant barriers to the change request. The final list was reviewed and agreed by the optimisation team (Appendix D). This data allowed the researcher to identify how the different change requests impacted across the different groups (OR-OE, OE-OD, OD-OS, OS-ODel, E2E Order Mgmt, E2E Re-Engineering, and E2E Admin) Table 7.15.

	OR-OE			OE-OD			OD-OS			OS-ODel			E2E Order Mgmt			E2E Re-Eng			E2E Admin			All Gı	
	n	% Gp	% All	n	% Gp	% All	n	% Gp	% All	n	% Gp	% All	n	% Gp	% All	n	% Gp	% All	n	% Gp	% All	n	
ɔss Category rriers	**13**	**20.6%**	**2.5%**	**3**	**11.1%**	**0.6%**	**29**	**13.7%**	**5.6%**	**17**	**17.7%**	**3.3%**	**1**	**20.0%**	**0.2%**	**8**	**10.0%**	**1.6%**	**11**	**35.5%**	**2.1%**	**82**	
Existing Resources	6	9.5%	1.2%	1	3.7%	0.2%	22	10.4%	4.3%	13	13.5%	2.5%	1	20.0%	0.2%	7	7.8%	1.4%	6	19.4%	1.2%	56	
Rewards	3	4.8%	0.6%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	3	
Arduous Relationship	4	6.3%	0.8%	2	7.4%	0.4%	6	2.8%	1.2%	4	4.2%	0.8%	0	0.0%	0.0%	1	1.3%	0.2%	4	12.9%	0.8%	21	
Culture (K Strategy)	0	0.0%	0.0%	0	0.0%	0.0%	1	0.5%	0.2%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	1	3.2%	0.2%	2	
chnology rriers	**11**	**17.5%**	**2.1%**	**8**	**29.6%**	**1.6%**	**22**	**10.4%**	**4.3%**	**28**	**29.2%**	**5.4%**	**2**	**40.0%**	**0.4%**	**24**	**30.0%**	**4.7%**	**1**	**3.2%**	**0.2%**	**96**	
Available Technology	10	15.9%	1.9%	5	17.5%	1.0%	17	7.0%	3.3%	18	17.8%	3.5%	1	20.0%	0.2%	14	17.5%	2.7%	1	3.2%	0.2%	66	12
Legacy Systems	1	1.6%	0.2%	3	11.1%	0.6%	5	2.4%	1.0%	10	10.4%	1.9%	1	20.0%	0.2%	10	12.5%	1.9%	0	0.0%	0.0%	30	5.
ganizational rriers	**20**	**31.7%**	**3.9%**	**13**	**47.1%**	**2.5%**	**86**	**40.6%**	**16.7%**	**36**	**37.5%**	**7.0%**	**2**	**40.0%**	**0.4%**	**28**	**35.0%**	**5.4%**	**14**	**45.2%**	**2.7%**	**199**	**37**
K Strategy	7	11.1%	1.4%	3	11.1%	0.6%	26	12.3%	5.1%	11	11.5%	2.1%	1	20.0%	0.2%	6	7.5%	1.2%	6	19.4%	1.2%	60	11
Causal Ambiguity	4	6.3%	0.8%	3	11.1%	0.6%	24	11.3%	4.7%	13	13.5%	2.5%	0	0.0%	0.0%	11	13.8%	2.1%	2	6.5%	0.4%	57	11
Poor Targeting of K	2	3.2%	0.4%	0	0.0%	0.0%	10	4.7%	1.9%	5	5.2%	1.0%	1	20.0%	0.2%	2	2.5%	0.4%	2	6.5%	0.4%	22	4.
Knowledge Cost	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.
Proprietary knowledge	2	3.2%	0.4%	1	3.7%	0.2%	1	0.5%	0.2%	2	2.1%	0.4%	0	0.0%	0.0%	1	1.3%	0.2%	0	0.0%	0.0%	7	1.
Distance	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.
Unprovenness	0	0.0%	0.0%	2	7.4%	0.4%	9	4.2%	1.8%	0	0.0%	0.0%	0	0.0%	0.0%	4	5.0%	0.8%	1	3.2%	0.2%	16	3.
Organizational Context	0	0.0%	0.0%	1	3.7%	0.2%	1	0.5%	0.2%	1	1.0%	0.2%	0	0.0%	0.0%	0	0.0%	0.0%	2	6.5%	0.4%	5	1.
Info not perceived as reliable	3	4.8%	0.6%	3	11.1%	0.6%	15	7.1%	2.9%	4	4.2%	0.8%	0	0.0%	0.0%	3	3.8%	0.6%	1	3.2%	0.2%	29	5.
Motivation (NIH	2	3.2%	0.4%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	1	1.3%	0.2%	0	0.0%	0.0%	3	0.
ople Barriers	**19**	**30.2%**	**3.7%**	**3**	**11.1%**	**0.6%**	**75**	**35.4%**	**14.6%**	**15**	**15.6%**	**2.9%**	**0**	**0.0%**	**0.0%**	**20**	**25.0%**	**3.9%**	**5**	**16.1%**	**1.0%**	**137**	**26**
Internal Resistance	3	4.8%	0.6%	1	3.7%	0.2%	21	9.9%	4.1%	0	0.0%	0.0%	0	0.0%	0.0%	4	5.0%	0.8%	1	3.2%	0.2%	30	5.

Self Interest	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	2	2.5%	0.4%	0	0.0%	0.0%	2	
Trust	5	7.9%	1.0%	1	3.7%	0.2%	12	5.7%	2.3%	5	5.2%	1.0%	0	0.0%	0.0%	2	2.5%	0.4%	1	3.2%	0.2%	26	
Risk	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	2	2.5%	0.4%	0	0.0%	0.0%	2	
Fear of exploitation	2	3.2%	0.4%	0	0.0%	0.0%	11	5.2%	2.1%	4	4.2%	0.8%	0	0.0%	0.0%	0	0.0%	0.0%	1	3.2%	0.2%	18	
Motivation (K as P Syndrome)	4	6.3%	0.8%	1	3.7%	0.2%	15	7.1%	2.9%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	1	3.2%	0.2%	21	
Fear of Contamination	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	3	3.8%	0.6%	0	0.0%	0.0%	3	
Lack of Retentive Capacity	3	4.8%	0.6%	0	0.0%	0.0%	4	1.9%	0.8%	1	1.0%	0.2%	0	0.0%	0.0%	4	5.0%	0.8%	0	0.0%	0.0%	12	
Lack of Absorptive Capacity	2	3.2%	0.4%	0	0.0%	0.0%	12	5.7%	2.3%	5	5.2%	1.0%	0	0.0%	0.0%	3	3.8%	0.6%	1	3.2%	0.2%	23	4.
	63	**100%**	**12.3%**	**27**	**100%**	**5.3%**	**212**	**100%**	**41.2%**	**96**	**100%**	**17.7%**	**5**	**100%**	**1.0%**	**80**	**100%**	**15.6%**	31	100%	6.0%	514	10

Table 7.15 Linkage of CRs to Barriers by Group. **Source: Developed for research**

The data in Table 7.15 show how the barriers are targeted by the change requests across the order flow process. Figures 7.47 and 7.48 provide a more visible representation of this.

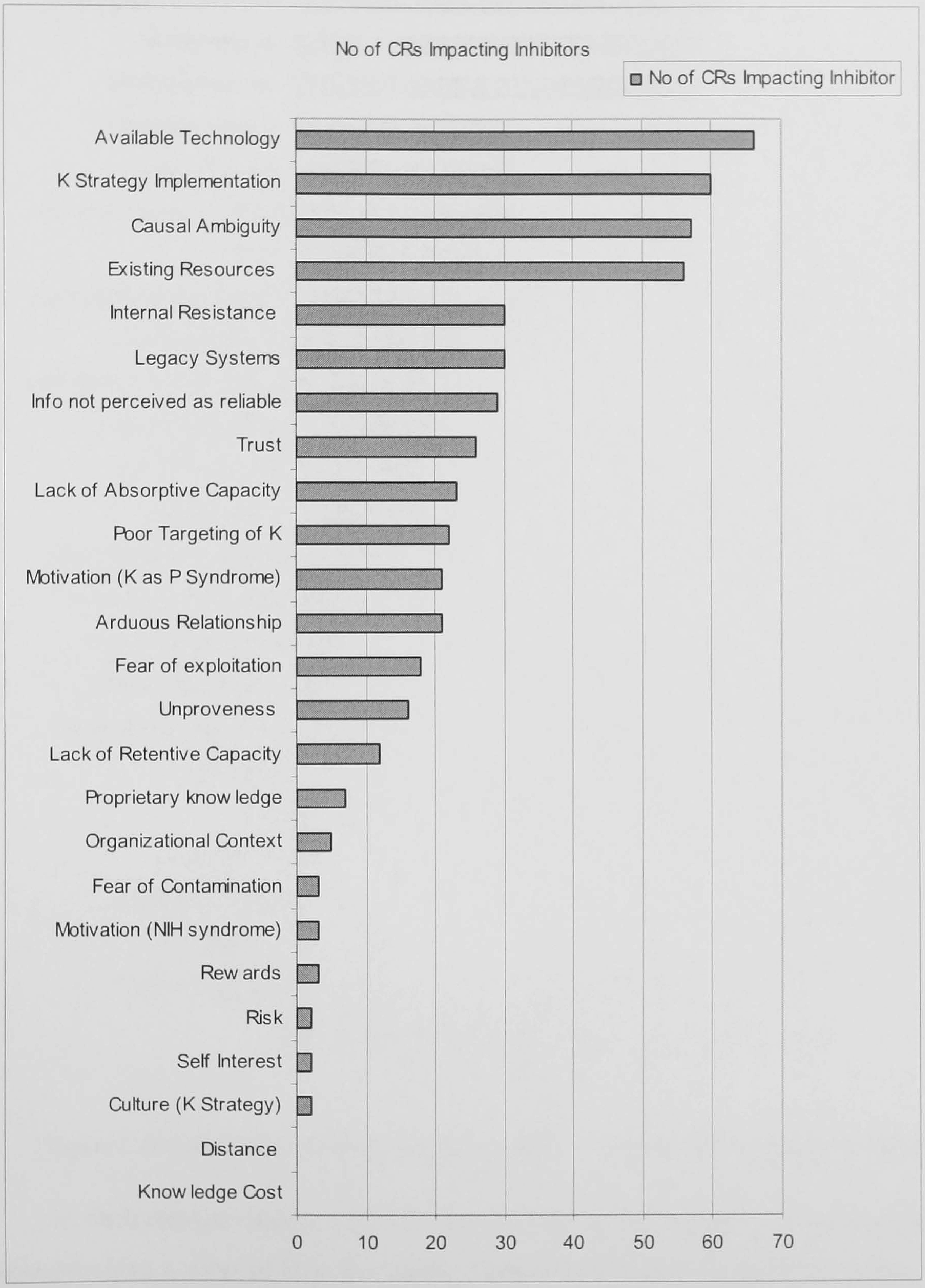

Figure 7.47 Number of CRs Impacting Barriers. Source: Developed for research

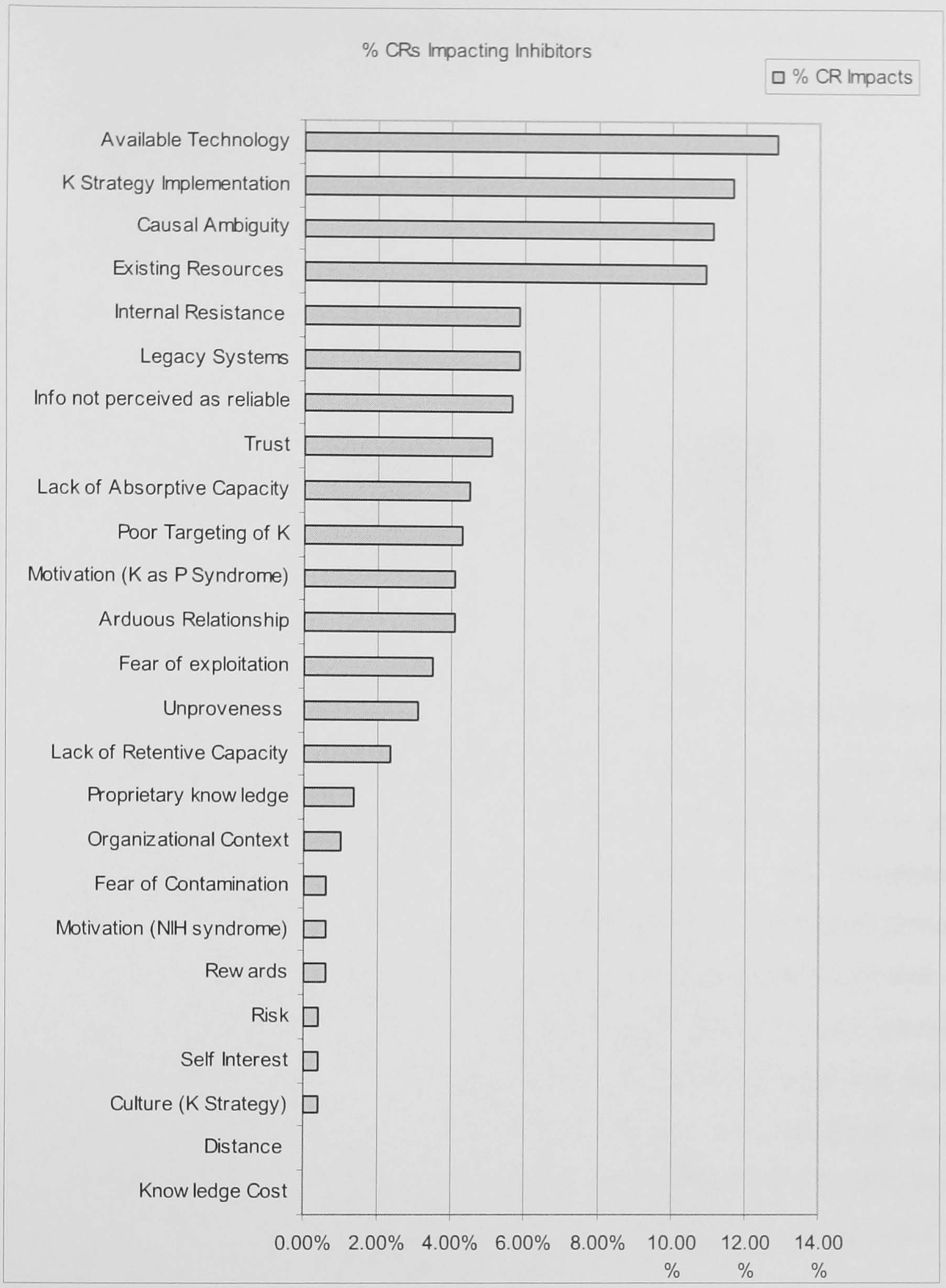

Figure 7.48 Percentage of CRs Impacting Barriers. Source: Developed for research

As each change request was also assessed for its knowledge transfer mechanism the data provided a view of how the change requests impacted the different barriers and in which quadrant of the learning organization model this happened.

