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Enterprise and Internet of Things (IoT):

Legitimating new business models in the 21st Century: **Legitimation of Internet of Things based new ventures and their business models.**

Aastha Pandey

Submitted in fulfilment of the requirements of the Degree of Doctor of Philosophy in Management

Adam Smith Business School
College of Social Sciences
University of Glasgow
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Abstract

This research shows the different types of boundary work undertaken by IoT-based start-ups in their quest for legitimacy. The overarching aim is to show how IoT-based ventures legitimise themselves and their business models and how investors, enablers like venture development organisations and customers contribute to this process of legitimisation. This thesis draws upon four literature strands – institutional theory, entrepreneurship, organisational work and business models.

The study reviews literature on legitimisation and boundary work across venture, institutional and artefact levels while considering the inputs from the three categories of evaluators – customers, venture development organisations and investors as well as broader impact of regulations, technological trends and disruptive events like COVID-19. A multi-case study approach was adopted investigating 20 cases from across EU, Asia, Africa and North America through semi structured interviews, secondary documents and grey literature. Interviews were conducted with CEOs and founders of identified case start-ups and the partners and directors of investor, accelerator and expert organisations. Thematic analysis and inductive approach were adopted to identify recurrent themes and build a theoretical framework.

IoT start-ups create and manage identity, artefact and firm symbolic and objective boundaries in their pursuit of legitimacy. The study shows some of the best practices and mechanisms used by start-ups to gain legitimacy. This study finds that start-ups actively co-opt the legitimacy of established actors to re-shape industry norms and create new institutional boundaries. Start-ups also re-defined the boundaries around traditional cultural and professional practices through the incorporation of IoT. This study found that IoT technologies-based start-ups face a set of legitimacy challenges and liabilities which are distinct from those faced by start-ups for whom hardware usage or implementation was unnecessary. Start-ups overcome these challenges through strategic pursuit of resources and constant change. In some

cases, ventures *temporarily* adapted their identities in anticipation of and in response to external jolts, advice of insiders from evaluator organisations and evaluator feedback. This was spurred along with the support of venture development organisations in the form of publicity or product development or funding. IoT start-ups dealing with business customers invested in mapped organisational hierarchies and demonstrated competence to support scaled adoption and legitimacy. Within the study, the ventures provided signals of legitimate authority through the technological boundary management of the IoT stack and exhibiting strong capability for integration across multiple levels. The study highlights the stark power asymmetry present in the start-up-customer relationships as customers are shown to exploit the start-up for information gathering purposes. This thesis also shows the dark side of legitimacy seeking efforts as start-ups tried to ensure alignment with evaluators at any cost. On the other hand, certain founder groups faced microaggressions and stigma from gatekeepers, mentors and investors.

This research makes a contribution to discourses on entrepreneurship, institutional theory, organisational work and business model literature by offering a comprehensive account of boundary work undertaken by IoT-based new ventures in a bid to gain legitimacy. The theoretical contributions from this thesis show that boundary work and legitimisation are recursive, as boundary work leads to legitimacy and in some cases legitimacy challenges, while legitimation further propagates boundary work. This thesis creates a typology of boundary work in the form of boundary creation, blurring, bridging and management, and a typology of different boundaries for IoT start-ups. Key mechanisms, practices and challenges of boundary work are identified. A model of pre-start-up boundary work is developed based on the boundary work efforts before the formalisation of a start-up. Key legitimacy outcomes of boundary work undertaken by IoT start-ups are also identified. Lastly, this thesis shows the temporal and spatial dynamics of legitimacy outcomes.

These implications serve as a set of guidelines that IoT start-ups can use to ease the journey of gaining and maintaining legitimacy. Further, this also provides an overview of the challenges that IoT start-ups face and the illegitimate means to gain legitimacy which policymakers can draw from to guide policies that encourage the growth of start-ups as well as ensure ethical business practices, prevent market distortions, and promote a competitive and transparent innovation ecosystem.

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Lastly, I am thankful to my family whose support and encouragement made me brave enough to leave my corporate career and pursue a lifelong dream to its conclusion.

Author's Declaration

I hereby declare that this thesis is my own work except where explicit reference is made to the contribution of others and has not been submitted for a degree anywhere else.

Printed Name: Aastha Pandey

List of Abbreviations

Abbreviation	Definition
AI	Artificial Intelligence
AAM	Advanced air mobility
UAM	Urban air mobility
B2B	Business to Business
B2C	Business to Customer
BM	Business Model
CEO	Chief Executive Officer
COO	Chief Operating Officer
CTO	Chief Technology Officer
CVO	Chief Visionary officer
IoT	Internet of Things
ISO	International Standards Organisation
IT	Information Technology
M2M	Machine to Machine
ML	Machine Learning
PoC	Proof-of-Concept
RFID	Radio Frequency Identification
SME	Small and Medium Enterprises
SECA	Sulphur Emission Controlled Areas
SCADA	Supervisory Control and Data Acquisition
VC	Venture Capital
CVC	Corporate VC
OEM	Original Equipment Manufacturers
LoRa	Long Range
LoRaWAN	Long Range, Wide Area Network
UTM	Urban Transport Mobility
PII	Personally identifiable information
PoC	Proof of Concept
5G	Fifth Generation of Mobile Network Technology
MVP	Minimum Viable Product

1: Introduction

1.1 The transformative and generative potential of IoT

> *"[…] I'm fairly sure the phrase "Internet of Things" started life as the title of a presentation that I made at Procter & Gamble (P&G) in 1999. Linking the new idea of RFID in P&G's supply chain to the then-red-hot topic of the Internet was more than just a good way to get executive attention. It summed up an important insight [...]that RFID and sensor technology enable computers to observe, identify and understand the world—without the limitations of human-entered data." (Ashton, 2009)*

Kevin Ashton, the inventor of the term 'Internet of Things (IoT)', framed IoT by associating RFID (radio frequency identification) with the 'internet' to evoke interest from key resource providers of the new RFID initiative at the Massachusetts Institute of Technology. This quote highlights the challenge that most IoT-based new ventures face: gaining legitimacy from key evaluators, including resource providers (Suchman, 1995; Deephouse *et al.*, 2017). In 2020, while IoT was hyped as "transformative", the number of connected IoT devices did not meet analysts' projections of 50 billion (Evans, 2011). However, there exists a consensus amongst scholars on the potential of Internet of Things as an enabler of new business models (Leminen *et al.*, 2012; Veit *et al.*, 2014; Kranz, 2018)

The artificial intelligence economy is powered by vast swathes of datasets collected, transported and transformed through IoT (Internet of Things). Major economies rely on intangible assets of knowledge and information enabled by digital technologies such as IoT. In this era of de-globalisation, most nation states are investing in digital autonomy. The EU's vision for digital sovereignty by 2030 is being driven by the growth of scale-ups and unicorns, the enablement of digital technology adoption for SMEs, the creation of digital infrastructure and an increase in digital skills (EU Commission, 2021; European Commission, 2023).

By 2030, IoT will be central to new products, manufacturing processes, and business models (EU Commission, 2021). IoT can automate and informate

processes and objects (Seidel and Berente, 2020). Its generativity leads to the development and emergence of new business opportunities, products, information and communication technologies (ICT), business models, processes, and services (Pandey, Chalmers, and Gordon, 2024). However, IoT also results in commodification for profit and the development of instrumentarian power over users and customers in the hands of organisations building IoT (Zuboff, 2019).

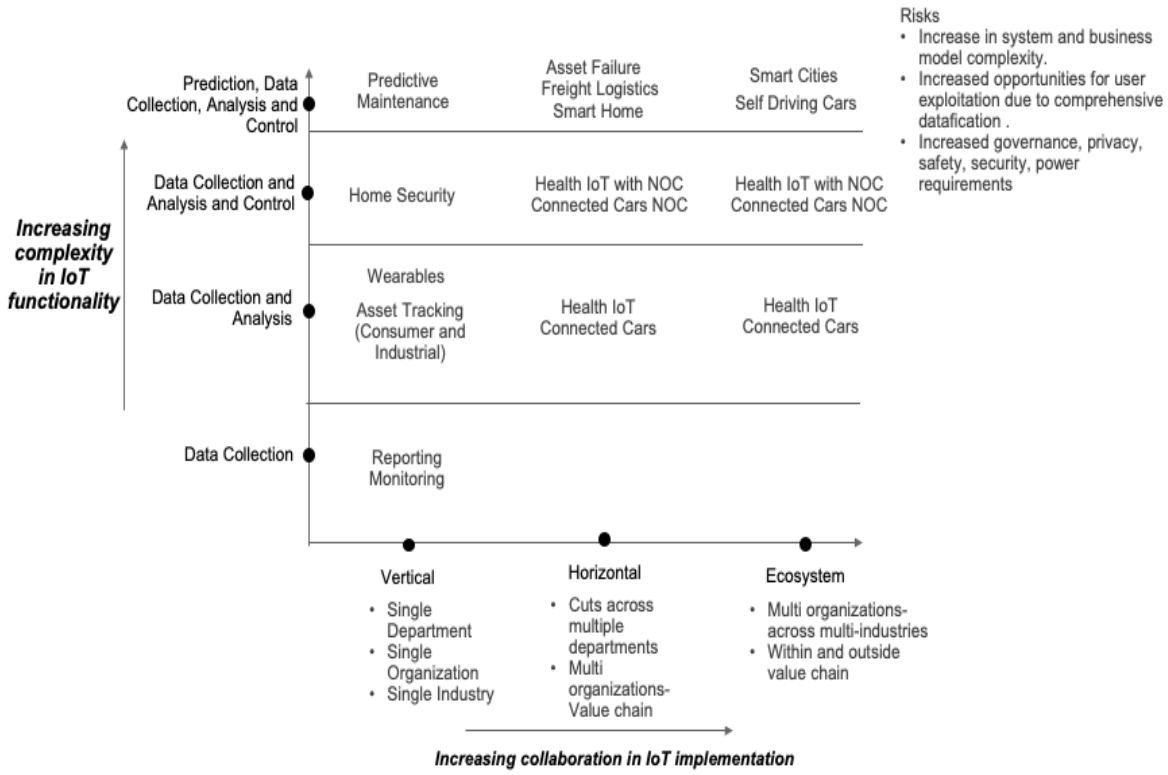


Figure 1 Illustrative use-cases across the IoT collaboration models in increasing order of complexity.

IoT also drives transformation of value chains, products, processes, business models and services by enabling collaboration across industry and organisational boundaries (Figure 1). However, it also poses challenges related to security, governance, privacy, interoperability, etc. For instance, IoT enables servitisation, i.e., companies transition from providing only products to offering products and services (Leminen et al., 2018). Companies can exploit servitisation if they understand the opportunities created by IoT, which can emerge through the interaction of organisational goals and IoT features (Naik et al., 2020). For new ventures, this means frequent engagement with customers not only for business development but also post-selection, to ensure that key decision-makers and end

users within the customer's organisation understand the technology and its affordances.