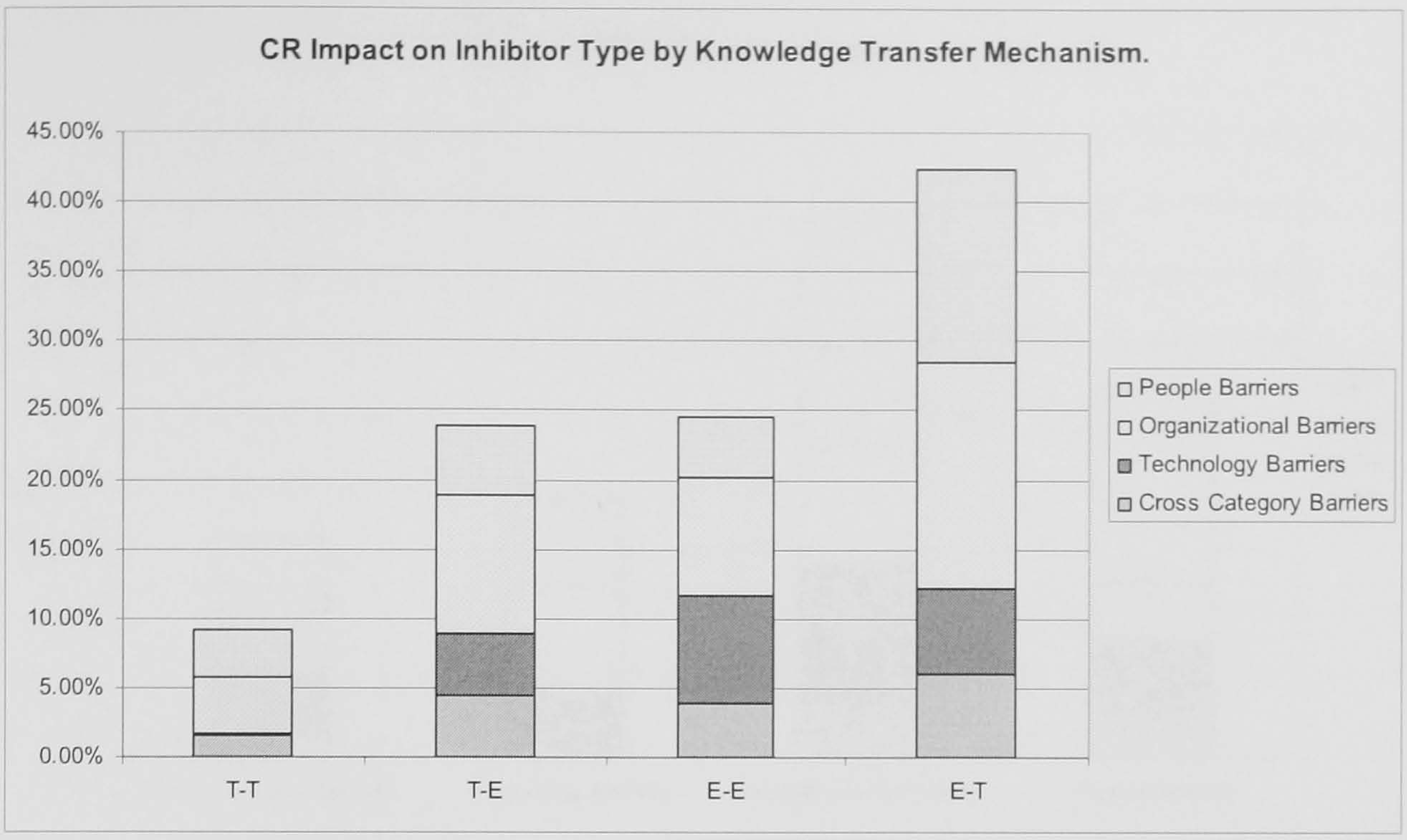

Figure 7.49 CR Impact on Barrier by Knowledge Transfer Mechanism.
Source: Developed for research.

Figure 7.49 shows how the change requests have impacted across the Learning Organization Model (Nonaka, 1995). In the case of the ISC order flow process the majority of changes have impacted barriers that relate to the 'Internalisation' of knowledge. Within this section the changes have focused on organizational barriers (OB) and people barriers (PB). What is also interesting is that across all four quadrants of the learning model (socialisation, externalisation, combination, and internalisation), the changes implemented, which in turn have lead to overall improved performance, have focused heavily on organizational barriers. Within the socialisation quadrant, as might be expected, little focus has been given to technology barriers (TB), whilst in the combination quadrant significant focus is given to technology barriers (Figure 7.50).

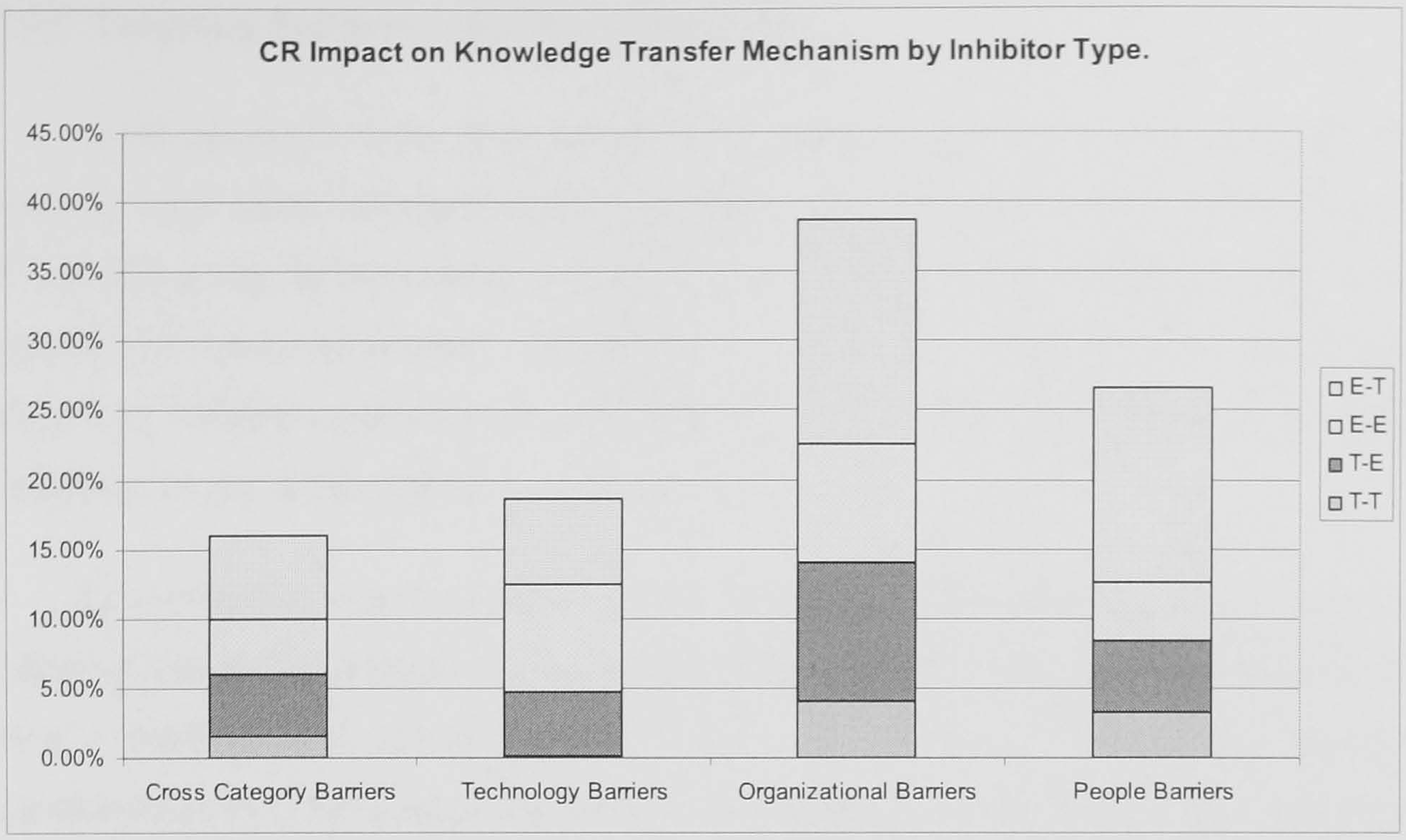

Figure 7.50 CR Impact on Knowledge Transfer mechanisms by Barrier Type. Source: Developed for research.

Figure 7.50 shows the type of transfer mechanism being impacted by the change requests for each barrier group (Table 7.16 giving the numerical values).

Barrier Groups	T-T	T-E	E-E	E-T	Totals
Cross Category Barriers (*CCB*)	1.56%	4.47%	3.89%	6.03%	**15.95%**
Technology Barriers (*TB*)	0.19%	4.47%	7.78%	6.23%	**17.68%**
Organizational Barriers (*OB*)	4.09%	9.92%	7.56%	16.15%	**37.72%**
People Barriers (*PB*)	3.31%	5.06%	4.28%	14.01%	**26.65%**
Totals	**9.14%**	**23.93%**	**24.51%**	**42.41%**	**100%**

Table 7.16 CR Impact on Knowledge Transfer mechanisms by Barrier Type. Source: Developed for research.

From Figure 7.50 and Table 7.16 37.72% of the implemented change requests have addressed organizational barriers; with people barriers next at 26.65% followed by technology and then cross category barriers at 17.68% and 15.95% respectively.

7.15 Targeting Barriers with Change Requests.

A core group of twenty-five barriers has been identified. Whether these barriers are seen to exist within an organization was then tested by questionnaire and interview. From this group the researcher was also able to determine the degree to which the barriers influence one another. Although the impact of each barrier can be varied, the degree of influence provides an understanding as to which barriers have the most influence, or are influenced the most by other barriers.

An assessment was also made of the change requests implemented in order to improve process performance. The assessment looked at the type of change request and how it impacted the various barriers. Table 7.17 shows the comparison between identified barriers, influencing and influenced barriers, and those barriers that have been targeted by performance improving change requests.

Barriers Identified	*Perception*	Influencing Barrier	*In*	Influenced Barrier	*Out*	Barriers impacted by CR	*CRs*
Existing Resources	*Common perception*	Existing Resources	*12*	Causal Ambiguity	*8*	Available Technology	*66*
Rewards	*Common perception*	Trust	*10*	Proprietary knowledge	*7*	K Strategy Implementation	*60*
Arduous Relationship	*Varied perception*	Motivation (K is P Syndrome)	*8*	Fear of exploitation	*7*	Causal Ambiguity	*57*
Culture (K Strategy)	*Common perception*	Rewards	*6*	Lack of Retentive Capacity	*6*	Existing Resources	*56*
Available Technology	*Varied perception*	Arduous Relationship	*6*	Lack of Absorptive Capacity	*5*	Legacy Systems	*30*
Legacy Systems	*Varied perception*	Available Technology	*6*	Info not perceived as reliable	*5*	Internal Resistance	*30*
K Strategy Implementation	*Varied perception*	Self Interest	*6*	Internal Resistance	*5*	Info not perceived as reliable	*29*
Causal Ambiguity	*Varied perception*	Fear of exploitation	*5*	Motivation (K is P Syndrome)	*5*	Trust	*26*
Poor Targeting of K	*Min Impact*	Culture (K Strategy)	*4*	Organizational Context	*4*	Lack of Absorptive Capacity	*23*
Knowledge Cost	*Min Impact*	Distance	*4*	Motivation (NIH Syndrome)	*4*	Poor Targeting of K	*22*
Proprietary knowledge	*Min Impact*	Legacy Systems	*3*	Culture (K Strategy)	*4*	Arduous Relationship	*21*
Distance	*Min Impact*	K Strategy Implementation	*3*	Self Interest	*4*	Motivation (K as P Syndrome)	*21*
Unprovenness	*Varied perception*	Unprovenness	*3*	Legacy Systems	*3*	Fear of exploitation	*18*
Organizational Context	*Varied perception*	Internal Resistance	*3*	K Strategy Implementation	*3*	Unprovenness	*16*
Info not perceived as reliable	*Common perception*	Risk	*3*	Unprovenness	*3*	Lack of Retentive Capacity	*12*
Motivation (NIH syndrome)	*Common perception*	Poor Targeting of K	*2*	Risk	*3*	Proprietary knowledge	*7*

Internal Resistance	*Common perception*	Info not perceived as reliable	*2*	Trust	*3*	Organizational Context	*5*
Self Interest	*Common perception*	Knowledge Cost	*1*	Existing Resources	*3*	Rewards	*3*
Trust	*Common perception*	Proprietary knowledge	*1*	Fear of Contamination	*2*	Motivation (NIH syndrome)	*3*
Risk	*Common perception*	Organizational Context	*1*	Poor Targeting of K	*2*	Fear of Contamination	*3*
Fear of exploitation	*Common perception*	Motivation (NIH Syndrome)	*1*	Available Technology	*2*	Culture (K Strategy)	*2*
Motivation (K is P Syndrome)	*Common perception*	Lack of Retentive Capacity	*1*	Knowledge Cost	*1*	Self Interest	*2*
Fear of Contamination	*Common perception*	Causal Ambiguity	*0*	Distance	*1*	Risk	*2*
Lack of Retentive Capacity	*Common perception*	Fear of Contamination	*0*	Arduous Relationship	*1*	Knowledge Cost	*0*
Lack of Absorptive Capacity	*Common perception*	Lack of Absorptive Capacity	*0*	Rewards	*0*	Distance	*0*

Table 7.17 Barrier Analysis. **Source: Developed for research.**

The first two columns show the list of identified barriers and a top-level view of how they are perceived across the eight groups. 'Varied perception' means that the barrier is perceived to exist or impact to a greater or lesser extent across the different groups. A 'Common perception' means the perceived impact is generally the same across the groups, and a 'minimum impact' indicated the general perception is that the barrier does not exist or impact across the groups.

The 'Influencing Barrier' column shows, in descending order, those barriers that have been assessed as having the most number of influencing links to other barriers. The column labelled 'In' shows the number of influencing links. The 'Influenced Barrier' column shows those barriers most influenced by other barriers, with the column labelled 'Out' showing the number of other barriers that have influence.

The final two columns lists in descending order those barriers most targeted by implemented, performance improving change requests as identified by the optimisation team.

What Table 7.17 shows is that the surveyed work force recognises the listed barriers, and that their impact is not always uniform across the organization. The table also shows how the changes implemented in order to improve performance have targeted barriers that are also seen as have most influence amongst the other barriers. However, there are a couple of notable exceptions. It must be assumed that no organization will be able to totally address its barriers to information and knowledge sharing. Therefore, if the barriers with a multiplicity of >3 degrees are identified as being the main influencers across the organization how many of them have not been addressed as part of the improvement process? Table 7.18 lists those influencing / influenced barriers which have not been addressed through the implementation of change requests, or have had significantly fewer numbers of change requests implemented against them.