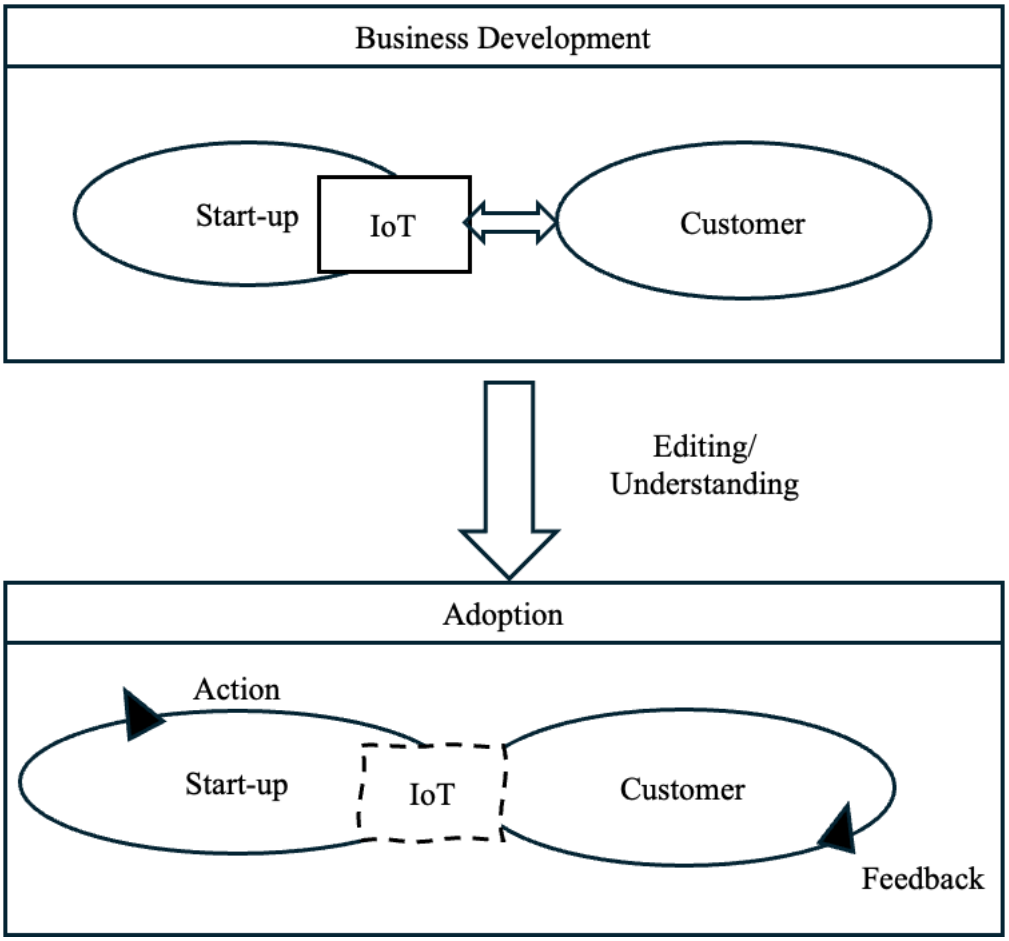


Figure 2 Adapting IoT

Creating IoT services requires cross-industry collaboration that impacts industry boundaries and company models (Leminen et al., 2018). IoT can boost the agility and alignment of companies in a value chain (Porter and Heppelmann, 2014; Nagy et al., 2018). IoT venture success depends on effective strategy; for example, Convoy failed due to its business model and inability to adapt to external changes (483 start-up failure post-mortems, 2024). Consumer and employee products can become surveillance tools, tracking everyday lives (Sterling, 2014). CarrierIQ, which tracked user behaviour via mobile apps used by companies like Sprint and Motorola, faced lawsuits and failure, with its software bought by AT&T and the company shut down (Lunden, 2015).

Unlike the internet, where the entity gathering and processing user data is visible and obvious, in IoT the sensors that process and analyse the data operate at the edge. There is no clear interface between the sensor and the user, so users are neither made aware of nor given a choice about the collection and use of their

data. Even with measures to ensure user anonymity at the device or network level, advances in analytics and natural language processing inadvertently mean that users' data can be de-anonymised (Maheswaran and Misra, 2015). It follows that, unlike the internet with visual web interfaces, privacy notices and agreements are difficult to implement for users within an IoT context.

As IoT networks scale and the number of IoT devices increases, the resources required to power them also rise. Each device within an IoT network must be secure. Moreover, IoT is connected to IT systems and is thus affected by IT vulnerabilities. To illustrate, a water supply plant in Oregon, USA, was hacked via a computer used at the plant, and the attacker attempted to raise the level of lye in the water, triggering a health crisis (Collier, 2021). There are discussions about the need for sensor manufacturers to mandatorily incorporate security into the devices themselves, including authentication checks, validity checks and data verification to prevent such incidents (Almeida, Doneda and Monteiro, 2015). These issues highlight the importance of companies developing IoT finding creative solutions that ensure user privacy, device security, conformance to regulatory guidelines and the reduction of undesirable affordances rendered by IoT. For instance, Hyperloop One failed to overcome technical and regulatory barriers *(*483 start-up failure post-mortems*, 2024)*. In addition, this shows the challenges of ensuring alignment with basic expectations and values of security, efficiency and privacy when it comes to hardware development.

In addition to these challenges, new business models enabled by IoT, such as platforms or ecosystems, involve multiple players providing access to data that can be integrated to achieve better analytical outcomes. Therefore, there needs to be transparency about which entities can access the data, how much data needs to be collected within a specific context, and which entity is responsible for its proper use (Almeida, Doneda and Monteiro, 2015). Ecosystems require interoperability of networked devices and a formal governance framework that outlines the roles and responsibilities of each player, including data management. Ecosystems and value chains rely on selecting legitimate partners and on value creation and capture for all actors within an ecosystem (Gawer and Cusumano, 2014). As such, collective legitimacy is important for the ecosystem’s value proposition (Thomas and Ritala, 2022). This becomes crucial for new ventures, as

they need to engage with more powerful players who provide the endorsement for access to and validity within the ecosystem.

As in the preceding paragraphs, the capabilities that make IoT transformative also lead to unintended negative consequences, vulnerabilities and risks. IoT, like other technologies, by virtue of its "in-between-ness", poses the danger of delegating humans to cyberspace outside the closed loop of reality (Floridi, 2013). Within an IoT environment, humans play three roles - object, user and creator. They interact and transact with the IoT and, through it, with each other (*Figure 3*).

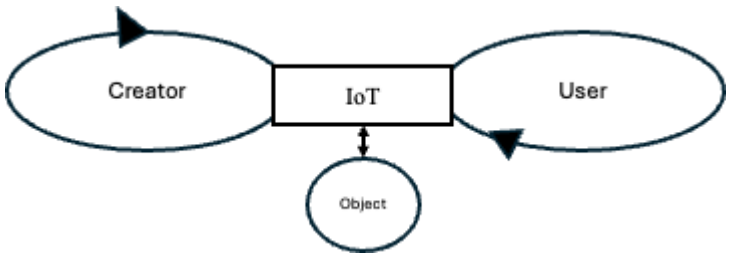


Figure 3 Feedback loops

With the incorporation of AI and other technologies, IoT systems use feedback loops to develop self-comparison, self-adaptation, and self-configuration capabilities. As such, the value associated with IoT is not just economic but arises at the intersection of social, economic, and technical domains (Nicolescu *et al.*, 2018). The economic value associated with IoT is largely linked to data as a core value proposition. However, data commodification should be prevented, as it can lead to power imbalances (Crain, 2018). Ventures developing IoT need to consider the consequences of the technology and business model beyond immediate economic value creation.

These consequences of IoT, as shown here, need to be factored into venture decision-making, as they influence the venture's legitimacy. "Hardware is hard" has become a popular refrain, as it requires high capital investment and product-iteration cycles consume significant resources (Chathoth, 2020). However, "*Investors have a deep-seated bias against hardware" (Graham, 2012)*.

1.3 The problem with IoT-based start-ups

Beyond the mortality rate, ventures developing IoT-based solutions or products need to be mindful of the legitimacy of the entity, the technology, and the business models. Once an IoT product is shipped to a customer, its hardware components cannot be modified. Thus, the initial customer-facing hardware version needs to meet customer expectations and quality criteria. The advent of 3D printing, Raspberry Pi, and Arduino boards has lowered prototyping costs. However, the prototype needs to be stable enough to gather feedback and should be production-ready (Chathoth, 2020). Alternative sources of investment, such as crowdfunding, are risky, since failure to deliver can lead to loss of legitimacy and failure. Kanoa raised $150K on a crowdfunding platform but shut down without refunding any of their customers (Riley, 2017).

After idea and product validation, start-ups need additional funding for mass production, extending post-sale consumer support, and subsequent production cycles. A consumer hardware start-up called OSSIC-X shipped the initial few orders, then ran out of money for mass manufacturing and was unable to secure more funding because many other hardware start-up failures had unnerved the investors (Matney, 2018). Some hardware start-ups end up exiting the business since they compete on margins against bigger technology organisations.

This points to a lack of understanding of financial management, highlighting the need for support from resource providers beyond funding. Securing support requires alignment with resource providers' expectations. Deviation from the values, beliefs, and ideologies of key stakeholders may render the technology, its associated business model (BM), and the venture developing it morally and culturally illegitimate or core-stigmatised (Hudson, 2008). This risk is particularly pronounced for start-ups developing IoT-based products and technologies, which lack resources, networks, and stocks of legitimacy.

1.4 Research Aims

The overarching aim is to show how IoT-based ventures legitimise themselves and their business models and how investors, enablers like venture development organisations and customers contribute to this process of legitimisation (Varas *et al.*, 2023; Kristiansen and Aas, 2024; Unteregger, 2025). This is important because

new ventures suffer from liabilities of newness, which they try to overcome by achieving legitimacy in front of various stakeholders (Stinchcombe, 2000; Aldrich and Fiol, 2007a; Aldrich and Yang, 2012).

Organisational legitimacy is the perceived appropriateness of an organisation within a social system, defined by rules, values, norms, and definitions (Deephouse *et al.*, 2017). Legitimisation is important for start-ups, as it can secure access to resources and ensure survival, especially in sectors such as IoT, where significant liabilities of newness and legitimacy challenges persist (Suchman, 1995). Legitimacy is socially constructed, and for new ventures this involves balancing the need to conform with the need to be distinctive (Suchman, 1995; Snihur, 2016). Thus, in seeking legitimacy, start-ups need to establish identities, demonstrate competence, and manage power relationships, all of which serve as powerful motivators for start-ups and their audiences to engage in boundary work (Santos and Eisenhardt, 2005; Lawrence and Phillips, 2019b) (Figure 4). However, the role of boundary work in legitimisation remains underexplored, apart from a few studies (Lindgren and Packendorff, 2006; Essers and Benschop, 2009; Zietsma and Lawrence, 2010; Greenman, 2012; Langley *et al.*, 2019).

As discussed previously, the success or failure of the venture is also dependent on its product and business models. The products or technology need to meet the criteria for optimal distinctiveness. Business models serve as mechanisms connecting technology and customer needs as organisations use them to exploit the opportunities presented by the technology (Chesbrough, 2010); and they are interfaces between the firm and the social context in which it is embedded (Berglund, Bousfiha, Mansoori, 2020). The business model is also developed through the work and inputs of various evaluative audiences. These audiences coordinate resources and practices and engage in a discursive system that enables the final form and the meaning of the business model. A business model is crucial for the successful commercialisation of a technology since it explicates the value creation, capture and delivery; and provides a mental and linguistic schema to employees and managers (Zott, Amit and Massa, 2011; Massa, Tucci and Afuah, 2017). Extant literature declares that the value of IoT lies only in its commercialisation, i.e., through the business model (Chesbrough, 2010)

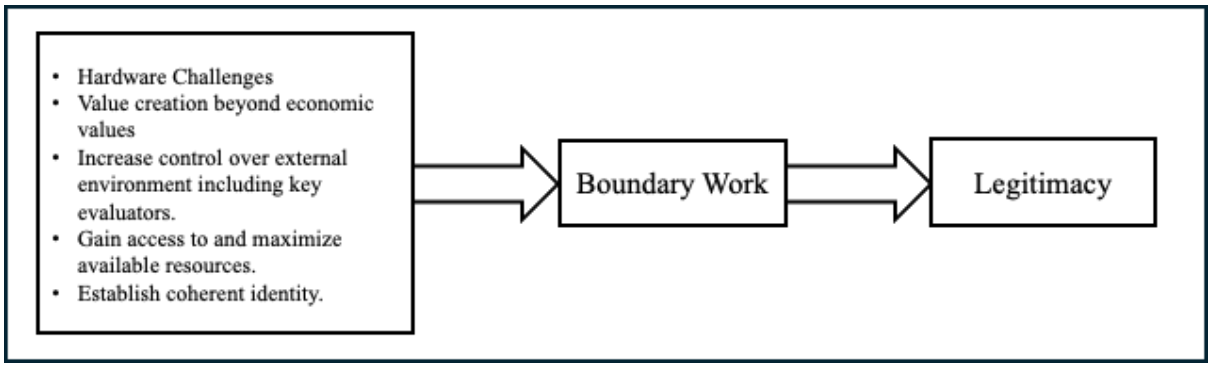


Figure 4 IoT startups performing boundary work to manage challenges and achieve legitimacy outcomes

1.5 Research Approach

The research uses a critical realist philosophy, a qualitative-inductive research approach and a multiple case study research design. This study is based on 20 in-depth case studies of companies in Europe, Asia, Africa and North America. Primary data in the form of semi-structured interviews was collected from founders and senior leadership of the identified start-ups. The interviews focused on the work undertaken by these start-ups to gain resources and acceptance from investors and accelerators and adoption from customers. In addition, primary data in the form of interviews was collected from investors and accelerators based on the research aims mentioned in the study, as well as IoT experts for context. This data was triangulated with secondary data and grey literature. A total of 50 interviews were conducted with 35 interviewees. A total of 11 hours and 36 minutes of pitches, marketing videos, and podcasts were analysed. A total of 74 secondary and grey literature documents were analysed.

1.6 Structure of Thesis

Outline of the thesis is as follows

1	Introduction
2	Literature Review

3	Research Design
4	Boundary Creation
5	Boundary Management
6	Boundary Bridging
7	Boundary Blurring
8	Discussion
9	Conclusion

Table 1 Structure

The study begins with a review of the relevant literature on legitimation and boundary work. The literature is contextualised through examples drawn from grey literature and case studies found in the literature. The relevance of legitimation for IoT ventures and business models is examined. The role of boundary work in gaining legitimacy is examined. This is followed by the methodology chapter, which outlines the research aims, philosophy, research approach and methods.

The findings chapters are developed through case analysis. They begin with boundary creation, showing the boundary formation process for new categories, new ventures and artefacts, and highlighting the roles of start-ups, accelerators, investors and customers. This is followed by a chapter on the management of organisational and external boundaries. The discussion then turns to strategies of boundary bridging and boundary blurring, with a focus on IoT start-ups. The discussion chapter builds on the findings chapters to develop a framework for the relationship between legitimacy and boundary work. It shows the pre-start-up boundary work undertaken to gain legitimacy. It discusses boundary work undertaken at the industry, firm and artefact levels to gain legitimacy. It shows the different legitimacy outcomes for each type of boundary work and builds a typology of legitimacy outcomes based on temporal and spatial dimensions. Lastly, it develops a typology of the different types of boundaries that ventures create

and negotiate. The conclusion chapter discusses the theoretical and empirical contributions of the thesis, the implications and limitations of the study.

Term	Definition	Anchor
Boundary	Boundary is defined as symbolic, institutional, or material demarcation, that is socially constructed, that distinguishes one entity, idea, category, or practice from another.	Lamont and Molnár (2002); Abbott (1995)
Boundary work	The concrete efforts or strategic action undertaken by actors to create, maintain, adapt, bridge or blur boundaries. In this thesis, taking four forms: creation, management, bridging and blurring.	Gieryn (1983); Abbott (1995); Langley et al. (2019);
Boundary creation	The drawing of new symbolic and objective distinctions where none previously existed namely distinct identities, product and idea boundaries, new practices, standards and categories.	Chapter 4
Boundary management	The maintenance, adaptation and defence of existing boundaries in response to evaluator expectations, internal interdependencies and external constraint.	Chapter 5
Boundary bridging	The spanning of cognitive, normative and material divides between a venture and its evaluative audiences, achieving alignment sufficient for legitimacy to be conferred while both sides retain distinct identities and logics. A process, enacted through observable actions..	Chapter 6
Boundary blurring	The strategic softening or dissolution of distinctions between categories, roles, domains and realms in order to gain legitimacy by association, flexibility or hybridity; produces values conflict when claims outrun capabilities or roles conflate.	Chapter 7
Artefact	Material or discursive artefacts – pitches, prototypes, proofs of concept, business model documents, technical standards – plastic enough to be adapted across groups yet robust enough to maintain a shared identity; the sites where boundary work is performed and observed. Any boundary work that is done on artefacts or for artefacts is done at the artefact level.	Star and Griesemer (1989);
Legitimacy	The generalised perception or assumption that the actions of an entity are desirable, proper or appropriate within a socially constructed system of norms, values, beliefs	Suchman (1995); Suddaby, Bitektine and Haack (2017);

	and definitions; treated throughout as a process of evaluative judgement rendered by audiences.	
Cognitive legitimacy	Legitimacy grounded in comprehensibility and taken-for-grantedness of the evaluated entity.	Suchman (1995);
Pragmatic legitimacy	Legitimacy grounded in the self-interest and practical benefit calculations of audiences.	Suchman (1995);
Normative (moral) legitimacy	Legitimacy grounded in the perception that the entity is ethically or morally appropriate.	Suchman (1995);
Regulative legitimacy	Legitimacy grounded in conformance to legislative standards, industry standards and certification requirements.	Deephouse and Suchman (2012);
Propriety and validity	Propriety is an individual evaluator's own judgement that an entity is appropriate. Validity is the collective, institutionalised judgement perceived as widely held.	Bitektine and Haack (2017);
Legitimation / legitimisation	The process by which legitimacy is gained, maintained, contested, lost or restored.	Suchman, 1995
Evaluative audiences	The actors who render legitimacy judgements and control the resources at stake: investors, venture development organisations (including accelerators), and customers; the linking concept between boundary work and legitimacy outcomes.	Fisher et al. (2017);
Category	A classification of products, technologies or markets that emerges through the convergence of actors, narratives and artefacts around a shared label; analytically, the outcome that a boundary encloses.	Zietsma and Lawrence (2010);
Internet of Things (IoT); IoT-based venture	Working definition: networked physical devices – sensors or actuators embedded in physical settings – that generate data for remote monitoring, analysis or control. A venture is IoT-based if its core value proposition depends on such devices; software-only analytics and non-networked hardware are excluded.	Ashton (2009); Nicolescu et al. (2018);
Business model	The mechanism connecting technology and customer needs, explicating value creation, capture and delivery; an entrepreneurial artefact whose boundaries are worked upon.	Chesbrough (2010); Zott, Amit and Massa (2011);
Level	Scale at which boundaries operate and where boundary work effects.	

Table 2 Key definitions

2: Literature Review

This chapter begins by establishing the importance of legitimacy for IoT-based ventures and new ventures, and thereby the importance of this study. It then defines legitimacy and legitimisation as adopted by new ventures to gain or maintain legitimacy. It specifies the actors and their roles in the new venture legitimisation process. It then discusses the different dimensions and states of legitimacy as discussed in the literature. It follows this with the process of legitimisation for products and business models. It establishes the legitimisation strategies followed at the venture, industry and artefact levels. It then explores the role of boundary work in legitimation. Lastly, it concludes by synthesising the literature and presenting a framework on boundary work and legitimacy, important concepts and a mapping of the framework to the research questions.

2.1 The Importance of Legitimacy for New Ventures in IoT

The conception and growth of IoT technologies were heralded as a golden age, a narrative anchored in technological determinism (Le Moan, 2020). However, low IoT adoption and high project failure rates revealed performance and value legitimacy issues, affirming researchers' belief that IoT is hyped (Ren, 2019). If expectations are unmet, hype delegitimises technologies and the ventures developing them by weakening trust relationships (Ruef and Markard, 2010).

Various organisations and individuals have offered multiple definitions of the Internet of Things over the past two decades (Atzori et al., 2017), leading to semantic confusion and technological pluralism (Pandey, Chalmers and Gordon, 2024). IoT's interpretative flexibility makes legitimisation challenging for ventures. Start-up founders must operate across technical and commercial spheres to build credibility (Thornton and Ocasio, 2008). They act as translators, understanding stakeholder needs beyond technology or money, framing innovations for non-experts. This creates a knowledge-expectation gap when seeking funding or sales, especially when founders struggle to explain benefits beyond technical aspects, a challenge compounded by semantic issues in IoT.

IoT enables new business models (BM) (Leminen et al., 2012; Naik et al., 2020; Seidel and Berente, 2020; Kohtamäki, Leminen and Parida, 2024). This includes a shift from transactional to servitisation BM, the emergence of platforms and

ecosystems, and the essential role of outcome- and performance-based models for successful deployment (Baines et al., 2007; Hui, 2014; Casadesus-Masanell and Ricart, 2011; Lopez, Castillo and Corchado, 2021).



Figure 5 Business Model and Product/Technology co-evolution

Servitisation involves transforming from a manufacturing business model to a service-oriented one through IoT (Naik et al., 2020; Kristiansen and Aas, 2024; Bucherer and Uckelmann, 2011). It creates value by meeting real-time customer needs repeatedly but faces moral hazard issues for startups and customers. Startups can build capabilities on customer data and infrastructure, which rivals can later access (Korkeamäki and Kohtamäki, 2020). Customers may also seek customization, which can strain startup resources (Korkeamäki and Kohtamäki, 2020).

Technological platforms coordinate agents, create value, and have a modular architecture (Gawer and Cusumano, 2014). IoT platforms benefit developers, service providers, and customers through modularity and offer end-to-end solutions. Platform success relies on network effects and user quality, requiring service provider screening. These BM shifts challenge traditional views on ownership, IP, and value capture, raising new concerns about data governance, privacy, and competition. Researchers note IoT value creation is ecosystemic (Iivari et al., 2016).

In the ecosystem business model view, a firm is part of an ecosystem cutting across multiple industries (Leminen et al., 2018). While a business model focuses on value exchange for a focal firm, ecosystems consider the exchange for both the firm and

the ecosystem (Brock et al., 2019). These studies see IoT as more than an enabler of traditional models; it's a generative force creating new archetypes. This novelty introduces legitimation challenges due to IoT BMs' complexity and lack of established templates, making legitimation especially demanding.

Ventures developing Internet of Things (IoT) technologies must manage various legitimacies—such as new venture, product, technology, ecosystem, and industry legitimacies—based on their context (Figure 6) (Binz et al., 2016; Turcan and Fraser, 2016; Thomas and Ritala, 2022). IoT combines hardware, software, protocols, data, and human actors, requiring ventures to engage in heterogeneous and symbolic engineering to create meaning and value for different social groups like investors, customers, support organisations, regulators, and industry players (Bazerman, 1998, p. 335). Feedback from these groups influences the development of IoT ventures' identities and artefacts, serving as evaluative audiences whose judgments affect legitimation (Bitektine and Haack, 2015). This legitimation depends on adapting IoT ventures' identities and artefacts to meet stakeholder feedback. Start-ups perform technology and boundary work to refine their narratives, identities, and offerings in response to stakeholder requirements.

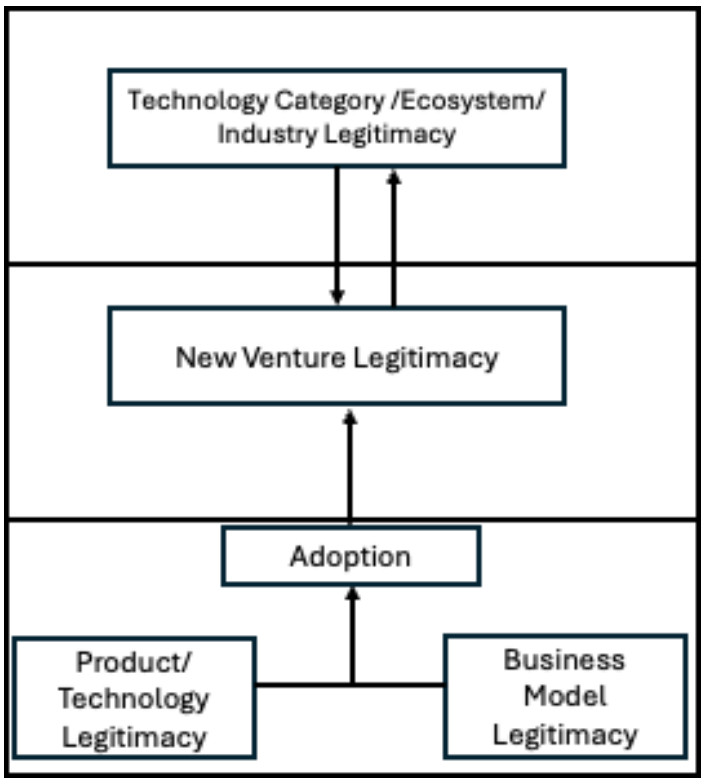


Figure 6 Differing legitimacies needed for IoT-based new ventures.

BMs are vital for IoT ventures' survival and success, even those with positive validity judgments. The comparison between Sigfox and LoRa alliance exemplifies this: Sigfox used centralised control to shape industry standards, while LoRaWAN relies on an open-source ecosystem. Sigfox's failure indicates BMs are crucial for legitimacy and survival, especially for ventures developing new standards (Pandey, Chalmers and Gordon., 2024).