Barriers	CR implemented against barrier.	Reason.
Rewards	3	*Rewards system is controlled and changed at a Corporate level. ISC process team have no authority to change.*
Self Interest	2	*Difficult to directly improve through direct process change as Arduous Relationship, Trust, Risk, and Fear of Exploitation impact this. With the exception of Risk the influencing barriers listed are all addressed through CR implementations.*
Culture (Knowledge Strategy)	2	*Perception from survey / interview is that a 'pull' culture is already dominant. However, there is still an element that expects information to be passed to them. Currently, it is not felt the existing IBM/ISC Culture is significantly impacting information and knowledge sharing. From the adjacency matrix Culture is influenced by Existing Resources, Arduous Relationships, Organizational Context, and Motivation (K is P). Of these barriers only organizational context is not addressed by the implementation of CRs.*
Distance	0	*Perception from survey / interview is that this barrier has minimum impact and does not need any focus at present.*
Organization Context	5	*The view is almost equally split between those who believe the organizational structure is conducive to encouraging information and knowledge sharing, and those who do not.* *Existing Resources, Rewards, Culture, and Knowledge Strategy influence Org Context. Existing Resources and Knowledge Strategy receive significant focus through the implementation of CRs.*
Motivation (NIH)	3	*Perception from survey / interviews is that this barrier is not seen as a major inhibitor to information and knowledge sharing.*

Table 7.18 Barriers and CRs. **Source: Developed for research.**

Table 7.18 gives a more detailed understanding as to why they were not directly targeted by the change requests. In the case of 'Self Interest', 'Culture', and 'Organizational Context' these barriers are being indirectly targeted through improvement changes to their main influencing barriers. In the case of 'Distance' and 'Motivation' (NIH) the general perception is that these barriers already have minimum impact, so the need to address them directly is not urgent. Finally, the 'Reward' barrier is seen as being of impact. However, changes to the current reward / compensation structure can only be implemented at a corporate level. Therefore, changes to this barrier cannot be directly influenced by the implementation of change requests.

7.16 Chapter Conclusions.

When looking across the organization the questionnaire revealed the existence of the 25 barriers. However, the perception as to how these barriers impact knowledge and information sharing is varied. This information by itself only really supports the researcher's selection of the barriers from recent research. However, when the connection is made to the way barriers influence and are influenced by one another the dynamic effect barriers have when they exist to differing degrees within the organization can influence the knowledge and information sharing practices across the organization. When the barriers were assessed from an influence perspective and then compared to the type of change request that was used to improve end-to-end performance it was seen that the majority of change requests concentrated on those barriers with the highest 'in-degree' and 'out-degree' connectivity. Therefore, by concentrating on 15 of the 25 identified barriers the ISC organization was able to significantly improve performance. What is interesting is that organizations embarking on a change programme to improve information and knowledge sharing will not always be able to address all the barriers. This may be due to implementation time lines, partnership issues, technology, and resource issues. However, by concentrating on the main influencing and influenced barriers the organization is more likely to successfully engineer a climate for improved information and knowledge sharing.

In Chapter 3 the researcher hypothesised that organizations need to target barriers within all four of Nonaka's Learning Organization Model quadrants if a successful knowledge-sharing environment was to be established. From the data gathered through observation, interview and questionnaire the change requests that have been implemented across the order flow process address the key influencing / influenced barriers within each quadrant.

The knowledge strategy in use within the different groups was also worth noting. The approach to accessing and sharing information and knowledge was different across the groups. Figure 7.51 shows how the group's approaches differ.

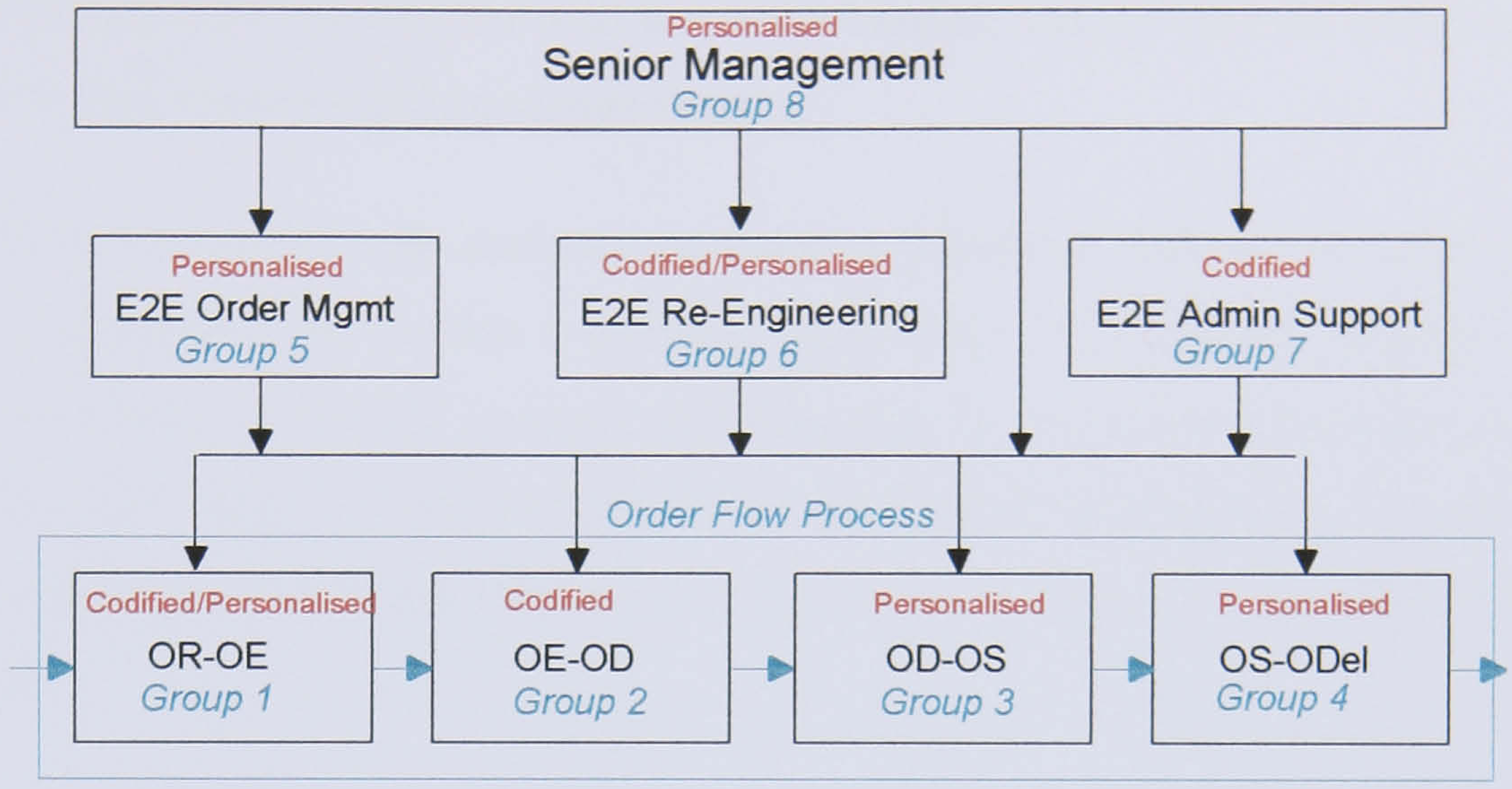

Figure 7.51 Knowledge Approach by Group. **Source: Developed for research.**

When the knowledge strategy was first reviewed in Chapter 2 the approach used across the IBM ISC organization, based on Tiwana's (2000) criteria, was mainly codified with some personalised components. However, when the groups' sharing practices were assessed against the identified barriers impacting them across the horizontal process, a different picture emerged. Based on an individual's desire to use personal networks and contact for sharing, over system driven methods of sharing, it can be seen that a lot more emphasis is placed on personalised implementation strategies. From the research conducted the barriers identified directly impacted the individuals choice of information and knowledge sharing, which in turn either support, or don't support the organizations implemented knowledge strategy. Certainly in the case of Tiwana (2000) the criteria used does not look at barrier impact. It is this failure to do so which results in the generation of a strategy which fails to consider the implications of existing sharing practice, complexity in organizational alignment, or cross boarder (third party) information and knowledge sharing.

Therefore, complex organizations need to assess barrier impact when choosing their knowledge strategy. Also, in order to affect performance improvements, processes must be understood, and also how the organization horizontally aligns itself around these processes. Once this is understood, and the barrier impact is assessed the organization can effect change that will target the barriers and develop an environment conducive to information and knowledge sharing.

Although social network analysis provides a powerful method of identifying informal information flows within a complex organization it is not the direction this research is pursuing. Certainly a clearer understanding of the informal networks which exist within the supply chain would provide additional understanding as to how complex organizations and their informal / formal networks impact overall performance (Cross, 2005).

8. Conclusion.

"A theory is not pieced together from observed phenomena; it is rather what makes it possible to observe phenomena as being of a certain sort, and related to other phenomena. They are built up in reverse – retroductively"

(Bulmer, 1979)

8.1 Introduction.

The process of answering the initial research question has been a long and convoluted one. The process has involved quantitative and qualitative techniques supported by social network analysis, IDEF0 process mapping techniques, and the clinical audit framework. The research has involved both inductive and deductive (retroduction) research methods in order to both understand the complex environment and identify an appropriate answer to a problem that is causing a lot of organizations to fail with their knowledge management initiatives.

Whilst endeavouring to hone in on the answer to the initial research question, many new and equally interesting questions arose which could have seduced the researcher onto an altogether different research theme. Not wishing to dismiss these areas of interest, the researcher will revisit them, and highlight their potential as possible areas for further research later, in this chapter. However, to ensure the key research objective has been met it is important to revisit the list outlining the initial question, and sub-questions, as identified in Chapter 1, and see if they have been adequately answered.

The process involved in completing a PhD has also raised some interesting challenges to the researcher. It is important to record these challenges as their impact was in some cases unexpected and caused the researcher to rethink certain aspects of the research strategy. As the Doctoral process is very much a learning process, the learning points experienced by the researcher should be recorded, as in a sense these provided as much a learning experience as the output from the final research analysis. To this end this chapter will not only look to see if the research question has been answered, but also to identify the contributions this research has made to the existing body of academic knowledge. The researcher will also identify and address any limitations the presented research findings may have.

8.2 Has the Research Question been addressed?

The research findings were presented in chapters 8 and 9. However, it is important to ensure the link between the initial question and the findings can be demonstrated. Therefore, it is necessary to revisit the main research question, as defined in Chapter 1. The main research question is as follows:

RQ: ***How does a supply chain organization ensure barriers to performance related knowledge transfer are identified and managed?***

In order to comprehensively address this question a number of sub-questions were devised (Chapter 1) that would allow a more structured approach to the development of an answer to the main research question. This is a necessary part of the research process as any emergent theory would be dependent on the answers and findings derived whilst investigating the research question, and its sub questions. Table 8.1 outlines the research sub-questions and respective findings.

Sub question	Findings.
SQ1: Why the need for Knowledge Management (KM) within a supply chain (complex) organization?	
• What does current research say about how KM impacts organizational performance, and in particular how KM impacts horizontally and vertically aligned organizational performance.	The majority of current research splits the notion of KM strategy firmly into two distinct approaches, codified (technology driven) or personalised (team driven). When looking at codified systems the emphasis is very much on the management of 'knowledge' through the use of IT. When talking about Personalised systems the research looks at how knowledge is created and flows across entire organizations. Personalised approaches usually point to the need for peer-to-peer support structures such as 'communities of practice', or the development of IT systems that improve peer-to-peer connectivity. What the current body of research fails to do is discuss or investigate what motivates individuals to share, and what capabilities individuals need to share knowledge and information. Current research also fails to address the question of how individuals access, create, and share information and knowledge at points within an organization. Research and literature discuss many complex and detailed methods for technological enablement to capture and transfer information. These are structures that in general support information and knowledge 'push' culture. However, some research and literature point to the need to develop a 'pull' culture. It is the belief of the researcher that a knowledge / information 'pull' culture is the desired option. In order to achieve this an organization must understand what motivates individuals to create and share.
SQ2: What is the core process flow for order management through the supply chain?	
• Need to identify and map the business process for order flow.	This was achieved by forming an optimisation team that identified the different business unit sections of the core process, and then verified the end-to-end process once it had been connected together and mapped. The mapping process followed the IDEF methodology. However, CIMOSA could also have been used. In this case the decision to opt for IDEF was based on time, software availability, and prior familiarity with the IDEF methodology.
• Need to identify the KPI performance points within the process flow.	Once the end-to-end process map was complete, the points at which operational metrics are measured can be determined. The ISC organization uses many metrics in its management of the order flow process. However, the primary metric is order turn around time. With the process completely mapped the researcher could identify which aspects of the process impacted the different stages of the order flow, and also, which parts of the organization were involved, and to what degree.

SQ3: What are the key performance indicators in a Supply Chain?	
• What are the KPIs for the supply chain, both from an IBM perspective, but also from a generic industry wide perspective?	Performance points were based on current performance metrics as used by the IBM supply chain organization. In the case of the order flow process, performance was measured by looking at order turn around time through key stages of the process; order receipt to order entry, order entry to order drop, order drop to order ship, and order ship to order delivery. It is accepted that these KPIs will vary depending on the type of process selected, and the type of organization owning the process. However, the key point is that any knowledge initiative should link its performance to the KPIs of the business process it is impacting.
• Investigate using primary research of company reports and serviceability documentation. Also use secondary research from journals / textbooks to identify generic KPIs.	Organizations use many terms and metrics in the management of their order fulfilment processes. These terms and metrics are shaped by the organizations structure, history, complexity, and ICT systems. However, the concept of having a defined time for order throughput is consistent. Time taken from receipt of an order to final delivery is commonly used, as the primary metric is customer focused supply chain organizations. Additional metrics such as stock turnaround, failure rates, and delivery times, are also used. For the purpose of this research performance impact relative to order turn around time has been used.
SQ4: Where are the knowledge transfer points that support the order flow process within the supply chain?	
• Map the Organizational ownership boundaries over the core order process to help identify where in the process are the main cross boundary transfer points.	This was achieved using basic Social Network Analysis. All departments involved with the order flow process were recorded. The business function of each department was then determined by analysing each department's 'Department Operating Manual'. This provides detailed description of the departments purpose and core processes. From this each department was linked to one of eight areas that impact the order flow process.
• Separate out the IBM specific transfer points if not relevant to generic KPI metric generation, or process flow.	The key performance indicators for the order flow process were commonly used by other organizations in the assessment of their respective order flow processes. Terms used to describe certain aspects of the process varied, but their underlying meaning remained relatively constant.
SQ5: What are the barriers to knowledge transfer?	
• What does the current research say about barriers within organizations to efficient knowledge transfer?	Current research on barrier impact looks at knowledge creation and sharing from an organization-wide perspective. The research does not look at how different parts of the same organization create and share knowledge.

• How does this research relate to knowledge transfer within a *horizontally* aligned organization?	Current research provides different lists of barriers to knowledge creation and sharing. By combining these lists a more comprehensive list can be developed. However, once again the barriers identified have not been linked to horizontal, or process aligned organizations. The research has focused on identifying the existence of these barriers within organizations, but does not look at how the barriers might impact different parts of the organization based on how they interact with key processes. For the purpose of this research 25 key knowledge barriers have been identified.
• The need to understand the difference between knowledge and value-add knowledge.	Everyone within an organization possesses knowledge. However, is that knowledge relevant to the organization's performance? This is difficult to assess on an individual-by-individual basis, especially if one considers the transient nature of knowledge within a dynamic business environment. In order to target value-add knowledge an organization must focus on how knowledge and information flow around and along the core business processes. Knowledge affecting the core process is 'value add' knowledge.
• What are the knowledge transfer barriers within the core Order flow process?	Using quantitative techniques (Kruskal – Wallis), and Social Network Analysis the impact of the 25 identified barriers was seen to vary across the different work groups associated with the core order flow process. This supports the belief that information and knowledge creation and sharing practices can vary along a core business process pathway.
• How do these barriers relate to key performance *points* within the process?	By analysing the main performance issues of a core business process, the researcher was able to directly correlate the performance issues to different barriers. In some cases performance issues revolved around the impact of more than one barrier. However, through Network Analysis an influence relationship diagram was developed outlining how the different barriers impacted one another. This was helpful in prioritising barriers against their degree of influence.

Table 8.1 Research Sub-question findings. **Source: Developed for research.**

The findings outlined in Table 8.1 are discussed in more detail throughout the preceding chapters contained in this thesis. From these findings the researcher has identified the need to understand how barriers to knowledge impact information and knowledge flow within an organization. Through the work on identifying the core process and then mapping the barriers, and respective organization's departments to the process, an understanding as to how barriers can impact the performance of core processes can be developed. The researcher then, using these findings, draws the conclusion that in order for a complex organization to manage inhibitors to performance related knowledge transfers it must understand its core business processes from an end-to-end perspective. This means looking at the process not as separated business unit processes, but from an end-to-end fully connected perspective.

The organization must then identify which parts of the organization interact with, drive, and own the process. How these different work groups interact with one another will determine how information and knowledge is created and shared; this will not be just down to the availability and capability of existing technology, but the desire and capability of the individuals to create and share information and knowledge.

Finally, organizations must align their knowledge management initiatives to key performance indicators (KPIs).

8.3 How has Research added to existing Body of Knowledge?

One of the main objectives of any PhD is to find or develop some unique insight into the subject being studied. This research was also conducted with that aim in mind. Through the course of this research the researcher identified some areas where there were gaps in the literature. Through further investigation, and a need to answer a question that had not been addressed before, the researcher has identified some areas where it is felt that the findings presented contribute to the existing body of knowledge.

The following sub-paragraphs outline where, and why, the researcher believes the presented research findings provide a unique contribution to existing theory.

8.3.1 Knowledge Transfer Barrier Analysis.

Through primary research the researcher identified a core list of 25 barriers that are believed to impact knowledge transfer. To date many academic and business practitioners have identified barriers to organizational learning. Apart from trust, motivation, causal ambiguity, and technology, there was a significant variation in the different views as to how barriers impact across organizations. There was also no evidence anyone had tried to collate a list of the different barriers, compare for overlap, and then produce a core list. In order to answer the main research question, the researcher had to do just that.

The list has been mapped to Barson *et al's* (2000) TOP Barrier framework, and tested to see if the barriers are perceived to exist across a complex organization. The testing of the list shows the list to contain a valid set of barriers. This is the first consolidated list, and as such provides a unique addition to the body of knowledge on knowledge transfer and organizational learning.

8.3.2 Barrier Impact within Complex Organizations.

Existing research talks about barrier impact as it effects the organization as a whole. There is little or no research that relates to how barriers vary in impact across a complex, or more specifically a supply chain organization. In order to understand how knowledge is created and shared along a core complex process, the researcher would need to understand if a barrier's impact is uniform across the process or not. By identifying a core process within IBM's supply chain organization the researcher was able to test for uniformity of impact along the core process. The findings showed that barriers can and do exist and impact to varying degrees along the core process. This was an important finding as many organizations implement knowledge strategies based on a top-level perspective of the existence of organization-wide barriers, such as motivation, technology and legacy systems. The reality is that because barriers impact will vary, then the impact on knowledge creation and transfer will also vary. This is a fundamental conclusion of this research that in turn drives the belief that organizations need to build their knowledge implementation strategies from the bottom-up.

8.3.3 Knowledge Transfer Barrier Interdependency.

From an academic perspective the identification of 25 barriers provides a clear indication of the ways knowledge creation and sharing can be impacted in complex organizations. However, from a practical business perspective few organizations have the managerial bandwidth to focus on the management of all 25 barriers at the same time. This caused the researcher to look at the barriers more closely in order to understand if there was a causal relationship between them. Through the use of Social Network Analysis a network diagram was developed outlining the interdependencies between barriers. Through further analysis of 'in-degree' and 'out-degree' of separation the barriers could be ranked based on the number of barriers they are impacted by, and in turn impact. This is the first time SNA has been used to analyse the relationship between barriers. The benefit of this analysis is that it allows organizations to focus their limited resources on key impact barriers.

8.4 Research Limitations.

The research has followed a proscribed methodology in order to answer a specific question. From an academic perspective the research completed what it set out to achieve. However, is the answer restricted in its application or relevance? If the answer is only relevant to a very specific aspect of knowledge transfer, under specific conditions, and only to a unique organizational structure how valuable are the research findings? Therefore, the findings presented in this thesis must be objectively assessed for their limitations and application within a suitable organizational context.

8.4.1 Research is Exploratory in Nature.

The first point to consider is that the research was exploratory in nature, where the emphasis was to develop an understanding as to how barriers can exist and impact along a complex process. Although the case study analysis largely supported the initial proposed theory the final theory may not be fully supported by findings from other complex organizations. Because of this the findings presented contain the caveat that the barrier analysis has not yet been extensively tested, and as such should be considered emergent and exploratory in nature. That said, what the research does show is that the 25 identified barriers do exist and can be shown to not always impact in a uniform manner across the organization.

8.4.2 How Research relates to Organizations.

Another area for consideration is the type of organization the research relates to. The initial IBM case used a supply chain process to identify the complex nature of knowledge barrier impact on performance. What makes the base case study findings relevant to other complex organizations is not the function of the process being investigated, but rather its complex structure (spanning multiple organizational boundaries), and the complex knowledge sharing relationships that formed around it. It is this sharing relationship along complex cross-boundaries that will shape, and be shaped, by the 25 barriers identified. How the barriers impact will be different to the level and type of impact experienced within IBM. However, the research shows how to check for barrier existence, and proposes a means of assessing the barriers from a codified / personalised perspective.

8.4.3 How Research relates to Process.

It should, therefore, also be noted that the emergent theory is most suitable for assessing and developing knowledge strategies for complex processes. Processes that are self contained within one function or business unit, with little external influence, it is believed by the researcher, will not show up the same variation in barrier impact, as those processes that span multiple business unit or organizational boundaries. Because the barrier impact will see less variation the researcher believes the knowledge creation and sharing habits along the process will also see less variation. Thus resulting in a less complex knowledge approach (codified or personalised) being deployed across the process. However, the caveat in this instance being that bottom-up process development and optimisation is still important, as this allows for the organic development of a process based on an understanding of existing barriers, and knowledge practices around the process.

8.5 Opportunities for Further Research.

Through the course of the research certain areas have come to light that may warrant further research. The reasons why they were not pursued during the course of this research were mainly due to their lack of direct relevance in answering the research question. Also, as the research was being conducted to a relatively tight timeline, lack of time was also a consideration. Listed below are the key areas the researcher has highlighted for further research, and the reasons, and possible benefits in doing so.

8.5.1 Development of Emergent Knowledge Strategy Theory.

As stated the findings presented have been used to develop an emergent theory concerning how barriers impact complex organizations. However, it is the researcher's belief that how these barriers are managed should be considered as part of any knowledge management strategy, and its implementation. The developed theory would need to be tested by organizations as part of the internal / external validation process.

In particular the researcher believes that a case study questionnaire, could be further developed, and used to test a wide population of organizations. This could provide a breakdown of organizations by industry sector. This in turn would show how those organizations with complex process structures are succeeding or failing with their knowledge initiatives by industry sector. This is an area of research that has still to be addressed.

8.5.2 Relationship between Knowledge Barriers.

Through the research presented, the researcher looked at the way barriers can influence each other. Through social network analysis those barriers that had the most and least influence were identified. However, this was only assessed as part of the IBM case study. The researcher used the optimisation team to identify the linkages and dependencies between the barriers. Although, determining the level of 'in-degree' and 'out-degree' separation was not a requirement in answering the research question, defining the dependencies has significant importance to how barriers are managed. Being able to identify and focus on the main impact barriers becomes more important within organizations with limited resources.

Therefore, a more in-depth assessment of barrier dependency is needed. This could be conducted as a multi-case study using social network analysis to define the interdependent nature of the barriers, as they are perceived to exist across different organizations. The barriers would not need to be mapped to any core processes in this instance, as the research centres more on how different individuals interpret the barriers, and their interdependent relationships.

8.5.3 Assessing and Improving CoP Performance in Complex Organizations.

There is a lot of research currently available on communities of practice (CoP) and communities of interest (CoI). However, research on CoPs is similar to the main body of knowledge management research in that few attempts have been made to link organizational performance to CoP output. Those who have looked at performance from a CoP perspective do not make any direct causal links between the two. The researcher believes there is a gap in the current theory that can be addressed by looking at the impact CoPs have on specific aspects of the organization, and the type of CoP (bottom-up -v- top-down) structure that has the most impact. The research would suggest looking at CoP alignment around core processes, and assessing them for impact based on performance improvement. Assessed over multiple organizations this would provide a view on how best to develop CoPs based on the tasks they are expected to achieve.

8.5.4 Using Social Network Analysis of Core Process Work Groups.

Using Social Network Analysis to understand how individuals relate and work together within a business or organization is not new. However, what is unique in this case is the way SNA was used to identify employee work groups along a core supply chain process. It is still common practice to talk about organizations from a hierarchical or functional perspective, even when referring to supply chain organizations. The need for process alignment is understood, however, academics and professionals still largely refer to the supply chain in terms of its functional components; procurement, manufacturing, distribution etc.

Using SNA the researcher believes a clearer understanding as to how organizations align themselves around their core supply chain processes can be better understood. By looking at centrality, and degree separation those departments / work groups that hold the most power / influence along the supply chain can be identified. This in turn can provide organizations with a clearer understanding of where along the horizontally aligned processes the main control hubs are situated.

8.6 Research Reflections.

The key aim of the research was to answer the initial research question. However, this was not the only learning outcome of the PhD process. Over the course of the PhD the process caused the researcher to question many things, such as the nature of the research, form and relevance of the question, methods of data gathering and analysis, and even the conclusions drawn from the research.

Some of the problems and tasks were expected, and some were not. However, in one way or another they all impacted the shape and direction of the thesis, and provided the researcher with a broader education concerning the process of research. The main learning points are covered from a practical, philosophical, and business perspective.

8.6.1 Practical Perspective.

How the process of conducting a PhD is approached is a very personal experience. However, from a personal perspective there are certain aspects of the research process that should be highlighted, as these had an unanticipated level of impact on the overall process.

1. **Defining the Research Question** – *Having a question, and having a research question are not always the same thing. After initially deciding on an area of research, and a possible question the researcher took the best part of 6 months to refine the question based on current academic literature. This certainly came as a surprise to the researcher, as defining the question was not initially considered to be that big a task. What made the task so long was the need to define a question that would provide a unique answer. Getting the research question into an acceptable format was a frustrating exercise as the researcher, coming from a business environment, was not used to spending so much time on the question. However, this was a useful lesson, considering the amount of effort that went into answering it. It would have been far more frustrating to get to the end of the process to find the wrong question was asked in the first instance.*

2. **Conducting the Literature Review** – *This was an interesting and enjoyable part of the process. However, the amount of literature that purports to deal with the research subject matter is vast. In order to capture, and more importantly remember the relevant references a method for classifying and categorising the reviewed literature needs to be used - preferably a method that allows cross-referencing and indexing. As the research develops, literature that may not have seemed relevant may become relevant, and vice versa. Therefore, a referencing system needs to be used from the start if the researcher is to avoid re-reviewing articles and papers. For this research project the researcher used a Lotus Notes database, which could be customised to list and sort literature reviews based on key words, relevance to research, review date, review status, author, journal, and title. This saved the researcher*

a lot of time and effort, especially through the latter stages of the research project.

3. **Collecting Data** – *Data collection for the IBM barrier analysis was impacted by environmental factors impacting the IBM work force. The lesson at this point is the need to understand the business environment in which the research is to be conducted. For example, within a manufacturing or supply chain environment, conducting a survey at month and quarter end's will result in a poor return rate as these times are key parts of the business performance cycle. Also, one needs to consider how one's target audience can be encouraged to provide the required data. Within a business environment, time is a guarded resource. Getting respondents to give up that time for free is not going to be easy. However, if it can be demonstrated that participation will result in some form of feedback this may improve response rates. However, care should be taken in ensuring individual participants' ethical rights are not impinged.*

4. **Writing-up** – *When looking back over the research process the scope and depth of information collated, which is relevant to the project, is immense. Getting a grasp on all aspects of the research can, if left to the write-up stage, be a forbidding task. In order to ensure nothing of importance was overlooked through the write-up stage the researcher maintained a daily research journal. The journal was created as an MS Word document and broken down by the key stages of the research process. The document was updated daily, and subsequently became the foundation document for the final write-up. This helped the researcher to keep focused on the research question through the research process.*

The points raised encompass the main learning points that the researcher feels can be generically applied to other research projects.

8.6.2 Philosophical Perspective.

Through the course of the research an understanding of research philosophy and methods needed to be developed. The discussion concerning objectivity and subjectivity whilst conducting research has interested the researcher. Coming from a business background, and using a case study organization the researcher is intimately familiar with, it would be difficult to be totally removed and objective.

The learning point for the researcher was that subjectivity can never be fully removed from the research, and in itself a subjective view is not necessarily bad. Subjectivity is important in that it is shaped by our beliefs, sense of reality, and experiences. To that end subjectivity helps define the way we formulate questions. For example, would a researcher with a background in deductive research, based on SME businesses, have asked the same questions, which lead to the formation of the research question used in this research?

What is important from a research validity perspective is that we as researchers understand the role our subjective views play, but employ objective reasoning in defining suitable research methodologies in order to answer the defined question. What is important is how the question is then answered.