Another challenge to IoT legitimacy is the increased vulnerability exploited by bad actors. Due to widespread monitoring of critical infrastructure and personal devices, security breaches and controversies have delegitimized the technology and its providers (Almeida, Doneda and Monteiro, 2015). Surveillance and datafication are tools of domination that require careful evaluation and governance (Lupton and Williamson, 2017; Zuboff, 2019).

IoT ventures must incorporate technology and industry-specific regulations to ensure safety, security, and privacy. Start-ups developing hardware face investor bias due to long development cycles and risks of early prototype releases undermining legitimacy (Graham., 2012; Pandey, Chalmers and Gordon., 2020). Legitimacy challenges for IoT ventures stem from interpretative flexibility, explainability issues, moral hazard concerns in partnerships, the need to legitimize various components, and the impact of the business model (BM). IoT's potential to automate and informate, as well as the role of multiple audience evaluations, and the critical role of BM choices also influence legitimacy, alongside security, safety, hardware lifecycle length, and failure risks.

The strategies and practices undertaken by start-ups to achieve legitimacy often involve boundary work which this thesis refers to as – "*The activities undertaken to create, manage, negotiate and redefine boundaries between different groups or domains including organisations, communities, individuals, knowledge systems and fields.*" In the case of IoT ventures, boundary work emerges as a central mechanism in the pursuit of legitimacy as start-ups have to negotiate boundaries due to innovation, market demands and institutional constraints. Research emphasises that legitimacy construction is a dynamic process requiring adaptability to evolving stakeholder expectations and industry standards (Deephouse *et al.*, 2017; Suddaby, Bitektine and Haack, 2017). For IoT ventures,

this adaptability is particularly crucial given the rapid pace of technological advancements and the shifting landscape of consumer preferences. At the same time, the advancements in IoT are also constrained by the slow pace of technological acceptance undertaken by business customers in several industries still stuck in ancient SCADA (supervisory control and data acquisition systems) times.

IoT-based new ventures need legitimacy for partnerships, resources, sales, and survival (Kuratko et al., 2017; Zimmerman and Zeitz, 2002, p. 414). It helps attract stakeholders and gain competitive advantage (Suchman, 1995; Deephouse et al., 2017). Legitimacy can help new ventures overcome the liability of newness, which relates to trust issues, lack of routines, and social ties (Aldrich and Yang, 2012; Stinchcombe, 2000). A new venture must meet achievement metrics and follow the code of entrepreneurship while doing so.

This thesis assumes that since new ventures have a limited portfolio of offerings, the legitimacy of the entrepreneurial artefacts, namely product, BM, opportunity and new venture itself contribute to the legitimacy of the organisation. The entrepreneurship code encompasses expert wisdom, including lean product development and startup methods (Aulet, 2013; Ries, 2014; Thiel and Masters, 2015). These studies suggest start-ups should align with evaluator and ecosystem expectations. Lean startup research shows that market feedback can boost legitimacy of products and business models (Zott and Amit., 2024).

Performance challenges arise when new ventures are viewed as failing their purpose, even if they perform well but lose sight of their vision, or when actions and narratives don't make sense to evaluators (Deephouse et al., 2017). New ventures must build strong relationships with key resource providers for two-way communication, alignment with performance expectations, and fulfilling claims. Legitimisation is a dynamic process that requires adapting to changing stakeholder expectations and industry standards (Deephouse et al., 2017). Entrepreneurs aim to create, gain, and maintain legitimacy, especially external legitimacy with investors, support organisations, partners, and customers.

2.2 Legitimacy

This section reviews legitimacy in new ventures, starting with its definition and legitimation process, then exploring key sources, dimensions, and states of legitimacy. It discusses challenges of legitimating new technologies and BMs and concludes with strategies startups use to acquire and maintain legitimacy.

2.2.1 Legitimacy and Legitimation

The concept of legitimacy has multiple interpretations across sociology, political science, and economics. Weberian legitimacy arises from conformity to authority, power, and domination, with Weber identifying three types of legitimate authority: traditional, charismatic, and legal-rational (Weber, 2019). Bourdieu further developed legitimation by emphasizing symbolic power, which involves actors controlling ideological production fields (Bourdieu, 1991). For example, VC's influence entrepreneurial fields by shaping narratives that define success and decide which businesses or ideas are scaled.

Subsequent work used social construction concepts to define legitimation, categorizing normative and cognitive dimensions and levels: incipient, theoretical, symbolic universe, and universe maintenance (Berger and Luckmann, 1991). Organisational theorists extended this through legitimacy typification and strategies (Fraser and Turcan, 2025).

Suchman's seminal work on legitimacy highlighted the role of perception in the legitimation process and the importance of gaining legitimacy when embarking on new lines of activity (Suchman., 1995). He defined legitimacy as "a generalised perception or assumption that the actions of an entity are proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions' (Suchman, 1995). Subsequent research found that legitimacy is an outcome of ongoing adaptation and a series of interactions between the organisation and its environment (Suddaby, Bitektine and Haack, 2017).

Legitimation involves stakeholders, leaders, or followers creating and maintaining legitimacy (Suddaby, Bitektine and Haack, 2017). For instance, GDPR implementation prompted organisations to adopt compliance practices to ensure

legitimacy of their products, business models, and themselves. Perceptions of appropriateness within socio-cultural and regulatory contexts influence legitimacy judgments and are crucial for start-ups to secure resources, attract stakeholders, and sustain operations (Zimmerman and Zeitz, 2002a; Aldrich and Fiol, 2007a; Deephouse et al., 2017).

Legitimacy judgements are affected by exogenous shocks (Tost., 2011). For example, social norms changed during the pandemic, and traditional practices were deinstitutionalised (Amis and Greenwood., 2021). Many start-ups also altered their products and practices to meet new legitimacy criteria (Pandey, 2022). External shocks influence a venture's legitimacy once it has been judged appropriate. Research indicates legitimacy formation is a multi-level process (Tost., 2011; Bitektine and Haack., 2015). At the micro-level, evaluators make propriety judgements that influence macro-level validity judgements when consensus is reached (Bitektine and Haack, 2015; Suddaby, Bitektine and Haack., 2017). Conversely, macro-level judgements via media or regulators affect propriety level judgements (Tost, 2011; Bitektine and Haack., 2015).

In technology ventures, novelty is key to technological propriety (Oftedal, Foss and Rutherford, 2024), referring to the newness of a product, service, process, or market with benefits customers are willing to pay for. Alongside efficiency, lock-in, and complementarity, novelty creates customer value (Amit and Zott, 2001). IoT transforms value creation and capture, enabling new propositions within and beyond the firm (Leminin et al., 2020). For example, smart energy metering provides real-time energy use data. Technological propriety also depends on testing outcomes and perceptions of usefulness (Ren, 2019; Oftedal, Foss and Rutherford, 2024). Organisational competence results from relational propriety evaluations (Oftedal, Foss and Rutherford, 2024), developed through recruiting employees, boards, and co-founders who assess the venture’s propriety.

2.2.2 Sources of New Venture Legitimacy

In new ventures, legitimacy is granted by various actors—shareholders, investors, partners, industry bodies, government, academia, customers, and employees (Figure 7). These act as “sources of legitimacy” and assess a firm’s capabilities. Legitimation enables new ventures, market offerings, and practices (Kimjeon and Davidsson, 2022, p.656). It can be triggered or boosted by reforms, funding,

partnerships, environmental and economic changes, and shifting narratives (Kimjeon and Davidsson, 2022).

2.2.2.1 Investors

IoT-based new ventures, and their offerings face high levels of uncertainty and information asymmetry. To mitigate this, investors such as VC's evaluate signals like top management team, patents, products, strategic partners, networks, growth potential, customer references to assess a firm's propriety (Mason and Harrison, 1996; Mason and Stark, 2004a; Becker-Blease and Sohl, 2015; Bitektine and Haack, 2015). Further, studies highlight the importance of direct and indirect network ties in helping start-ups overcome the problem of information asymmetry between themselves and investors (Cable and Shane, 1997)

The actions undertaken by VC firms (VCs) such as screening, selection, post-investment monitoring, value adding activities and disengagement activities are means to avoid moral hazard and adverse selection problems (Fried and Hisrich, 1994; Hellmann and Puri, 2000, 2002; De Clercq and Manigart., 2007; Gordon, 2014). For instance, VC's may influence founders to bring their products to market faster, replace founders with CEOs and influence the formation of early management teams (Hellmann and Puri, 2000, 2002). Earlier research also proposed that VC firms may not add value and in fact constrain innovation (De Clercq and Manigart., 2007; Caselli, Gatti and Perrini, 2009). Recent studies show that VC's support commercial innovation (Pahnke, Katila and Eisenhardt, 2015).

Investors are reluctant to invest in certain BMs associated with new technologies due to high uncertainty and longer route to profitability. For instance, companies with a hardware focused BM may find it difficult to get funded (Graham, 2012). Within the investor audience also, each type of investor has different criteria for evaluating the propriety of the venture and offers different value to the start-ups (Mason and Stark., 2004). As a result, start-ups need to tailor their business plan for each audience (Mason and Stark., 2004). For instance, angels can help start-ups by facilitating opportunity exploitation through provision of guidance and feedback leading to evolving BMs (Crick and Crick, 2018).

Corporate VC investment functions as a legitimising signal for new ventures (de Lange and Valliere, 2020). While corporate VC's can support new ventures in their technological development and innovation, they cannot and are not interested in impacting other parts of the venture (Pahnke, Katila and Eisenhardt, 2015; de Lange and Valliere, 2020). Research suggests that funded start-ups are less likely to fail if the investor brings relevant knowledge and expertise to the relationship (Dimov and De Clercq, 2006; Liang, Liu and Yin, 2019).

VC involvement impacts the value retention of specific BMs i.e. firms with innovative BMs benefit from high VC involvement while firms with efficiency BMs are negatively impacted from high VC involvement (Guo *et al.*, 2017). Existing research primarily evaluates investors' selection criteria, their impact on new firms and their BMs. However, the processes underpinning investor impact on new ventures, using qualitative research design, remain underexplored (Mason and Stark., 2004; De Clercq and Manigart., 2007; Gordon, 2014).

2.2.2.2 Accelerators

Extant literature highlights the role of accelerators as gatekeepers and validators for start-ups (Lall, Bowles and Baird, 2013; Drori and Wright, 2018; Hornberger, Mack and Baiyere, 2022). Some accelerators use sorting and signalling mechanisms to identify promising ventures while others genuinely support start-ups through bias mitigation and advice (Beyhan, Akcomak and Cetindamar, 2024). Thus, accelerators play a direct and indirect role in propriety evaluations of start-ups.

Accelerators and investors share similar screening criteria: value proposition, novelty, market size, time to market, team expertise, competence, and coachability (Beyhan, Akcomak and Cetindamar, 2024; Lall et al., 2013). Association with reputed accelerators signals quality and competence (Drori and Wright, 2018; Neuberger et al., 2024). Positive evaluations enable further assessments and resource acquisition (Neuberger et al., 2024). Specialized accelerators help build cultural capital. Accelerators signal success probabilities to founders (Yu, 2020). However, limited research exists on the legitimation process during engagement with accelerators (Neuberger et al., 2024).

Some accelerators acquire equity in their portfolio companies in exchange for funding or services (Cohen et al., 2019). They assist new ventures in market entry through mentoring, coaching, and other services (Fishback et al., 2011). Accelerators facilitate access to social networks and information (Eckhardt and Shane, 2010). They offer expertise in prototype development, fundraising, business model design, field knowledge, and pitching (Wenzel and Koch, 2018). They provide support systems and networks. Researchers suggest companies supported by accelerators have higher survival and success rates (Lall, Bowles and Baird, 2013). Studies show that participating start-ups "fail fast" and raise less funding (Yu, 2018). Since accelerators are time-limited, ventures focus on scaling or launching, potentially neglecting the development of dynamic capabilities (Qin, Wright and Gao, 2019). Thus, accelerator involvement may hinder long-term success.