Another learning point centres on the realisation that the research methodology approach needs to be driven by the question. If the researcher decides on a methodology based on convenience, for instance ease of use, the optimal approach may not be realised. This in turn may restrict the full impact or scope of the question, and subsequent answer. Therefore, an important lesson for the researcher has been the need to decide on the methodology based on the need to answer the question. This might lead the researcher down the qualitative or quantitative path, or indeed, as in this case a combination of both. Because of this the researcher needs to be aware of the strengths and weaknesses of the different philosophies, methodologies, and methods.

8.6.3 Business Perspective.

Academic research and business research have a different set of priorities. Academic research looks to the development of unique research with a relatively long time frame, whereas, business research places the emphasis on the formulation of a business solution that is not necessary unique, but is delivered in a timely manner. This can lead to friction between the researcher conducting the research, and the business sponsor paying for the research. Although, through the course of this research IBM placed no time constraints on the research, the conflict between the academic and business environment was still obvious. Figure 8.1 shows the main areas for concern from an academic and business perspective, as experienced by the researcher.

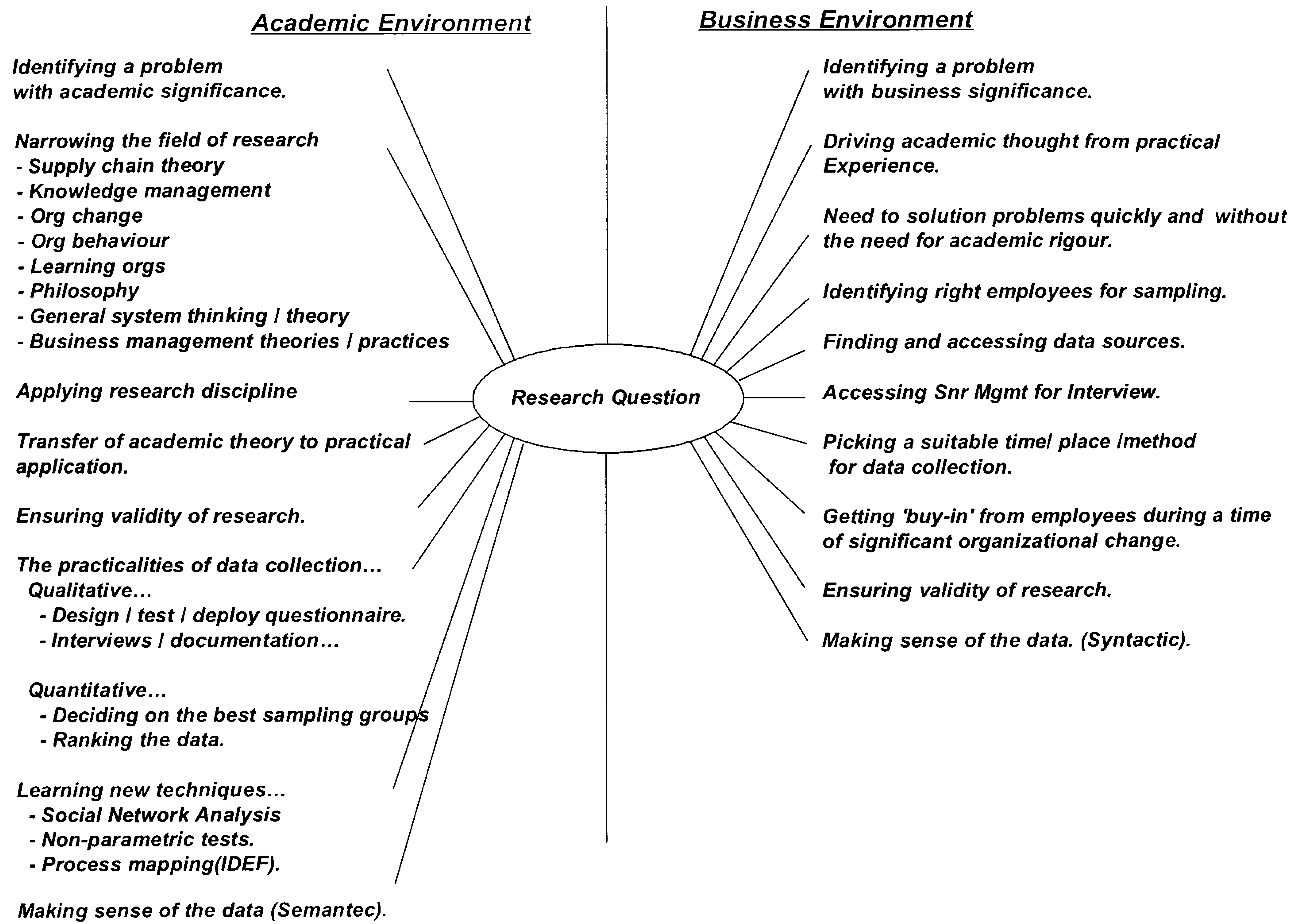

Figure 8.1 Comparison of Business and Academic Research Drivers.

Source: Developed for research

For further researchers the learning points when conducting academic research within a business environment are as follows:

1. **Agree Levels of Involvement** – *What is the research about, and how does the researcher expect the supporting business to be involved? Will the researcher need to be on-site, or will the interaction with the business / employees be conducted remotely? The researcher will need to be clear as to the impact their research will have on the business environment. The researcher will also need to ensure the amount of interaction does not start to 'creep' upwards, as if operational performance is at risk of being impacted the supporting business might put on hold, or conclude the research relationship altogether.*

2. **Agree Priority** – *Within the business environment timely solutions may be more desirable than unique solutions. If the research centres on the development of a unique capability that provides a competitive advantage businesses may allow more time to complete. However, time is money and the research will be expected to complete on time. Therefore, before requesting support the researcher needs to be clear about the time frame for completion and its relevance to the business environment. In general the shorter the timeframe the more acceptable the proposed research becomes to business.*

3. **Agree Research Deliverables** – *Not all businesses are as interested in research as academic institutions are. In order to get the necessary access the researcher may need to rely on more than just the altruistic nature of the respondent. The researcher must be prepared to demonstrate the value of the research, and possibly, the value the researcher may have to the participating organization. In order to do this the researcher must understand the business environment being researched, and the potential value of the research to potential participating businesses.*

4. **Agree Timeframe** – *This refers to the time taken through the different stages of the research project. The researcher should be clear about how much time the business will need to commit to the project. If the researcher is unclear about this during the initial request for support, the business might feel the researcher*

is not fully prepared or aware of the scope of his/her project. It is reasonable to say that businesses will be less inclined to engage in the research at this stage.

5. **Agree Resources** – *Once again the researcher need to be clear up front with the business as to what resources will be needed. This can mean access to documentation, databases, people, interviewing facilities etc, If the researcher intends to ask for access to different resources as and when required the supporting business may feel the researcher is not fully aware of the scope of their research, and once again be less inclined to engage.*

What the learning points identify is that for researchers to improve their chances of a successful research engagement with businesses, they must think about the research from a business perspective. Failure to do so might result in misunderstandings concerning the focus and expected outcome from the research, and in the worst case, the failure to engage a suitable business for the purpose of the research.

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10. Appendices

Appendix A – Top Level Process Chart.

Appendix B – On-line Questionnaire.

Appendix C – Senior Management Questionnaire.

Appendix D – Categorization of Change Requests.

Appendix E – Assessment of Barriers by Optimisation Team.

Appendix F – Adjacency Matrix for Barriers.

Appendix G – Case Study Audit Questionnaire.

Appendix H – Paper Abstracts.

Appendix A Top Level Process Chart.

Figure A-1 shows the top level process diagram for the IBM ISC order flow process. From this diagram the IDEF0 process mapping was carried out. The boxes highlighted in red, blue, and green were the focus of the IDEF mapping exercise.

For the purpose of confidentiality, IBM has requested that the IDEF process maps are not included in the thesis.

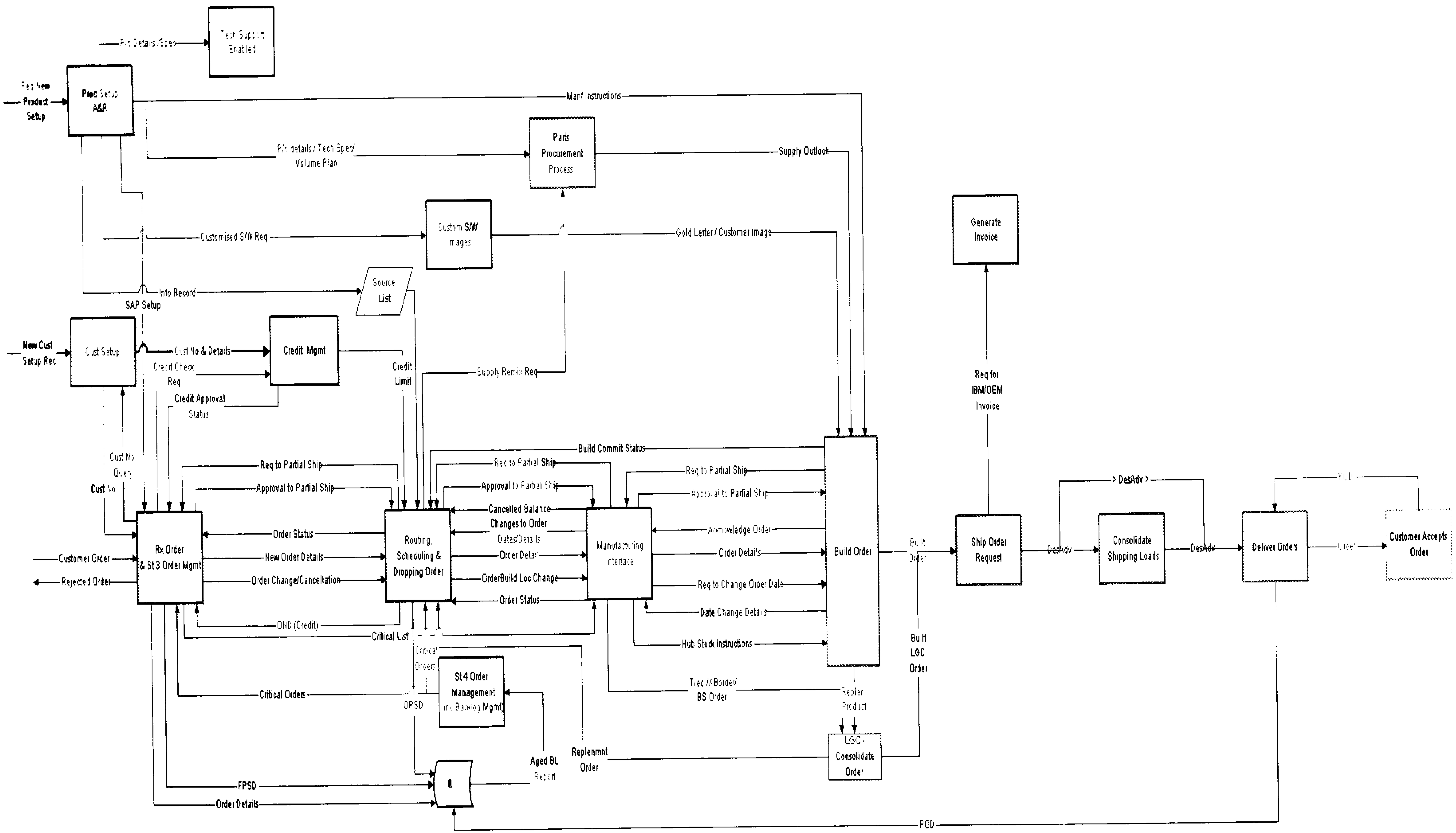

Figure A.1 Top level Order Flow Process.

Source: Developed of research.

Appendix B On-line Questionnaire.

This is the questionnaire used to assess barrier impact across the IBM ISC order flow process. The questionnaire was completed by employees of IBM, Lenovo, and Scanmina SCI. The questionnaire was distributed to the target audience via Lotus Notes. This is a commonly deployed work group application available to employees within the three organizations listed above.

Send To : Stephen.mclaughlin4@btopenworld.com

Subject :Response to

Date :09/06/2006

Improving Organizational Performance Questionnaire

Please find below 25 simple questions which have been designed to identify inhibitors to performance within our complex orgnaization.
I'd be grateful if you could take a couple of minutes (as that is all it will take!) to quickly work down through the questions and then send me the responses by clicking the 'Submit Answers' button on the bottom of the form.

The purpose of this Questionnaire is to gauge how successful we, within a complex supply chain environment, are at creating, sharing, and utilising knowledge. Therefore, can you be as forthright and honest as possible in selecting your answers.

The data collected from this questionnaire will be used to help identify a methodology for ensuring organizations (not just IBM) are able to identify inhibitors to performance related to knowledge transfer, and manage them accordingly. Thanks for your help.

PS - Double click on the form first to allow you to check the boxes...

Before you start...

Ethical Research Considerations - All data collected will be treated as anonymous and confidential. This research is being carried out in conjunction with Glasgow University Business School and as such complies with their ethical research guidelines which can be viewed at http://www.gla.ac.uk/departments/businessandmanagement/content/ethics/ethics.htm . All commercailly sensitve information will be treated confidentially in line with IBM Business Controls guidelines. by completing this questionnaire you are consenting to participating in the research.

Q1. Does a lack of any of the following exisitng resources directly impact you effectiveness to communicate and use information?
(Select as many answers as you feel relevant)

- ☐ 1. Lack of financial investment in the area.
- ☐ 2. Lack of time to complete tasks/access data.
- ☐ 3. Lack of technology to support job.
- ☐ 4. Lack of skills/training to support job.
- ☐ 5. Lack of personnel to support the job
- ☐ 6. Don't know

You may list any additional comments in the text box below...

Q2. How do you think the current reward system (PBC contribution) impacts overall organizational performance?
(Please select only one answer)

- ○ 1. Encourages me to strive for personal success in meeting my goals.
- ○ 2. Encourages me to look for ways of cooperating and working with my peers.
- ○ 3. Does not really impact the way I work, or interact with colleagues.

You may list any additional comments in the text box below...

Q3. When working within a matrix environment what factors improve the way you share information and knowledge?
(Select as many answers as you feel relevan)

- ☐ 1. All I need is effective email Communication.
- ☐ 2. A shared understanding of the job.
- ☐ 3. Physically meeting and knowing your colleagues.
- ☐ 4. Regular face to face meetings.
- ☐ 5. None of the above.

You may list any additional comments in the text box below...

Q4. When looking for information to do your job which statement below best suits?
(Please select only one answer)

- ○ 1. The Organization provides specific databases and data sources for me to do my job.
- ○ 2. I am encouraged to look where ever I want for the necessary info / knowledge to do my job.

You may list any additional comments in the text box below...

Q5. Does the deployed IT solution support the way you access, create and share knowledge throughout the organization?
(Please select only one answer)

- ○ 1. The IT systems support the way I need to access, create, and share knowledge.
- ○ 2. The IT systems support the way I need to access, and create but NOT share knowledge.
- ○ 3. The IT systems support the way I need to access, but NOT create, and share knowledge.
- ○ 4. The IT systesms do NOT support the way I need to access, create, and share knowledge.

You may list any additional comments in the text box below...

Q6. Do you see IT legacy systems as having an impact on inter-organizational transfer of information and knowledge?
(Please select only one answer)

- ○ 1. Compatibility between legacy systems seriously impacts the way we transfer knowledge.
- ○ 2. Compatibility between legacy systems impacts the way we transfer knowledge.
- ○ 3. Compatibility between legacy systems does not impacts the way we transfer knowledge.

You may list any additional comments in the text box below...

Q7. How would you determine the importance or value of information presented to you in the course of your day to day job?
(Please select only one answer)

◯ 1. Mainly through Teamrooms/reports/databases.(IT systems)
◯ 2. Mainly through face to face meetings.(Contact with SME's)

You may list any additional comments in the text box below...

Q8. How do you determine if information / knowledge generated within your work group has implications for the wider organization?
(Please select only one answer)

◯ 1. I rely on the IT systems to transfer the info/knowledge to different parts of the Organization. They can then decide on its value to them.
◯ 2. I look at the info/knowledge and discuss it with cross functional peers to see if additional benefit can be found.

You may list any additional comments in the text box below...

Q9. When trying to find the answer to a unique problem relating to your job how do you proceed?
(Please select only one answer)

◯ 1. There are easy to find Data repositories on the system which can direct you to the right location for help.
◯ 2. The Organization has nominated SMEs who can be easily contacted for help.
◯ 3. I rely on an informal network of friends and colleages to find the answer.

You may list any additional comments in the text box below...

Q10. The $ cost of setting up and running inter-organizational collaboration (face to face meetings, Team rooms, intranet access etc) is directly impacting your ability to create and share information / knowledge through the organization. How do you feel about this satement?
(Please select only one answer)

◯ 1.Strongly Agree
◯ 2.Agree
◯ 3.Makes no difference
◯ 4.Disagree
◯ 5.Strongly Disagree

If you Strongly Disagree please say why...

Q11. As part of a Function / Department, what is your approach to sharing information / knowledge (which has been developed within your area) with other Functions / Departments?.
(Please select only one answer)

- ◯ 1. We share information and knowledge freely and openly with all who want it.
- ◯ 2. We share information and knowledge freely and openly only with those in our own Organization.
- ◯ 3. We share information and knowledge freely and openly only with those related to our business function.
- ◯ 4. We share information and knowledge openly and freely only with those who work in our Department.
- ◯ 5. We share information and knowledge only on a need to know basis.

Please list any additional factors in the text box below...

Q12. How does phsical distance, cultural differences, or language effect the way you communicate and share knowledge with people throughout the organization?.
(Please select only one answer)

- ◯ 1. These factors prevent me from doing an effective job.
- ◯ 2. These factors are present but do not prevent me from doing an effective job.
- ◯ 3. I am aware of the factors but do not see them having any significance to my job.
- ◯ 4. I am not aware of these factors at all.

Please list any additional factors in the text box below...

Q13. When you receive information / knowledge from the different sources throughout the ISC organization how do you gauge its usefeulness?
(Please select only one answer)

- ◯ 1. I only assume the information / knowledge to be useful based on my prior experience of the source of the information / knowledge.
- ◯ 2. I assume all information / knowledge from Organizational sources to be accurate and useful.
- ◯ 3. I assume all infomation / knowledge from IT systems to be useful, but do not always accept it from colleagues unless I regard them as being relia
- ◯ 4. I assume all infomation / knowledge from colleagues to be useful, but do not always accept it from IT Systems unless I regard them as being reli

You may list any additional comments in the text box below...

Q14. Do you think the way the supply chain organization is structures supports the creation and sharing of information and knowledge across organization?
(Please select only one answer)

- ◯ 1.Strongly Agree
- ◯ 2.Agree
- ◯ 3.Makes no difference
- ◯ 4.Disagree
- ◯ 5.Strongly Disagree

If you Strongly Disagree please say why...

Q15. When you receive information / knowledge how do you determine the reliability of the source of the information / knowledge?
(Please select only one answer)

- ◯ 1. I automatically view all IBM sources as reliable.
- ◯ 2. I automatically view all ISC sources as reliable.
- ◯ 3. I only automatically view sources within my Function/Dept as reliable.
- ◯ 4. I only view sources whom I know personnally, or who have been vouched for by a reliable source as being reliable.

You may list any additional comments in the text box below...

Q15a. What percentage of the information you receive on a day-to-day basis would you consider coming from a reliable source?
(Please select only one answer)

- ◯ 1. All information / knowledge is reliable.
- ◯ 2. Less then 20% is reliable.
- ◯ 3. Less then 40% is reliable.
- ◯ 4. Less then 60% is reliable.
- ◯ 5. Less then 80% is relaible.
- ◯ 6. All information / knowledge is unreliable.

You may list any additional comments in the text box below...

Q16. How do you view the personal knowledge you have about your job and the processes you work with?
(Please select only one answer)

- ◯ 1. The more unique knowledge I have the more I'm worth to the organization.
- ◯ 2. The more I share my knowledge the more I'm worth to the organization.

You may list any additional comments in the text box below...

Q17. The desire to protect the interests of the Dept / Function / Otganization effects your desire to share information / knowledge with others. How do you feel about this statement?
(Please select only one answer)

- ◯ 1.Strongly Agree
- ◯ 2.Agree
- ◯ 3.Makes no difference
- ◯ 4.Disagree
- ◯ 5.Strongly Disagree

If you Strongly Disagree please say why...

Q18. When sharing information / knowledge with suppliers and business partners you censor the information / knowledge in case the supplier or business partner pass this on to you competitors. How do you feel about this statement?
(Please select only one answer)

- ◯ 1.Strongly Agree
- ◯ 2.Agree
- ◯ 3.Makes no difference
- ◯ 4.Disagree
- ◯ 5.Strongly Disagree

If you Strongly Disagree please say why....

Q19. Trusting a recipient to use your information / knowledge correctly will be a key consideration when determining the quality and quantity of information / knowledge you pass on. How do you feel about this statement?
(Please select only one answer)

- ◯ 1.Strongly Agree
- ◯ 2.Agree
- ◯ 3.Makes no difference
- ◯ 4.Disagree
- ◯ 5.Strongly Disagree

If you Strongly Disagree please say why...

Q20. In your part of the organization are there any risks such as fear of penalty payments for poor performance, losing profits, or customer dissatisfaction associated with sharing information / knowleged?
(Please select only one answer)

- ◯ 1.Yes
- ◯ 2.No
- ◯ 3.Don't know

If you Strongly Disagree please say why...

Q21. For you to continue sharing information / knowledge it is important that the recipient also shares information / knowledge with you. How do you feel about this statement?
(Please select only one answer)

- ◯ 1.Strongly Agree
- ◯ 2.Agree
- ◯ 3.Makes no difference
- ◯ 4.Disagree
- ◯ 5.Strongly Disagree

You may list any additional comments in the text box below...

Q22. When sharing information / knowledge with other parts of the organization which are geographically, culturally, or linguistically separated from you, you experience resistance from them in considering and using your information and knowledge (Not invented here syndrome). How do you feel about this statement?
(Please select only one answer)

- ◯ 1.Strongly Agree
- ◯ 2.Agree
- ◯ 3.Makes no difference
- ◯ 4.Disagree
- ◯ 5.Strongly Disagree

If you Strongly Disagree please say why...

Q23. When working with suppliers or business partners the level of collaboration between you will be directly related to their ability to perform on the same professional level as you. How do you feel about this statement?
(Please select only one answer)

- ◯ 1.Strongly Agree
- ◯ 2.Agree
- ◯ 3.Makes no difference
- ◯ 4.Disagree
- ◯ 5.Strongly Disagree

If you Strongly Disagree please say why...

Q24. When you create new information / knowledge relating to improving the way you work (e.g. process improvements, lessons learnt) the current IT Systems only provide you with the means of quickly storing or implementing your new knowledge <u>if</u> it is in the form and format of existing information / knowledge. How do you feel about this statement?
(Please select only one answer)

- ◯ 1.Strongly Agree
- ◯ 2.Agree
- ◯ 3.Makes no difference
- ◯ 4.Disagree
- ◯ 5.Strongly Disagree

If you Strongly Disagree please say why...

Q25. When presented daily with volumous amounts of information how do you identify the information / knowledge that is of benefit to you?
(Please select only one answer)

◯ 1. I only access sources of info / knowledge which have been identified as being relevant to my job.
◯ 2. I sometimes access info / knowledge sources outside the scope of my job for info / knowledge which might improve the way we work.
◯ 3. I often access info / knowledge sources outside the scope of my job for info / knowledge which might improve the way we work.

You may list any additional comments in the text box below...

Thank you for taking the time to answer this questionnaire. Can you please now click on the button below and send the completed form back to me...

Submit Answers...

(Do not use the sent, reply, or forward buttons at the top of this form or you may end up sending your response back out to everyone on the distribution list...just click on the Submit Answers button above, and then simply send the note created on to me.)

Appendix C Senior Management Questionnaire.

This questionnaire follows the same format as the on-line questionnaire. However, this part of the data gathering was conducted on a one-to-one interview basis.

Understanding Performance Inhibitors within a Complex Supply Chain Environment

Questionnaire / Structures Interview

Completion of this Questionnaire / Interview is being conducted as part of on-going research into performance inhibitors which impact knowledge creation and sharing within a complex supply chain environment.

Interviewer: Stephen McLaughlin (stephen_mclaughlin@uk.ibm.com)

Q1. Does a lack of any of the following existing resources directly impact your Team's effectiveness to communicate and use information?
(Select as many answers as you feel relevant)

1. Lack of financial investment in the area.
2. Lack of time to complete tasks/access data.
3. Lack of technology to support job.
4. Lack of skills/training to support job.
5. Lack of personnel to support the job
6. I'm not aware of any resource issues.

You may list any additional comments in the text box below...

Q2. How do you think the current reward system (PBC contribution) impacts overall organizational performance?
(Please select only one answer)

1. Encourages people to strive for personal success in meeting their goals.
2. Encourages people to look for ways to cooperate and work with their peers.
3. Does not really impact the way people work, or interact with colleagues.

You may list any additional comments in the text box below...

Q3. When working within a matrix environment what factors improve the way your team share information and knowledge?
(Select as many answers as you feel relevant)

1. We need an effective email Communication.
2. We need a shared understanding of the job with colleagues.
3. We need to physically meet and know our colleagues.
4. We need regular face to face meetings.
5. We need shared and understood business goals.
6. None of the above.

You may list any additional comments in the text box below...

Q4. When looking for information to do their job which statement below best suits?
(Please select only one answer)

1. The Organization provides and identifies specific databases and data sources for employees to do their job.
2. The Organization provides but does not actively identify specific databases and data sources for employees to do their job.
3. Employees are encouraged to look where ever they want for the necessary info / knowledge to do their job.

You may list any additional comments in the text box below...

Q5. Does the deployed IT solution support the way your Team access, create and share knowledge throughout the organization?
(Please select only one answer)

- ☐ 1. The IT systems support the way they need to access, create, and share information.
- ☐ 2. The IT systems support the way they need to access, and create but NOT share information.
- ☐ 3. The IT systems support the way they need to access, but NOT create, and share information.
- ☐ 4. The IT systems do NOT support the way they need to access, create, and share information.

You may list any additional comments in the text box below...

Q6. Do you see IT legacy systems as having an impact on inter-organizational transfer of information and knowledge (for example e.g. the ability to pull information warehouse data, like info on Db2 tables, to get useful information)?
(Please select only one answer)

- ☐ 1. Compatibility between legacy and current systems seriously impacts the way we transfer knowledge.
- ☐ 2. Compatibility between legacy and current systems impacts the way we transfer knowledge.
- ☐ 3. Compatibility between legacy and current systems does not impact the way we transfer knowledge.

You may list any additional comments in the text box below...

Q7. How would you determine the importance or value of information presented to your team in the course of their day to day job?
(Please select only one answer)

- ☐ 1. Mainly through Teamrooms / reports / databases and structured data repositories. (IT systems)
- ☐ 2. Mainly through face to face meetings, phone or email conversations, (Personal contact)

You may list any additional comments in the text box below...

Q8. How do you think your Team determines if information / knowledge generated within your work group has implications for the wider organization?
(Please select only one answer)

- ☐ 1. They rely on the IT systems to transfer the info/knowledge to different parts of the Organization. Other parts of the Org can then decide on its value to them.
- ☐ 2. They look at the info/knowledge and discuss it with cross functional peers to see if additional benefit can be found.

You may list any additional comments in the text box below...

Q9. When trying to find the answer to a unique problem relating to their job how do you think your

employees generally proceed?
(Please select only one answer)

- ☐ 1. There are easy to find Data repositories on the system which can direct them to the right location for help.
- ☐ 2. The Organization has nominated Subject Matter Experts who can be easily contacted for help.
- ☐ 3. They mainly rely on an informal network of friends and colleagues to find the answer.

You may list any additional comments in the text box below...

Q10. The financial cost of setting up and running inter-organizational collaboration (face to face meetings, Team rooms, intranet access etc) is directly impacting your ability to create and share information / knowledge through the organization. How do you feel about this statement?
(Please select only one answer)

- ☐ 1.Strongly Agree
- ☐ 2.Agree
- ☐ 3.Makes no difference
- ☐ 4.Disagree
- ☐ 5.Strongly Disagree

If you strongly disagree please say why...

Q11. As part of a Function / Department, what is your approach to sharing information / knowledge (which has been developed within your area) with other Functions / Departments?.
(Please select only one answer)

- ☐ 1. We share information and knowledge freely and openly with all who want it.
- ☐ 2. We share information and knowledge freely and openly only with those in our own Organization.
- ☐ 3. We share information and knowledge freely and openly only with those related to our business function.
- ☐ 4. We share information and knowledge openly and freely only with those who work in our Department.
- ☐ 5. We share information and knowledge only on a need to know basis.

Please list any additional factors in the text box below...

Q12. How does physical distance, cultural differences, or language effect the way your Team communicate and share knowledge with people throughout the organization?.
(Please select only one answer)

- ☐ 1. These factors prevent them from doing an effective job.

2. These factors are present but do not prevent them from doing an effective job.

3. I am aware of the factors but do not see them having any significance to their job.

4. I am not aware of these factors at all.

Please list any additional factors in the text box below...

Q13. When your Team receive information / knowledge from the different sources throughout the ISC organization how do you think they gauge its usefulness?
(Please select only one answer)

1. They only assume the information / knowledge to be useful based on prior experience of the source of the information / knowledge.

2. They assume all information / knowledge from Organizational sources to be accurate and useful.

3. They assume all information / knowledge from IT systems to be useful, but do not always accept it from colleagues unless they regard them as being reliable.

4. They assume all information / knowledge from colleagues to be useful, but do not always accept it from IT Systems unless they regard them as being reliable.

You may list any additional comments in the text box below...