2.2.2.3 Gatekeepers

Other actors, besides investors and accelerators, that evaluate a venture's propriety and validity include gatekeepers within the entrepreneurial ecosystem. Entrepreneurial ecosystems include gatekeepers that can provide new ventures with access to essential resources (Spigel, 2017). These gatekeepers could be individuals, experts and corporate actors. Corporates function as investors, partners as well as customers. Start-ups need to show differentiation and novelty to engage with corporates as customers or partners, however they also need to meet the selection criteria which is designed for more established companies (Fisher, 2020)

2.2.2.4 Partners and Customers

Start-ups seek alliances with larger partners for legitimacy, especially in resource-intensive sectors like IoT, needing knowledge, capabilities, and resources to survive (Dacin, Oliver and Roy, 2007; Khoury, Junkunc and Deeds, 2013). Prestigious partners and networks boost performance and legitimacy (Partanen et al., 2020). Partnerships are judged by societal perceptions, and partners may avoid stigmatised ventures to prevent stigma transfer (Suddaby, Bitektine and Haack, 2017; Hudson, 2008).

An especially important source of legitimacy for start-ups is customers. The value creation and capture strategies implemented by a start-up are crucial to its acceptance amongst its customers (Zott and Amit, 2010). The customer's decision to adopt the start-ups' offerings also depend on whether they are early adopters (Rogers, 2003). Customer organisations use multiple criteria to assess the appropriateness of an innovation in a required context.

Start-ups often can't provide customer references, so customers look for performance demonstrated through experimentation (Pandey, 2022). Successful validation signals technology value (Suchman, 1995; Bojovic, Genet and Sabatier, 2018). Customers also expect compliance with regulations and standards (Pandey, 2022). Past crowdfunding success enhances legitimacy and competence perceptions (Maier et al., 2023).

2.2.2.5 Regulators

Regulators shape institutions by establishing rules, monitoring compliance, and enforcing sanctions (Greenwood et al., 2002; Maguire and Hardy., 2009; Scott., 1995). Ventures adopt regulation to maintain legitimacy, even without technical benefits (Suddaby, Bitektine and Haack., 2017). For example, charitable registration served as an approval mark from Revenue Canada, lowering new venture mortality (Singh, Tucker and House., 1986). Some opportunities are only available to compliant businesses (Deephouse et al., 2017). Regulations can foster or hinder innovation (Hargadon and Douglas, 2001) and sometimes promote isomorphism (Suddaby, Bitektine and Haack., 2017). Regulative legitimacy remains vital throughout a venture's life, adapting to business and regulatory changes (Delmar and Shane, 2004). Regulatory approval signals legitimacy (Suddaby, Bitektine and Haack., 2017), and governing bodies set standards to ensure fair competition (Kim and Pennings., 2009). Certifications boost trustworthiness (Stam., 2025., p.158). Legitimacy as a 'law-abiding' and 'trustworthy' image helps ventures access government resources, subsidies, and tax benefits. In new markets, startups can influence regulators to shape supportive regulations, enhancing their sector's legitimacy (Andersen et al., 2020).

2.2.2.6 Internal Sources

Endorsement from external sources can confer legitimacy on resource-constrained start-ups. This endorsement can also take the form of including reputed businessmen and experts as board members and advisors (Singh, Tucker and House, 1986). Internal sources of legitimacy include management teams and employees who negotiate the norms and beliefs that determine legitimacy for the organisation and establish organisational procedures that are socially accepted (Drori and Honig, 2013). Founders and initial team members need to actively engage with the network and the information available (Yang and Aldrich, 2017). In addition, they need to demonstrate internal coherence (Yang and Aldrich, 2017).

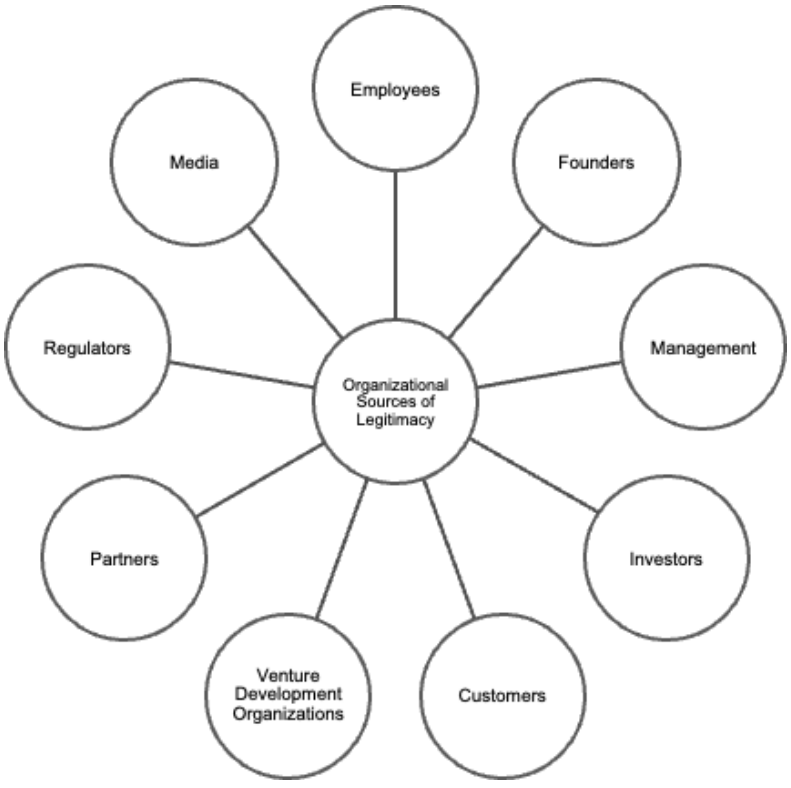


Figure 7 Sources of Legitimacy

External sources can also hamper the organisation by asserting influence over decision-making and strategy, thereby undermining internal legitimacy. For example, VCs may pressure startup founders to pursue larger funding rounds to

secure an appropriate exit for their investments (Dimov and De Clercq, 2006; Hallen and Eisenhardt, 2012; Zuboff, 2019; Yao and O'Neill, 2022). For instance, Convoy, a trucking platform, began taking greater business risks under pressure from its investors, becoming too large to raise further funding in a slowing market (Cheng, 2024). Each new investor on board affects decision-making, power relationships, and leads to increased task conflicts that constrain the radicalness and speed of the firm's innovation (Otto, Greven and Brettel, 2025). Frequent internal changes, such as shifts in company boards, even when driven by a need for external legitimacy, negatively affect internal congruence among stakeholders (Drori and Honig, 2013, p. 348). It follows that internal legitimacy is affected by changes in organisational values, leadership type, consistency in vision and execution strategies, firm structure, conflict/collaboration between teams, and individual motivation (Drori and Honig, 2013, pp. 346–347).

2.2.3 Dimensions of Legitimacy

While Suchman's legitimacy typology explicitly calls out cognitive, normative and pragmatic legitimacy (Suchman., 1995). Various studies discuss the similarities with this typology to other legitimacy types. For instance, Suchman's pragmatic legitimacy is said to include regulative components (Ruef and Scott., 1998., p.877). In addition, cognitive and regulative elements comprise sociopolitical legitimacy (Aldrich and Fiol., 1994; Ruef and Scott., 1998., p.877). Legitimacy dimensions discussed across various strands of literature include normative, cognitive, pragmatic and socio-political or regulative (Deephouse and Suchman, 2012). The cognitive dimension of legitimacy or legitimation concerns the comprehensibility or taken-for-grantedness of the evaluated entity (Suchman, 1995). Organisational, product or BM isomorphism is an indicator of a form's cognitive legitimacy (Ruef and Scott, 1998). Pragmatic legitimacy is based on self-interest and practical benefits (Suchman, 1995). Moral or normative legitimacy is the perception that the entity is ethically or morally appropriate (Suchman, 1995). Sociopolitical legitimacy indicates that opinion leaders, government representatives and the public find the entity appropriate (Aldrich and Fiol, 1994; Deephouse and Suchman, 2012). For instance, normative claims by generative frontier AI companies such as Anthropic, which claim to incorporate ethics, justice and fairness, lead evaluators to perceive them as a more legitimate alternative to their competitors (Perrigo, 2024). However, the comprehensibility and taken-for-

grantedness associated with habituation to generative AI remain significantly low, indicating the need for strong legislation. Legislation can play a role in overcoming some of the looming challenges stemming from a lack of trust and cognitive legitimacy (Suchman, 1995; Perrigo, 2024). Regulatory legitimacy requires organisations to meet the legislative standards set by state bodies and the standards set by industry regulators and certification authorities. Alignment with standards signals that a venture operates through institutionally sanctioned means.

This thesis foregrounds cognitive and pragmatic legitimacy as the primary analytical lenses and regulative and moral legitimacy as secondary analytical lenses. Cognitive legitimacy is particularly salient for IoT-based new ventures, which operate in a category where evaluators often lack established mental models for assessing their technology and BMs (Suchman, 1995, pp. 582–583). Pragmatic legitimacy is a variant of power dependence relations, responsiveness to audience interests, and personification (Suchman, 1995, pp. 578–579). IoT ventures must continually demonstrate tangible exchange value to resource providers, namely investors, accelerators, and customers, most of whom wield power in the industry, evaluate ventures primarily on instrumental grounds, and from whom ventures seek advice and feedback. Normative and regulative legitimacy are treated as a secondary dimension in this analysis. This is because the primary legitimacy challenges faced by IoT start-ups in this study relate to comprehensibility and value demonstration rather than to moral or ethical evaluation per se. Normative legitimacy is engaged where it surfaces empirically, in boundary-blurring that generates and resolves values conflicts (Chapter 7). Sociopolitical legitimacy, as discussed in Section 2.5.5, is engaged through the treatment of standard and regulatory conformance.

2.2.4 States of Legitimacy

Legitimacy as a construct is a property, process and perception at the same time (Suddaby, Bitektine and Haack, 2017). As a property, legitimacy is acquired, accumulated, diffused and repaired (Suchman, 1995; Rossman, 2014; Suddaby, Bitektine and Haack, 2017). Organisations need to repair legitimacy in the face of negative judgements from resource providers. Failure to do so can cause new

ventures to become illegitimate, which casts doubt on the entity's performance, ability to generate value for stakeholders and its right to exist (Pfeffer and Salancik, 2003, pp193-202). New ventures can also be stigmatised if they are perceived to be in violation of the values, norms and beliefs of the evaluators (Hudson, 2008).

To overcome stigma, an organisation can engage in values work through emerging and performed value practices (Espedal, 2020; Gehman et al., 2013) as well as technology work through technologies and technological frames shaping (Pinch and Bijker, 1984; Lawrence and Phillips, 2019). In line with this strand of studies, four states of legitimacy have been defined – accepted, proper, debated and illegitimate (Deephouse et al., 2017). Accepted refers to the legitimacy state associated with the venture's taken-for-granted quality, while proper is the outcome of an active evaluation process. Evaluators render favourable judgements when the venture is perceived by the environment and by evaluators to be proper or appropriate (Bitektine and Haack, 2015; Suddaby, Bitektine and Haack, 2017). Evaluators may differ in their assessment of a venture's validity, leading to a state of debated or contested legitimacy (Suchman, 1995; Bitektine and Haack, 2015; Suddaby, Bitektine and Haack, 2017; Deephouse et al., 2017). Unfavourable judgements by evaluators lead to a state of illegitimacy. This can occur when the venture fails to conform to or comply with the environment or the evaluators' system of norms, beliefs and values (Suchman, 1995; Hudson, 2008; Deephouse et al., 2017). However, illegitimate actions of a venture can also lead to organisational legitimacy through impression management (Elsbach and Sutton, 1992). Illegitimacy can arise from changes in the environment; thus, start-ups need to constantly adapt to the environment to stay legitimate (Glynn and Marquis, 2004).

2.2.5 Legitimating New Technologies

New technologies proliferate through popularization (Suchman., 1995). A technology that is widely diffused due to development or adoption, is more than likely to be legitimate (Sahlin-Andersson, 2012, p. 72). Diffusion of disruptive technologies takes place when they evolve to meet the needs of different types of users (Rogers, 2003). Innovators and early adopters endorse new technologies

leading to cognitive plausibility and influence legitimacy (Suchman., 1995). For the early majority, endorsements and references are crucial. While the late majority look to standards bodies and certifications before adopting a new technology – conformance is key. New technologies need to be distinct enough to pique the interest of early adopters but at a certain point in its lifecycle, need to conform to a category. In contrast, legitimacy literature has focused on the phases of legitimacy building for technologies, first at the category level, followed by legitimacy building at the individual level (Navis and Glynn, 2010; Markard, Wirth and Truffer, 2016). Further, categories and their meanings are dynamic constructs whose legitimacy status is at risk of change as category associations change (Garud, Gehman and Karnøe., 2010). To gain acceptance at organisation level, a technology needs to improve organisational performance of tasks considered necessary by organisational users and requiring the use of the technology needs to be considered necessary by the organisational users of the technology and the technology needs to be considered strategic for the organisation's long-term vision by users (Ren, 2019). Start-ups can also encourage business adoption through technology work and technological frames shaping (Pinch and Bijker, 1984; Lawrence and Phillips, 2019). Technology work lead to social construction of technologies, relationships between the technologies and organisations (Lawrence and Philiips., 2019). Technological affordances interact with interests, values and aims of organisational actors, enabling and constraining (Lawrence and Phillips., 2019, p180). In the case of IoT ventures, the building of IoT-based products, the change in the BMs and the adoption of new practices as a result of adoption are examples of technology work.

Ventures developing new technologies and products in existing or new categories need to gain legitimacy but also maintain and repair legitimacy in accordance with the number and type of evaluators, changes in the environment and their own actions (Suchman., 1995). These ventures lack legitimacy due to the lack of information about the technology that investors require to make their decisions as well as the ambiguity, uncertainty surrounding the new products. For example, Pellion technologies, was a company designing lithium-metal batteries. These batteries packed in more energy than lithium-ion batteries and the company had found a niche in the drone market. The biggest market for the product were

automotive manufacturers, but the founders needed additional capital to develop the product to meet stringent automotive industry requirements. The company was stuck in a vicious cycle of requiring legitimacy through the applicability of the technology to a broader, more profitable market to gain funding but not being able to pursue the market without the funds. Their investors declined to invest further. Thus, Pellion was unable to maintain legitimacy in the eyes of investors, nor gain legitimacy in the eyes of prospective customers (Rathi, 2022).

With a new differentiated product, organisations need to engage in a lot of legitimacy building at organisation, industry and societal levels (Suddaby, Bitektine and Haack, 2017, p. 461). The adoption of standards serves as one of the institutional mechanisms through which new ventures signal conformity and achieve legitimacy (Kim, 2025, p. 343). Organisations face isomorphic pressures to adopt standards, with mimetic adoption specifically oriented towards achieving legitimacy with audiences who expect compliance with recognised frameworks (DiMaggio & Powell, 1983; Kim., 2025). Furthermore, in nascent industries, the start-ups need to build legitimacy for the technology and the category as well (Santos and Eisenhardt., 2009).

2.2.6 Legitimating New BMs

Researchers have categorised the extant literature on BMs as murky due to the number of definitions and frameworks and its status as a still developing field (Fielt, 2013). BMs come into being through iterative interactions between firms and their environments (Zott and Amit, 2007, Ahokangas et al. 2014; Iivari et al., 2016; Ahokangas and Myllykoski., 2014). BM legitimacy is inseparable from this process of social construction (Laifi and Josserand., 2016). In the context of this thesis, BMs are artefacts that are adapted and changed to gain legitimacy from evaluators including partners, resource providers and customers. BMs success is dependent on alignment between internal operations and external firm strategy (Spieth, Schneckenberg, and Ricart ., 2014).

Appropriate BMs are significant drivers of performance and crucial to a firm's survival and growth (Massa, Tucci and Afuah, 2017; Snihur and Zott, 2020). They are used by businesses as a symbolic tool to create shared meaning frameworks and gain linguistic and technical legitimacy across varying groups (Osterwalder

and Pigneur, 2002; Hacklin and Wallnöfer, 2012). BMs help organisations build identity (Zott and Amit, 2010; Hacklin and Wallnöfer, 2012). New ventures exploit the BM schemas to reframe the ventures to resonate with diverse audiences increasing institutional alignment and enhancing organisational legitimacy (Fisher *et al.*, 2017). These narrativised objects are carefully framed to foreground economic and social contributions, aiming to secure pragmatic legitimacy (financial viability), pragmatic legitimacy (usefulness) and moral legitimacy (social acceptability) despite initial high risk and lack of track record (Howcroft and Leaver., 2025). The reframing of BMs involves emphasising different components. BMs can serve as performative artefacts through which new ventures signal conformity to institutionalised expectations (Karlsson and Honig.,2009).

It follows, that the creation and transformation of BMs involve choices crucial to determining the technological outcomes and legitimisation and monetization of new technologies and products (Baden-Fuller and Haefliger, 2013; Casadesus-Masanell and Ricart, 2010; Ritter and Lettl, 2018; Zhang, Gisca, Sadeghian and Ahokangas., 2022). For instance, the incorporation of users in product development through crowdsourcing or crowdfunding is a BM choice as it allows the new venture and the audience to come to a consensus about the value proposition served by the product. Venture openness plays a role here as the technology and BM choice are a means to align with the expectations of the customer to encourage acceptance of both (Baden-Fuller and Haefliger., 2013). BM's also need to appeal resource providers. New ventures are pushed by accelerators and investors to revise and reconsider their BMs in order to fit into their mould of a successful startup (Neuberger, Mattioli, Richards, Nyilasy and Tracey., 2025). BM choice here means having to choose between rapid and incremental innovation to be commercially feasible versus long term vision (Felin et al., 2020). Other aspects of the external environment include adherence to popular industry practices, commitments to societal values, or partnerships with legitimate organisations. In the context of IoT, partnerships become crucial since no company can deliver IoT solutions in isolation and have to collaborate with other organisations. IoT further enables Servitisation. These aspects facilitate the emergence of ecosystems (Schroeder et al., 2020; Westerlund, Leminen and Rajahonka, 2014; Hui., 2014). The choice of BM is important in ecosystems context as BM decision would determine the role of the different players in a venture's ecosystem and the activities to undertaken by each group. (Zott and Amit., 2010).

Legitimacy is a core challenge for ecosystemic BMs in the industrial internet. (Iivari et al., 2016, p.43). BM configurations that represent radical departures from industry norms such as fully servitised or ecosystem-orchestrated models face higher legitimation barriers than incremental variations on established templates (Taran, Boer, and Lindgren.,2015). Ecosystemic legitimacy must be negotiated across multiple levels: at the level of individual participants, at the level of inter-firm relationships, and at the level of the ecosystem as a whole. A new industrial IoT ecosystem may face scepticism from potential partners uncertain about the reliability of the platform orchestrator, from regulators concerned about data sovereignty and security, and from end-users unfamiliar with connected product services. Securing legitimacy in this context requires coordinated effort across the ecosystem, not just from any single actor. Ecosystem legitimacy is therefore a distinct and multi-layered challenge.

This collective action problem is particularly acute for IoT ventures operating within platform ecosystems, where the legitimacy of the focal venture is intertwined with the perceived legitimacy of the wider ecosystem infrastructure (Thomas and Ritala, 2022). A platform that lacks a sufficient base of credible complementors or that has not achieved standards-level acceptance will struggle to confer pragmatic legitimacy on even the most technically capable start-up operating within it (Gawer and Cusumano, 2014). Conversely, a start-up that achieves strong product legitimacy can act as a legitimating anchor for an emerging ecosystem, drawing in further complementors and accelerating collective acceptance (Autio and Thomas, 2022). Ecosystem legitimacy thus operates through both top-down processes – where the orchestrator defines the identity, value proposition and normative boundaries of the ecosystem – and bottom-up processes, where the quality, diversity and performance of individual participants shape external perceptions of the ecosystem as a whole (Thomas and Ritala, 2022). For IoT start-ups, this means that legitimacy-seeking strategies must account not only for the venture's own positioning but also for how its participation within platform or ecosystem structures reflects upon and is reflected by the broader network (Iivari et al., 2016; Leminen et al., 2018; Binz et al., 2016; Press, Robert and Maillefert, 2020). It follows that ecosystem legitimation requires discursive and performative work undertaken by actors

within an ecosystem driving cognitive and normative legitimacy and constructing ecosystem identity (Thomas and Ritala, 2022).

Since BMs reflect the environment, it follows that BMs are continuously adapted to changing needs (Ahokangas and Myllykoski., 2014). Pivoting represents a particularly acute legitimacy risk. Existing customers may perceive a model change as a violation of their original value exchange expectations while investors may regard model flexibility as a positive signal of adaptability, or negatively as evidence of strategic uncertainty. Managing these audiences requires a deliberate and intensive communication in terms that resonate with each audience (Zott and Amit., 2010).

Earlier, this section referred to the change in BMs to incorporate divergent evaluator inputs for the venture to gain legitimacy. The BM as an outcome needs to address multiple evaluative audiences with different and sometimes conflicting legitimacy criteria making legitimation (Snihur and Zott, 2020). Investors assess whether the model generates a credible and scalable revenue stream; customers evaluate whether it delivers fair value and aligns with familiar transactional norms; partners scrutinise whether it offers appropriate risk-reward balance; and regulators examine whether it conforms to prevailing legal and ethical standards. A novel BM might cause legitimacy contestation (Snihur and Zott., 2020). New ventures use narratives as an important mechanism to render BM comprehensible and gain cognitive legitimacy from key evaluators (Doganova and Eyquem-Renault, 2009, p.1567). BM components including financial projections, market size estimates and partnership logic, all perform a calculative function that constructs the market and mobilises support for the venture's value proposition (Doganova and Eyquem-Renault., 2009, pp. 1567-1568). For IoT start-ups, where the network effects and data monetisation logic of the BM are often opaque to non-technical audiences, narratives are especially critical.

Developing or choosing BMs introduces a further legitimacy challenge: the need to simultaneously claim novelty (to differentiate from incumbent models) and conformity (to align with established institutional expectations) (Snihur, 2016; Zott and Amit, 2010). In practice, new ventures often legitimise innovative BMs by anchoring them to familiar precedents such as subscription models being framed to established SaaS providers, outcome-based pricing and data

monetisation being contextualised within the norms of platform businesses. For IoT ventures specifically, the legitimation of Servitisation or platform-based models requires extensive education of prospective customers where expectations are rooted in traditional product ownership norms (Naik et al., 2020; Kohtamäki, Leminen and Parida, 2024). The category of the venture and its institutional embeddedness create path dependencies that shape the most viable BMs (Thornton and Ocasio., 2013; Snihur and Zott., 2020; Massa, Tucci and Afuah., 2017). In the absence of established schemas, ecosystem participants must negotiate commercial terms as well as the cognitive frameworks through which BM activities are understood. This is a form of institutional work through which schemas are reified into negotiable physical forms (Taran, Boer, and Lindgren.,2015). To conclude, BMs is a legitimacy claim made simultaneously to multiple evaluative audiences. In contexts like IoT where roles and norms are still being written that claim has to be negotiated collectively.

2.2.7 Legitimation Strategies

Venture Level Strategies

Start-ups find it difficult to gain funding especially if they are involved in new lines of activity. Evaluators may de-legitimate the start-up because of information asymmetry. Thus, start-ups need to signal information –such as board composition, management team, market presence and affiliation with third parties such as venture development organisations (Certo, 2003; Plummer, Allison and Connelly, 2016); presence of early customers (Wang, Song and Zhao, 2014); certifications (Rao, 2004); venture financing (Davila, Foster and Gupta, 2003); media reputation (Deephouse., 2000). Start-ups use visual symbols (Clarke, 2011), analogical and metaphorical reasoning (Cornelissen and Clarke, 2010) and entrepreneurial stories (Lounsbury and Glynn., 2001) to convey the signal information. These, signals help receiver overcome information asymmetry to a certain extent. Evaluative audiences' response and lines of action they initiate towards the signaller indicates their perception of the information (Goffman, 2012).

Start-ups also undertake selection strategy at venture level, adjusting organisation goals to meet moral legitimacy requirements and obtaining explicit certifications to attain cognitive legitimacy from customers (Technology

companies avail ISO 27701 certifications which is a standard to be implemented by organisations collecting PII) (Suchman., 1995; Rao, 2004). Conformance strategy entails use of customised responses to different types of audiences or customer/partner references to achieve pragmatic legitimacy, formalization and professionalisation to achieve cognitive legitimacy, establishing partnerships with legitimate organisations to achieve normative legitimacy (Dacin, Oliver and Roy, 2007). Manipulation strategy is implemented by using advertising and social communication with exchange partners to attain dispositional legitimacy and using storytelling to enhance comprehensibility and ensuring prevalence of their form to attain cognitive legitimacy (Suchman, 1995; Kuratko et al., 2017).