Q14. Do you think the way the supply chain organization is structured supports the creation and sharing of information and knowledge across the organization?
(Please select only one answer)

1.Strongly Agree

2.Agree

3.Makes no difference

4.Disagree

5.Strongly Disagree

If you strongly disagree please say why...

Q15. When your Team receive information / knowledge how do you think they determine the reliability of the source of the information / knowledge?
(Please select only one answer)

1. We automatically view all IBM sources as reliable.

2. We automatically view all ISC sources as reliable.

3. We only automatically view sources within our Function/Dept as reliable.

4. We only view sources who we know personally, or who have been vouched for by a reliable source as being reliable.

You may list any additional comments in the text box below...

Q15a. What percentage of the information that your Team receive on a day-to-day basis would you consider coming from a reliable source?
(Please select only one answer)

- 1. All information / knowledge is reliable.
- 2. Between 0% and 20% is reliable.
- 3. Between 20% and 40% is reliable.
- 4. Between 40% and 60% is reliable.
- 5. Between 60% and 80% is reliable.
- 6. All information / knowledge is unreliable.

You may list any additional comments in the text box below...

Q16. How do your Team view the personal knowledge they have about their job and the processes they work with?
(Please select only one answer)

- 1. The more unique knowledge they have the more worth they are to the organization.
- 2. The more they share their knowledge the more worth they are to the organization.

You may list any additional comments in the text box below...

Q17. The desire to protect the interests of the Dept / Function / Organization effects your desire to share information / knowledge with others. How do you feel about this statement?
(Please select only one answer from each section)

Interests of Dept...	Interests of Function...	Interests of Organization...
1.Strongly Agree	1.Strongly Agree	1.Strongly Agree
2.Agree	2.Agree	2.Agree
3.Makes no difference	3.Makes no difference	3.Makes no difference
4.Disagree	4.Disagree	4.Disagree
5.Strongly Disagree	5.Strongly Disagree	5.Strongly Disagree

If you strongly disagree please say why...

Q18. When sharing information / knowledge with suppliers and business partners you censor the information / knowledge in case the supplier or business partner pass this on to your competitors. How do you feel about this statement?
(Please select only one answer)

- 1.Strongly Agree

- [ ] 2.Agree
- [ ] 3.Makes no difference
- [ ] 4.Disagree
- [ ] 5.Strongly Disagree

If you strongly disagree please say why....

Q19. Trusting a recipient to use your information / knowledge correctly will be a key consideration when determining the quality and quantity of information / knowledge you pass on. How do you feel about this statement?
(Please select only one answer)

- [ ] 1. Strongly agree
- [ ] 2.Agree
- [ ] 3.Makes no difference
- [ ] 4.Disagree
- [ ] 5.Strongly Disagree

If you strongly disagree please say why...

Q20. In your part of the organization are there any risks such as fear of penalty payments for poor performance, losing profits, or customer dissatisfaction associated with sharing information / knowledge?
(Please select only one answer from each section)

Fear of Penalty Payments...	Losing Profits...	Customer Dissatisfaction...
☐ 1.Yes	☐ 1.Yes	☐ 1.Yes
☐ 2.No	☐ 2.No	☐ 2.No
☐ 3.Don't know	☐ 3.Don't know	☐ 3.Don't know

You may list any additional comments in the text box below...

Q21. For you / your Team to continue sharing information / knowledge it is important that the recipient also shares information / knowledge with you. How do you feel about this statement?
(Please select only one answer)

- [ ] 1.Strongly Agree
- [ ] 2.Agree
- [ ] 3.Makes no difference
- [ ] 4.Disagree
- [ ] 5.Strongly Disagree

You may list any additional comments in the text box below...

Q22. When sharing information / knowledge with other parts of the organization which are geographically, culturally, or linguistically separated from you, you experience resistance from them in considering and using your information and knowledge (*Not Invented Here Syndrome*). How do you feel about this statement?
(Please select only one answer from each section)

Separated by Geo / Physical Distance...	Separated through cultural difference...	Separated through language difference...
1.Strongly Agree	1.Strongly Agree	1.Strongly Agree
2.Agree	2.Agree	2.Agree
3.Makes no difference	3.Makes no difference	3.Makes no difference
4.Disagree	4.Disagree	4.Disagree
5.Strongly Disagree	5.Strongly Disagree	5.Strongly Disagree

If you strongly disagree please say why...

Q23. When working with suppliers or business partners the level of collaboration between you will be directly related to their ability to perform on the same professional level as you. How do you feel about this statement?
(Please select only one answer)

1.Strongly Agree
2.Agree
3.Makes no difference
4.Disagree
5.Strongly Disagree

If you strongly disagree please say why...

Q24. When you create new information / knowledge relating to improving the way you work (e.g. process improvements, lessons learnt) the current IT Systems only provide you with the means of quickly storing or implementing your new knowledge <u>if</u> it is in the form and format of existing information / knowledge. How do you feel about this statement?
(Please select only one answer)

1.Strongly Agree
2.Agree
3.Makes no difference
4.Disagree
5.Strongly Disagree

If you Strongly Disagree please say why...

Q25. When presented daily with voluminous amounts of information how do you identify the information / knowledge that is of benefit to you?
(Please select only one answer)

- 1. I only access sources of info / knowledge which have been identified as being relevant to my job.
- 2. I sometimes access info / knowledge sources outside the scope of my job for info / knowledge that might improve the way we work.
- 3. I often access info / knowledge sources outside the scope of my job for info / knowledge that might improve the way we work.

You may list any additional comments in the text box below...

Q26. How long have you worked in your current role within the ISC (If you have recently moved (since December) then the question refers to your previous role within ISC), and overall within IBM?
(Please select only one answer from each section)

Time in ISC role

- Less than 6 mths
- 6mths to 1yr.
- 1yr to 2yrs.
- Greater than 2yrs

Time with IBM

- Less than 1yr
- 1yr to 2yrs
- 2yrs to 4yrs
- 4yrs to 6yrs
- 6yrs to 8yrs
- 8yrs to 10yrs
- Greater than 10yrs.

You may list any additional comments in the text box below...

Appendix D Categorization of Change Requests.

Table attached shows how the Change Requests, identified for the purpose of process improvement, have been assessed against knowledge transfer type, and knowledge approach.

Process Area Impacted	Change Request (CR) No	CR Priority	Owner Process Group	Impacted Milestone(s)	Focus of Change Request	Type of Knowledge Transfer	Required Knowledge Approach for CR
Process & System Support	1	3	Re-Eng	1,2,3,4	Direct Collaboration	T->T	P
Process & System Support	2	1	Re-Eng	3	IT Change	E->E	C
Supply Commit & Scheduling	3	1	CS	1,2,3	Direct Collaboration	E->E	C
Supply Commit & Scheduling	4	1	CS	1,2,3	Direct Collaboration	E->E	C
Supply Commit & Scheduling	5	1	CS	1,2,3	Direct Collaboration	E->E	C
Supply Commit & Scheduling	6	1	CS	1,2,3	Direct Collaboration	E->E	C
Operations & Management System	8	3	CT/Ops	1,2,3,4	Direct Collaboration	E->T	P
Operations & Management System	9	3	CT/Ops	1,2,3,4	Direct Collaboration	T->T	P
Operations & Management System	11	1	CT/Ops	2,3	Direct Collaboration	E->E	C
Operations & Management System	12	3	CT/Ops	2,3	Direct Collaboration	E->T	P
Customer Fulfilment	13	2	CF	1,2,3,4	Direct Collaboration	E->T	P
Customer Fulfilment	14	3	CF	1,2	Direct Collaboration	T->E	C
Customer Fulfilment	15	1	CF	3	Direct Collaboration	T->E	P
Customer Fulfilment	15a	3	CF	3	Direct Collaboration	T->E	C
Customer Fulfilment	15b	2	CF	2,3,4	IT Change	E->E	C
Customer Fulfilment	15c	2	CF	3	Direct Collaboration	T->E	P
Operations & Management System	17	1	CT/Ops	2,3	Direct Collaboration	E->T	P
Distribution	18	3	GL	4	IT Change	E->E	C
Operations & Management System	19	1	CT/Ops	1,2,3,4	Direct Collaboration	T->T	P
Operations & Management System	19a	1	CT/Ops	1,2,3,4	Direct Collaboration	E->T	P
Operations & Management System	19b	2	CT/Ops	1,2,3,4	Direct Collaboration	E->T	P
Operations & Management System	19c	2	CT/Ops	1,2,3,4	Direct Collaboration	E->T	P
Operations & Management System	19d	2	CT/Ops	2	IT Change	T->E	C
Operations & Management System	19e	2	CT/Ops	1,2,3,4	Direct Collaboration	E->T	P
WW ISC	20	2	WW Process	1,2,3,4	Direct Collaboration	T->T	P
WW ISC	21	2	WW Process	1,2,3,4	Direct Collaboration	T->E	P
WW ISC	22	3	WW Process	2	Direct Collaboration	T->E	P
WW ISC	23	1	WW Process	1,2,3,4	Direct Collaboration	T->E	P
End2End Quality	25	1	CT/Ops	3	Direct Collaboration	E->T	P
Process & System Support	26	1	Re-Eng	3	Direct Collaboration	E->T	C
Operations & Management System	27	3	CT/Ops	1,2,3,4	Direct Collaboration	E->T	P
Process & System Support	28	1	Re-Eng	3,4	IT Change	E->E	C
Process & System Support	31	1	Re-Eng	3	IT Change	E->E	C
Operations & Management System	35	1	CT/Ops	2,3	Direct Collaboration	E->T	P
Operations & Management System	36	1	CF	3	Direct Collaboration	T->T	P
WW ISC	36a	1	WW Process	1,2,3	IT Change	E->E	C
Operations & Management System	38	1	CT/Ops	1,2,3,4	Direct Collaboration	T->E	C

Customer Fulfilment	41	3	CF	1,2,3	Direct Collaboration	T->E	C
Customer Fulfilment	43	1	CF	1,2,3,4	Direct Collaboration	E->T	P
Distribution	44	2	GL	4	Direct Collaboration	T->E	C
Distribution	45	3	GL	4	Direct Collaboration	E->T	P
End2End Quality	47	2	CT/Ops	1,2,3,4	Direct Collaboration	T->E	C
Process & System Support	51	3	Re-Eng	2,3	IT Change	E->T	C
Customer Fulfilment	52	2	CF	1,2,3,4	Direct Collaboration	T->E	P
Process & System Support	53	2	Re-Eng	2	IT Change	E->E	C
Operations & Management System	54	3	CT/Ops	3	Direct Collaboration	E->T	P
Engineering	55	3	CT/Ops	1,2	IT Change	E->E	C
Engineering	55a	3	CT/Ops	1,2	IT Change	E->E	C
Engineering	55b	3	CT/Ops	1,2	IT Change	E->E	C
Engineering	55c	3	CT/Ops	1,2	IT Change	E->E	C
Distribution	56	1	GL	4	IT Change	E->E	C
Engineering	58	2	CT/Ops	1,2	Direct Collaboration	E->T	C
Process & System Support	60	3	Re-Eng	3	IT Change	E->E	C
Distribution	62	2	GL	4	IT Change	E->E	C
Customer Fulfilment	63	2	CF	1,2,3,4	Direct Collaboration	T->E	C
Distribution	63a	1	GL	4	Direct Collaboration	T->E	C
Process & System Support	63b	2	Re-Eng	3	IT Change	E->E	C
Process & System Support	64	1	Re-Eng	2	IT Change	E->T	C
Process & System Support	64a	1	Re-Eng	2	IT Change	E->T	C
Process & System Support	64b	1	Re-Eng	2	IT Change	E->T	C
Customer Support Programmes	69	3	CProgs	2	Direct Collaboration	T->E	C
Process & System Support	70	1	Re-Eng	3	IT Change	E->T	C
Customer Fulfilment	72	1	CF	1,2,3,4	IT Change	E->T	C
Customer Fulfilment	73	1	CF	1,4	Direct Collaboration	E->T	C
Distribution	76	1	GL	4	Direct Collaboration	E->T	P
Distribution	76a	2	GL	4	IT Change	E->E	C
Distribution	76b	3	GL	4	IT Change	E->E	C
Distribution	76c	3	GL	4	IT Change	E->E	C
Distribution	76d	3	GL	4	IT Change	E->E	C
Distribution	76e	3	GL	4	Direct Collaboration	T->E	C
Distribution	76f	2	GL	4	IT Change	E->E	C
Process & System Support	77	1	Re-Eng	3	IT Change	E->E	C
Distribution	78	3	GL	4	Direct Collaboration	E->T	P
Distribution	78a	1	GL	4	Direct Collaboration	E->T	P
Distribution	78b	1	GL	4	Direct Collaboration	E->T	P
Distribution	78c	1	GL	4	Direct Collaboration	E->T	P
Distribution	78d	2	GL	4	Direct Collaboration	E->T	P

Process & System Support	80	1	Re-Eng	2	IT Change	E->T	C
Process & System Support	80.03	3	CT/Ops	2	IT Change	T->E	C
Process & System Support	80.04	3	CT/Ops	2	Direct Collaboration	T->E	C
Process & System Support	80.05	3	CT/Ops	2	Direct Collaboration	T->E	C
Process & System Support	80.06	3	CT/Ops	2	Direct Collaboration	T->E	C
WW ISC	83	3	WW Process	4	Direct Collaboration	T->E	C
Operations & Management System	85	2	CS	2	Direct Collaboration	T->E	C
Operations & Management System	86	1	CT/Ops	3	Direct Collaboration	T->T	P
Operations & Management System	86a	2	CT/Ops	3	Direct Collaboration	T->T	P
Operations & Management System	86.03	3	GL	3	IT Change	E->E	C
Operations & Management System	86.04	3	CT/Ops	3	IT Change	E->T	P
Operations & Management System	86.05	3	CT/Ops	2	Direct Collaboration	E->T	P
Operations & Management System	89	2	CT/Ops	4	IT Change	T->E	C

Table C.1 Categorization of Change Requests. **Source: Developed for research.**

Appendix E Assessment of Barriers by Optimisation Team.

Table attached links the change requests to specific barriers. As can be seen from the table change requests may have an impact on more than one barrier at a time.