Industry Level Strategies

Innovators may employ manipulation, selection or conformance strategy (Suchman, 1995) or creation strategy (Kuratko *et al.*, 2017) to gain and maintain legitimacy. Manipulation involved forming consortiums and ecosystems to influence existing normative order to attain moral legitimacy (The confidential computing consortium helps to define and develop open-source technologies that can ensure data privacy) (Suchman., 1995). Selection strategy involves selecting a new target market that values the innovation to achieve pragmatic legitimacy. Creation strategy is the most difficult to implement since it requires creation of new norms, standards etc and requires the highest level of change within the ecosystem (Uber created a new category and had to create legitimacy in the eyes of regulators, drivers and investors. Once the initial legitimacy for the category was established, me-too players entered the market). New ventures lack influence and resources which are pre-requisites of executing creation and manipulation strategies (Zimmerman and Zeitz, 2002a; Karlsson and Middleton, 2015)

Artefact Level Strategies - The narrative and rhetoric mechanisms used by IoT start-ups to gain legitimacy.

Narratives are used to render innovations comprehensible, establish credibility, venture identities, mobilise allies and increase plausibility of delivering the expected outcomes (Garud, Gehman and Giuliani, 2014). Legitimation process

requires persuasive rhetoric and taken-for-granted narratives (Suddaby, Bitektine and Haack., 2017).

Entrepreneurs need to adapt legitimation mechanisms to each type of audience (Fisher *et al.*, 2017) and need to align with the dominant logics held by the targeted audience (Thornton and Ocasio, 2013). Start-ups developing IoT-based products or technology need to align with multiple institutional logics as discussed in previous sections. They use emphasis framing involving language and symbols that can be adjusted to the audience, or issue framing involving a high level of abstraction to associate disruptive ideas to socially accepted values (Fisher et al., 2017; Aldrich and Fiol, 2007a). Organisations with novel offerings use institutional vocabularies to expose the inconsistencies in underlying institutional logics, challenging the taken-for-granted status of the incumbents. These theorizations subsequently offer a solution (Suddaby, Bitektine and Haack., 2017). This increases the comprehensibility of the novelty (Suddaby and Greenwood, 2005, p.57).

Both institutional vocabularies and theorizations of change are used by entities to meet cognitive legitimacy requirements, (Suddaby and Greenwood., 2005; Garud, Schildt and Lant, 2014). Narratives include pitches, business plans and actions such as developing prototypes, business development etc (Garud, Gehman and Giuliani, 2014). Narratives and other boundary artefacts like BMs are evaluated by resource providers and customers during the new venture legitimation process (Star and Griesemer, 1989; Doganova and Eyquem-Renault, 2009). Evaluator inputs are incorporated into the narrative (Garud, Schildt and Lant, 2014).

Digital start-ups tread the tightrope of conformity and differentiation (McDonald and Eisenhardt, 2020; van Angeren et al., 2022). Narratives establish the distinctiveness of start-ups against established solutions (Bitektine and Nason, 2019). Researchers have discussed conformity in terms of legitimate distinctiveness (Navis and Glynn, 2011; Oftedal, Foss and Rutherford, 2024); isomorphism (DiMaggio and Powell, 2000); image borrowing (Younger and Fisher, 2020); optimal distinctiveness (Snihur, 2016). New ventures need to conform with prevailing regulatory and industry norms (Suddaby, Bitektine and Haack., 2017).

Start-ups also need to show that their innovation is compatible with an existing technology or system to ease integration with customer's infrastructure (Pandey., 2021). Where new ventures are introducing new categories, they combine narratives and collective mobilization to gain legitimacy (Bitektine and Nason, 2019)

Adapting Identities

Organisational identity adaptation includes both differentiation and conformity (Oftedal, Foss and Rutherford, 2024). Conformity is a crucial input to legitimacy as it signals the organisation's ability to meet the expectations of its environment (Ashforth and Gibbs, 1990; Suchman, 1995; DiMaggio and Powell, 2000; Navis and Glynn, 2011). This balance between conformity and distinctiveness has been elaborated through the concepts of legitimate distinctiveness (Navis and Glynn., 2011); categorical fit (Suddaby, Bitektine and Haack, 2017); image borrowing (Younger and Fisher, 2020); optimal distinctiveness (Snihur., 2016).

This highlights venture identity adaptation, as early-stage ventures signal uniqueness and align with institutional realities over time (Navis and Glynn, 2011). The optimal distinctiveness concept relies on the BM to gain legitimacy. New ventures use BM innovation for boundary work—initially setting blurry boundaries and sharpening them based on external feedback (Snihur, 2016). To gain legitimacy, ventures must fit within a category or reshape expectations (Suddaby, Bitektine, and Haack, 2017). This underscores the dynamic, negotiated nature of legitimacy between the organisation and key evaluators.

However, new ventures that are creating new categories may face cognitive and socio-political legitimacy pressures from evaluators and incumbents (Aldrich and Fiol., 1994). New ventures can address this by positioning their category within an existing category and invoking cues of innovation and novelty (Hargadon and Douglas, 2001). Further, start-ups face multiple legitimacy thresholds in their lifecycle and have to undertake significant efforts to ensure the continuance of the (Zimmerman and Zeitz, 2002a; Fisher, Kotha and Lahiri, 2016). They need to deal with the fallout of gaining legitimacy at one stage i.e. loss of legitimacy in other contexts due to venture-identity embeddedness (Fisher, Kotha and Lahiri., 2016). On the other hand, new ventures might also benefit from legitimacy

buffering in new contexts (Fisher, Kotha and Lahiri., 2016). Since different categories of actors have different perceptions of what is a legitimate organisation, the legitimacy thresholds vary throughout venture lifecycles, and venture identity changes throughout the venture lifecycle, this research looks to show the temporal and spatial dynamics in the context of new venture legitimacy (Fisher, Kotha and Lahiri, 2016; Fisher, 2020

2.3 On Boundaries

This section reviews the literature on boundaries as it relates to new venture legitimacy. It begins with classical sociological conceptions of boundaries before examining how boundary dynamics operate within entrepreneurial settings, including category formation, boundary work, and the mechanisms through which artefacts mediate boundary-spanning activities. The section concludes by connecting boundary work to entrepreneurship, establishing the conceptual foundation for this thesis's analytical framework.

2.3.1 The Traditional View of Boundaries

Traditional ideas of boundaries are linked with legitimacy, power, and inequality in literature. Boundaries serve as classification tools for inequality, power regimes, social spaces, and as instruments for crossing classes (Bourdieu, 1991; Weber, 2019). They help define legitimate authority, such as rulers using violence within territorial boundaries (Weber, 2019). Bourdieu linked legitimacy to symbolic recognition within fields, where boundaries between classes compete to define cultural legitimacy (Bourdieu, 1991). He illustrated how new learning systems created by the bourgeoisie blurred scholastic achievement boundaries, reproducing power hierarchies (Bourdieu, 1984). Bourdieu argued that "to define is to impose boundaries" (Bourdieu, 1991). Boundaries can be sharp, fluid, or blurred, and may be socio-economic or territorial. They encompass territories, communities, professions, identities, status groups, or fields. These studies view boundaries as tools for legitimising or de-legitimising knowledge, groups, and power. Entities often engage in boundary work to assert or reinforce legitimacy.

2.3.2 Boundary Work

Boundary work comprises the concrete efforts or strategic practical action undertaken by actors to impact existing boundaries through exploration, creation,

management and contestation (Zietsma and Lawrence, 2010; Langley et al., 2019). It serves as a critical lens for understanding the ways in which identities, fields, and organisations are segregated or demarcated from environmental context. Boundary work involves actions that shape boundaries along with transmitting knowledge across boundaries (Barley, 2015). It is an *ongoing, rhetorical process* that demarcates, expels, incorporates ideas, groups and practices from a field (Houf, 2020). Actors engage in boundary work to maintain intellectual authority (Green, 2021). Its connection to legitimacy, power, competence and efficiency make it an important lens to understand venture creation, change and survival and yet it is underexplored in the new venture context (Santos and Eisenhardt, 2009; Langley et al., 2019; Lawrence and Phillips, 2019b).

Boundary work was first defined as construction of epistemic and social boundaries by scientists to demarcate between science and non-science (Gieryn., 1983). Non-scientists legitimated or challenged the cognitive authority, credibility, power and resources of science through boundary work (Gieryn, 1995). Instability of the boundary between science and policy led to a constant negotiation of legitimacy through communication, structure and engagement between the three bodies of science (Gieryn, 1995,pp.435-439). Boundary work construct has helped explain phenomena in professions (Abbott, 1995; Greenman, 2012); immigration (Zolberg and Woon, 1999; Alba, 2005); science and technological studies (Gieryn, 1983) among other strands of literature.

Boundary work was traditionally considered as a way for insiders and outsiders to gain control over norms of conduct within a field (Gieryn., 1999). Gieryn highlighted the key mechanisms through which boundary work is performed by scientists (Table 4) - monopolisation where scientists claimed their expertise granted them authority in the domain, expansion where the jurisdiction of science is extended into adjacent domains claimed by other groups, expulsion from the legitimate domain of science through negative labelling, and protection of science from interference by non-scientific actors such as politicians or industrialists (Gieryn, 1983, pp. 782–784; Gieryn., 1999, pp. 15–17). New ventures engage in analogous practices: monopolisation (claiming unique technological expertise), expansion (extending their identity into adjacent categories),

expulsion (distinguishing themselves from failed or fraudulent actors in their space), and protection of autonomy (resisting inappropriate control by investors or customers). Drawing on Gieryn's work, neo-institutional scholars explored the interplay of boundary work and practice work to effect institutional change (Zietsma and Lawrence., 2010); legitimisation of organisational identity as a mechanism of boundary work (Drori, Sapir and Ellis., 2015); the use of boundary work to maintain authority and claim new domains, collaborate and legitimate new categories (Hargadon and Douglas.,2001; Santos and Eisenhardt., 2005; Langley et al., 2019)

Literature adjacent to Gieryn's work includes the studies on professionalisation of fields which examined defensive boundary work and legitimacy (Abbott., 1988; Abbott., 1995). According to Abbott, boundaries precede the formation of entities - professions, fields or organisations, due to their emergence at sites where interactions and negotiations between actors take place and where multiple points of differences line up (Abbott., 1995). This also means that boundaries are inchoate and unstable (Abbott., 1995). This is very different from early neo-institutional theories that treated stability as a default condition (Abbott., 1992). Abbott identified four structural weaknesses in neo institutionalism (Abbott., 1992, p.754-755). First, new institutionalism did not account for power dynamics and material interest. Second, neo-institutionalism was focused on theorising stability and consequently undertheorised change. New institutionalist frameworks are built around the mechanisms of isomorphism and explain the reproduction of institutional fields (Greenwood and Hinings., 1996; Dimaggio and Powell., 2000). These frameworks do not explain how new categories come into existence or how institutional configurations are destabilised and reconstituted (Dimaggio and Powell., 2000; Meyer and Rowan., 1977). Change can also be explained by external factors like regulation or trends that lead to emergent categories as addressed through the linked ecologies concept (Abbott., 2005., pp. 245-274). Third, new institutionalism neglected real consequences of institutional phenomena like isomorphism or decoupling as a result of assuming legitimacy through script adoption (Abbott., 1992, p.755; Meyer and Rowan., 1977). Fourth, neo institutionalist ontology was fundamentally processual and yet was examined through variables (Abbott., 1992, p.756). These weaknesses were addressed *in part* through the rise of studies on institutional work (Lawrence and Suddaby.,

2006; Zietsma and Lawrence., 2010). These studies account for power dynamics by showing that *actors* use institutional work to distribute and deliberately lock-in resources unequally and they use boundary work to establish and challenge who(actors) and what (legitimate practices) belong in a field (Santos and Eisenhardt.,2005; Lawrence and Suddaby., 2006; Zietsma and Lawrence., 2010). Further, they examined the processual dynamics of institutional transformation, theorizing change (Lawrence and Suddaby., 2006; Zietsma and Lawrence., 2010). Lastly, some studies showed the creation of new categories through boundary work (Santos and Eisenhardt., 2009). *This thesis contributes to this strand of literature by showing the different type of boundary work that IoT ventures undertake leading to different legitimacy outcomes.* Abbott's critique of neo institutionalism informs this analysis as this thesis shows that boundary work is influenced by power relations, power imbalance between start-ups and their evaluators as well as strategies to navigate these imbalances and accrue power; that change is an intrinsic component of these companies and occurs at different levels of analysis; the category formation strategies used by IoT start-ups in order to gain legitimacy; the legitimacy outcomes of boundary work that are crucial for survival. This thesis provides both a process and typology view on boundary work. The processual ontology as expressed by Abbott and later adopted by neo-institutional theorists to examine boundary work informs the methodological approach adopted in this thesis.