Task	Description	Owner	Transfer Type	Codified/Person	Barriers impacted
1	BRIO Mis-reporting order route -	Re-Eng	E->T	C	1,5,8,24
2	All Orders Credit check on order load, not drop	Re-Eng	E->T	C	5,8,24
3	SAP-F Artificial Ties on orders untied by customer	Re-Eng	E->E	C	1,5,6,7,8,13,25
4	Organizational Change - Cross-functional team	Re-Eng	T->T	P	1,8,9,13,15,17,25
5	SSCI Inventory Control Simplification	Re-Eng	E->T	C	1,5,6,7,8,11,15,16,17,18,19,20,22
6	Remove S & C Africa countries from EMEA in SAP P	Re-Eng	E->E	C	5,6
8	CEMA Logistics - GL Response Times	GL	E->T	P	1,5,6,7,8,19,21,25
9	Customer Critical Tracking	GL	T->E	C	5,7,8,9,14,24
11	Each CT manager to document the policies & rules of thumb for routing orders.	CT/Ops	T->E	C	7,8,17,21,22
12	Invoices received before Freight	GL	E->E	C	1,5,6
13	Reduce date churn - CN 11 Shared Shipping point	CF	E->E	C	3,5,15
14	Exception Process for Communicating Date Changes	CF	T->E	C	5,16,22
15	Reduce date churn.	CF	T->E	P	1,2,5,24
17	Each CT to verify the source report against the documented routing policies. This should be repeated every month, in the 1st week of the month.	CT/Ops	T->E	C	7,8,17,21,22
18	Delays in making C/DP Nos shippable	CT/Ops	E->T	C	1,5,6,7,8
19	CTs must ensure that all XSeries, Thinkcentre & Option parts are set up in GNK to permit desired routing	CT/Ops	T->E	C	7,8,17,21,22
20	Assure Quality of Supply Commit	WW Process / Admin	T->E	P	1, 7, 14
21	OEM Suppliers should honour Priority codes	WW Process / Admin	T->E	C	1, 7, 14
22	Residue of Partial Ships - Retain OPSD FPSD	WW Process / Admin	E->E	C	1,5,9
23	Mgmt Sys to drive issues to closure	WW Process /	T->E	P	1,3,7,8

		Admin			
25	Claim / Ship after agreed cut-off -XSeries	CT/Ops	T->T	P	1,7,8,15,17,19,21,22
26	Order Routing/Single brand orders dropping on LGC	Re-Eng	E->T	C	5,6,7,8,25
27	MIPR Shipment Errors	GL	E->E	C	1,5,7,8,15,25
28	Status P errors @ SCSI	Re-Eng	E->E	C	1,5,6,7,8,13,17,22
31	FGI Returns Process	Re-Eng	E->T	C	1,3,5,6,7,8,9,13,15,17,18,20
35	CEMA Logistics - Customs Invoices	GL	E->T	P	1,5,6,7,8,19,21,25
36	Identify Servers requiring longer mfg cycle	CT/Ops	E->T	P	1,8,9
38	CEMA Logistics - SSCI/CT Issues	GL	E->T	P	1,5,6,7,8,11,19,21,25
41	Cancellation tracks in St 3 & St 4 by brand/region	CF	T->E	C	5,7
43	Unauthorised Partial Ships	CF	T->T	P	1,7,8,17,19,21
44	MIPR Process	CT/Ops	T->E	C	1,5,6,7,8,25
45	CSD recalculation	CT/Ops	T->E	C	5,6,7,8
47	ThnkPad Reliable Supplier Focus	CT/Ops	E->T	P	1,5,7,13, 15,17,19,21,22
51	Pricing - major G status detractor	Re-Eng	E->E	C	5,6
52	Expedite ship process	CF	T->E	C	1,5,6,7
53	Partials, Toggles, "Untied" - no new Credit Check	Re-Eng	E->T	C	5,8,24
54	Wrong Weights & Dimms	GL	E->E	C	1,5,6,8
55	Mixed Brand Reliable Supplier Focus	CT/Ops	E->T	P	1,5,7,13, 15,17,19,21,22
56	MBO / LGC Management System	CT/Ops	E->T	P	1,5,7,13, 15,17,19,21,22
58	XSeries Reliable Supplier Focus	CT/Ops	E->T	P	1,5,7,13, 15,17,19,21,22
60	Expedite ship process - System Fix	Re-Eng	E->E	C	1,5,6,7,8,19,22
62	Include qual of delivery on CF ScoreCard	CF	E->T	C	5,16,22
63	Reduce date churn - Past MADs process	CF	T->E	C	3,5,11,15,19
64	Incorrect discription on Customs Invoices	GL	E->E	C	1,5,8
69	C/D PNo - Content Transition Management	CProgs	T->E	C	1,5,6,7,9
70	FODS rejecting all invoice IDOCS	Re-Eng	E->E	C	5,6
72	Reduce date churn - CF/CT Management system	CF	T->E	P	1,2,5,24
73	Selective Customer Communication of (NEAD)	CF	E->T	P	7,8,17,19
76	IIPC visibility of EMEA Order Backlog - St3 & St4	CS	E->E	C	5,6
77	DESADV failure in SAP P for various reasons.	Re-Eng	E->E	C	5,6

78	Claim / Ship after agreed cut-off (ThinkC)	CT/Ops	T->T	P	3,7,8,9,17,19,21,22,25
80	CEMA Logistics	GL	E->T	P	1,5,6,7,8,
80.03	Estab. UPS 2 Day Delivery from IIPC for Top 10	GL	E->E	C	5,7,9
80.04	Quality of Delivery - Hungary (then Grnk)	GL	E->T	P	3,5,7,8,9,15
80.05	Certificate of Origin	GL	E->E	C	1,5,6
80.06	Decide site response A) Do nothing - continue to miss delivery dates for High End Server customers and up to 20% of ThinkCentre customers B) Require SSCI to ship on PSD-1 C) Add 1 day to standard Transit Times from GNK.	GL	E->E	C	3,7,9,13, 15, 17,19,21,22,25
83	Confirm priority for optimization effort	WW Process / Admin	T->E	P	1,3,4,7
85	Server CPNo Set Up to FOT complete	CT/Ops	E->E	C	1,5,7,8,24,25
86	Dedicated GNK team to focus on Tied Orders	CT/Ops	E->T	P	1,8,9,13,15,17,25
86.03	Cancellation Process manual & prone to error	CT/Ops	E->T	P	1,8,9,13,15,17,25
86.04	Orders Trapped at SSCI Mfg Checkpoints	CT/Ops	E->T	P	1,3,4,7,8,17,
86.05	Dedicated GNK team to focus on Options Fulfillment	CT/Ops	E->T	P	1,8,9,13,15,17,25
89	Metrics & Management System for Desktops ship on PSD-1	CT/Ops	E->T	P	3,7,8,9,15,17,19,22,25
15a	Critical's - fb through DB not spreadsheet	CF	E->T	C	1,5,7
15b	Critical List Process and Priority Codes	CF	T->E	P	3,7,8,9,11,17,19,22,25
15c	Scorecard	CF	E->T	P	3,7,8,9,15,17,19,21,22,25
19a	Supplier Freight Loading Quality Mgmt Sys	GL	E->T	P	1,3,5,8,11,19
19b	CEMA Logistics - GL/Carrier Issues	GL	E->T	P	1,5,6,7,8,19,21,25
19c	Moss End - EDI issues -	GL	E->E	C	3,5,7,8,9,15
19d	Logistics Center Startup Support	CT/Ops	T->T	P	1,8,9,13,15,17,25
19e	Expedite ship-Fix backend of Manual work round	GL	T->E	C	3,5,7,8,9,15
36a	Roundtable Meetings on ISC strategy	WW Process / Admin	T->T	P	1,3,7,8
55a	CPNo Set Up to FOT complete	CT/Ops	E->E	C	1,5,7,8,24,25

55b	Thinkcentre - CPNo Set Up to FOT complete	CT/Ops	E->E	C	1,5,7,8,24,25
55c	Thinkpad CPNo Set Up to FOT complete	CT/Ops	E->E	C	1,5,7,8,24,25
63a	Cancelled Order Management System.	CT/Ops	T->E	C	1,5,7,8,9,13,14,17
63b	Credit check on order load, not drop	Re-Eng	E->T	C	5,8,24
64a	Mismatch between Customs Invoice & SAP-F Invoice	GL	E->E	C	1,5,6
64b	Value on Customs Invoice for Internals	GL	T->E	C	1,5,6
76a	Quality Issue -SSCI Hungary	CT/Ops	E->T	P	3,5,7,8,9,11,15,19,22
76b	Options Reliable Supplier Focus	CT/Ops	T->E	C	3,7,8,9,15,17,19,22,25
76c	SSCI visibility of EMEA Order Backlog - St 3 & 4	CS	E->E	C	3,5,6,11,14,17,19,22
76d	SSCI Pilot of Daily PSD Process : XSeries	CS	E->E	C	3,5,7,8,13,15
76e	Daily Rescheduling	CS	T->E	C	1,5,6,7,8,15
76f	IIPC Pilot of Daily PSD Process: TP	CS	E->E	C	5,7,8,13,15
78a	IIPC Tied Order Process	CT/Ops	E->E	C	1,5,6,7
78b	Buffer Stock Management System	CT/Ops	E->T	P	1,3,7,8,15,17,19,22
78c	Reliable Supplier Focus - Date Stability	CT/Ops	T->T	P	1,5,7,13, 15,17,19,21,22
78d	Thinkcentre Reliable Supplier Focus	CT/Ops	E->T	P	1,5,7,13, 15,17,19,21,22
86a	Produce a report showing, for each xSeries, ThinkCenter & Option PNo, whether or not it is set up in SCO and HUN, and whether there are blocks stopping it being sourced on SCO or HUN. This report will be defined by Paul McBride, Ian Grieve and Jack Bryant	CT/Ops	T->E	C	5,6,7,8,15,17

Table D.1 Linking Barriers to process improving change requests. **Source: Developed for research.**

Appendix F Adjacency Matrix for Barriers.

This adjacency matrix shows the inter-dependency between barriers.

Directed Adjacency Matrix for Barriers to information and knowledge sharing.

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Outdegree
CCB	Existing Resources	1	0		1		1		1																			3
CCB	Rewards	2		0																								0
CCB	Arduous Relationship	3			0																1							1
CCB	Culture (K Strategy)	4	1			0	1									1		1										4
TB	Available Technology	5	1				0	1																				2
TB	Legacy Systems	6	1				1	0				1																3
OB	K Strategy Implementation	7	1		1		1		0																			3
OB	Causal Ambiguity	8	1	1	1					0			1					1	1		1		1					8
OB	Poor Targeting of K	9				1					0						1											2
OB	Knowledge Cost	10	1									0																1
OB	Proprietary knowledge	11		1									0	1				1	1	1	1	1						7
OB	Distance	12												0				1										1
OB	Unprovenness	13					1	1							0						1							3
OB	Organizational Context	14	1	1		1			1							0												4
OB	Info not perceived as reliable	15	1				1	1			1				1		0											5
PB	Motivation (K is P syndrome)	16		1										1				0		1	1		1					5
PB	Internal Resistance	17	1		1													1	0	1	1							5
PB	Self Interest	18			1															0	1	1	1					4
PB	Trust	19			1													1		1	0							3
PB	Risk	20																		1	1	0	1					3
PB	Fear of exploitation	21		1		1								1	1			1		1	1		0					7
OB	Motivation (NIH Syndrome)	22		1										1	1		1							0				4
PB	Fear of Contamination	23	1															1							0			2
PB	Lack of Retentive Capacity	24	1																1		1	1	1	1		0		6
PB	Lack of Absorptive Capacity	25	1			1			1		1															1	0	5
	Indegree		12	6	6	4	6	3	3	0	2	1	1	4	3	1	2	8	3	6	10	3	5	1	0	1	0	

Table F.1 Adjacency Matrix for Barriers. **Source: Developed for research.**

Appendix G Paper Abstracts.

Listed below are the abstracts from the peer-reviewed journal articles which relate to the PhD research project.

Publications arising from this thesis.

McLaughlin SA, Paton R, & Macbeth DK (2006). "Managing change within a complex supply chain: An IBM Case Study", *Decision Management.* 44(8). Pp 1002-1019.

Abstract.

It is argued that for organizations to truly achieve consistently high levels of performance within a supply chain environment they must move from a functional to a process alignment (Day, 1994, Teece, 1998). This can be difficult, as it requires significant organizational changes, with associated cross-functional integrated decision-making and coordination, which can take time to implement. IBM in Europe recently found itself faced with under performing end-to-end performance within its personal computer supply chain. Knowing that a shift from functional to process management across the organization would take too long to implement the organization implemented a hybrid model for managing performance and decision-making. The organization considered the core order management process to be the main area impacting upon performance. However, to understand the impact of change anywhere along the process the end-to-end process would need to be mapped and understood. In order to do this a cross functional team of subject matter experts were assembled to better understand the end-to-end process and identify necessary improvements. Although the order flow process used the latest software systems, it was not until a cross functional process orientated team assembled to look at the end to end process logic, skills alignment, effective codified knowledge systems, and the prioritisation of change, that real improvement in the process performance were realised. In effect IBM managed to drive a process focus within a functionally aligned organization to achieve the desired performance improvements. This paper shows how this was achieved over a relatively short period of time.

McLaughlin SA, Macbeth DK (2006). "Identifying knowledge transfer barriers within a complex supply chain organization", In Mendibil K & Shamsuddin A (Eds), *EurOMA: Moving up the value chain.* Glasgow: Strathclyde University Press.

Abstract.

This paper covers aspects of a PhD currently being undertaken by the first author. The aim of the research is to look at how knowledge creation and transfer is impacted across a complex process orientated (Supply Chain) organization. The paper specifically looks to identify a list of common barriers which have been identified though secondary research, and then investigates how these barriers exist across employee groups across a core, horizontally aligned, business process. The intent of the research being to show how barriers can impact knowledge transfer across a process and that the impact of the barriers is not always consistent across the organization. It is the authors' belief that organizations need to be aware of these barriers and their impact when considering a suitable supply chain performance knowledge strategy.

Articles under review.

McLaughlin SA, Paton R, & Macbeth DK (2006). "Barrier impact on organizational learning within complex organizations", *Journal of Knowledge Management.*

Abstract.

Today's supply chains are operating more complex processes in order to drive performance up within highly competitive businesses. However, in order for organizations to maximise their supply chain performances this paper argues they must first look to how their employees access, create, and share information and knowledge along their main core business processes. Through research outlined in this paper, 25 key barriers to information and knowledge transfer have been identified. However, the barriers identified, when tested against one of IBM's core supply chain processes, were seen to impact differently along the core process. Therefore, barrier impact cannot be assumed to be uniform across an organization. The implication of this to organizations is that effective process performance needs barrier identification and management not at an organization level, but at a process level. The deployment of generic information technology (IT) and business systems needs to be questioned as to their deployment based on organizational needs as opposed to process needs may be detrimental to overall business performance.

McLaughlin SA, Paton R, & Macbeth DK (2006). "Knowledge strategy framework for process aligned organizations: an IBM case", *European Management Journal.*

Abstract.

Organizations proactively looking to develop their knowledge strategy largely tend to consider their strategy from an organization-wide, top-down perspective, which in turn tends to drive a predominantly codified or personalised approach. However, this approach in determining the best knowledge strategy fit does not always result in the development of a suitable strategy. The author's content that for organizations where inter and intra organization collaboration is vital to overall end-to-end business performance, such as in a supply chain environment, a bottom up approach in understanding how the different parts of the organization create and transfer information and knowledge needs to be a key consideration in the development of the organization's knowledge strategy. Based on how information and knowledge are created and shared along a core IBM supply chain process the authors have formulated a knowledge strategy development framework which they feel will help organizations better utilise effective knowledge and information sharing practice with end-to-end business performance.

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