2.3.3 Boundaries and Boundary work in Entrepreneurship

'Entrepreneurship means doing boundary work in different ways' (Lindgren and Packendorff, 2006). Boundaries are essential to creating identity but also to separating the venture from the external environment and the venture from the entrepreneur (Santos and Eisenhardt, 2005, 2009; Jacobides and Winter, 2007; Sundaramurthy and Kreiner, 2008; Fauchart and Gruber, 2011; Katz and Gartner, 2016). Creating and driving an innovative company is not enabled by the founder alone but requires engagement with multiple stakeholders and resource providers across organisational boundaries. Research also shows that boundaries are shaped by the negotiations between actors, which is a form of work on boundaries (Quick and Feldman, 2014; Langley et al., 2019) – for instance, the formation of partnerships and brokering between peripheral and central actors (McMillan,

Goodman and Schmid, 2016; Tisenkopfs et al., 2015). Legitimacy loss can stem from risk, uncertainty and lack of accountability between actors in partnerships where work at the boundary is mismanaged or negotiations fail (Hansen Löfstrand and Uhnoo, 2020).

Boundary work can be used to exchange knowledge, define identities, demarcate between groups, determine access to resources and establish criteria for power and control (Abbott, 1995; Lamont and Molnár, 2002; Santos and Eisenhardt, 2005, 2009; Sturdy et al., 2009; Glimmerveen, Ybema and Nies, 2020). When multiple groups propagate contesting category ideas, category boundaries become porous, impeding legitimacy acquisition, as in the case of technology ethics (Green and Viljoen, 2020; Houf, 2020). Scholars have concluded that boundaries are dynamic and evolve continuously (Abbott, 1995; Sturdy et al., 2009; Langley et al., 2019; Glimmerveen, Ybema and Nies, 2020).

Entrepreneurs create symbolic boundaries based on mental schemas and pattern recognition capabilities. Symbolic boundaries are internal classification systems and temporal, spatial and visual cognitive distinctions made by actors for the purposes of categorisation (Lamont and Molnár, 2002; Lamont, Pendergrass and Pachucki, 2015). Evaluators use these distinctions to curtail or provide access to resources and grant or revoke status (Klopf, Fortwengel and Etter, 2025). Symbolic boundaries make it possible for entrepreneurs and their audiences to negotiate and shape identity and category and to acquire legitimacy (Lamont and Molnár, 2002; Santos and Eisenhardt, 2009; Zietsma and Lawrence, 2010; Grodal, 2018; Granqvist and Siltaoja, 2020; Siltaoja et al., 2020; Klopf, Fortwengel and Etter, 2025). A venture acquires an identity when it has drawn and defended boundaries that distinguish its idea, product or practice from alternatives, i.e. by situating its ideas within an existing category or finding new categories prior to any opportunity identification or discovery. Thus, boundary work is crucial to identity formation and legitimacy creation. A category is a shared classification used by audiences to evaluate and legitimate a new venture (Navis and Glynn, 2011). A boundary defines category membership criteria and demarcates one category from another (Lamont and Molnár, 2002; Santos and Eisenhardt, 2009).

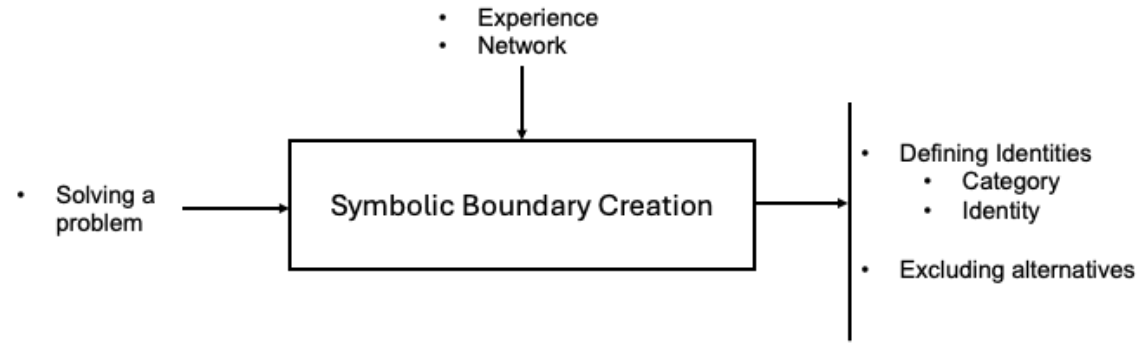


Figure 8 Symbolic Boundary Creation in entrepreneurship

Symbolic boundaries are a prerequisite for the formation of social and objective boundaries (Lamont, Pendergrass and Pachucki, 2015). Once consensus between evaluators and ventures is achieved, the symbolic boundaries are formalised into social boundaries, resulting in taken-for-granted patterns of interaction (Lamont, Pendergrass and Pachucki, 2015; Rantatalo, Lindberg and Haake, 2024, p. 3). While symbolic boundaries may take the form of differentiating an idea from available solutions in the market, objective boundaries take the form of patents and licensing that establish the authority of the entrepreneur and the venture over the novelty of the idea. In the context of new categories or sectors, symbolic boundaries are constantly evolving as various actors negotiate the category's shared meaning. Symbolic boundaries are socially constructed and create categorisations between legitimate and illegitimate entities, in-groups and out-groups (Faulconbridge, Sarwar and Spring, 2023). Established boundaries are challenged by new technology categories, creating new opportunities for boundary work. New technologies disrupt professions, while professionals focus on repairing and creating boundaries to re-assert domain authority. This leads to the creation of new boundaries and necessitates realignment with prevailing power structures to ensure the viability of claims of authority (Faulconbridge, Sarwar and Spring, 2023, pp. 2016–2017). One type of boundary work can necessitate or create opportunities for other types of boundary work (Faulconbridge, Sarwar and Spring, 2023). Investors use boundaries to bridge boundaries with stakeholders, create temporary boundaries and manage tensions across cross-functional groups (Carlson and Safavi, 2024). While studies show the importance of stable boundaries as a source of legitimacy, in the context of new ventures boundaries are flexible and rapidly evolving to ensure survival. In fact, flexibility and even ambiguity in organisational attributes is one of the key requirements of resource providers such as VCs when legitimating a new venture (Fisher, 2020) Within

entrepreneurial ecosystems, social boundaries along the stage or category of venture, category of support and ethnicity separate high-growth entrepreneurs from survival entrepreneurs (Neumeyer, Santos and Morris, 2019).

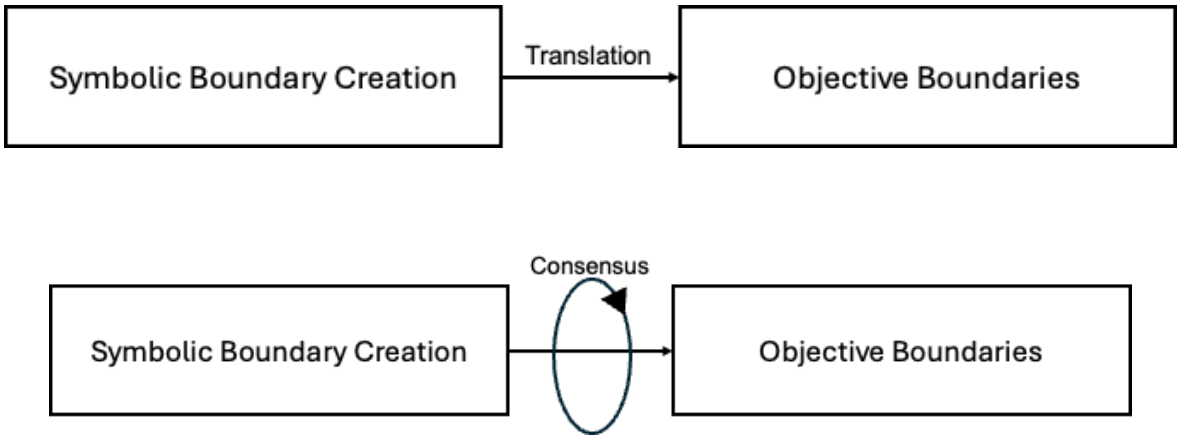


Figure 9 Symbolic to objective boundaries is a process of translation and consensus

The formation of cognitive categories or stereotypes due to race- and gender-based boundaries leads to bias in selection for resources (Knight, 2016). In emerging markets, where boundaries are ambiguous and in a state of flux, identities are incoherent (Granqvist and Siltaoja, 2020; Aldrich and Fiol, 1994). Entrepreneurs therefore try to legitimise their firms by situating them in existing categories even when there is weak alignment with the criteria for category membership (Grodal, 2018; Hargadon and Douglas, 2001). Where start-ups are trying to create and legitimise new categories, they need to connect emergent category narratives with existing categories to allow for commensurability (Khaire and Wadhwani, 2010).

Incumbents create sharp category boundaries by defining clear category membership criteria. Legitimacy retention involves adopting selective elements of emerging categories to gain legitimacy and gain control of aspects of the new category that might challenge the incumbents' position (Zietsma, Ruebottom and Slade Shantz, 2018). Stigma by association can be avoided through boundary work, such as discursive construction between organic and biodynamic farming categories while at the same time discursively blurring boundaries between biodynamic and traditional farming categories (Siltaoja et al., 2020). New firms use soft power tactics such as illusion, exploitation and the use of timing to gain legitimacy in new categories (Santos and Eisenhardt, 2009). After becoming

cognitive referents, new ventures form alliances. Lastly, they undertake acquisitions to eliminate competition and demarcate their category from others (Santos and Eisenhardt, 2009).

The act of entrepreneurship involves the exploitation or resolution of conflicts or tensions, which boundary work can help manage. Diversity and conflicts lead to creativity or innovation, but this innovation cannot be effectively utilised without alignment with other actors (Tisenkopfs et al., 2015). This is demonstrated by the RockCityAB case, where music entrepreneurs aimed to balance innovation and conformity to local culture. First the entrepreneurs tried to create a new hybrid category, then they tried to influence the town's community to accept the hybrid form and associated events through mechanisms of articulation, practice reconfiguration and practice cross-appropriation (Lindgren and Packendorff, 2006).

Drawing upon these themes and Simon's (1996) triadic design framework of goal, artefact and environment, the design perspective in entrepreneurship looks at entrepreneurial artefacts such as new ventures, minimum viable products, prototypes, BMs and entrepreneurial opportunities as epistemic objects (Simon, 1979; Berglund and Glaser, 2022; Berglund and Dimov, 2023). This overlap between entrepreneurship as design and entrepreneurship as boundary work has not been explored in existing research.

Within institutional theory, entrepreneurship literature briefly discusses the change in organisational boundaries concomitant with the venture's life cycle which is consistent with the assumptions in this thesis(Fisher, Kotha and Lahiri, 2016).Another strand of literature within entrepreneurship finds that undertaking bricolage helps entrepreneurs bypass industry boundaries, navigate regulatory or cultural boundaries and leverage non-formal partnerships to facilitate BM innovation (Flaminiano, 2024; Xu et al., 2024). This thesis shows findings that resonate with this theory. Institutional pluralism has been found to be a key strategy adopted by organisations in order to gain legitimacy from diverse audience groups and as a response to institutional complexity; however, it can also cause conflicts (Marquis and Lounsbury, 2007; Greenwood et al., 2011). This thesis shows that boundary work undertaken by start-up organisations can address

conflicts arising from pluralistic logics. Institutional entrepreneurship literature looks at how actors' structural position within fields creates conditions for boundary bridging and boundary misalignment (Suddaby and Greenwood, 2006). In nascent markets, entrepreneurs shape both markets and organisations through boundary work using claiming, demarcating and controlling strategies (Santos and Eisenhardt, 2009). Third-party organisations also sometimes act as bridges between start-ups and large organisations (Johnson, Joshi and Kreiner, 2023). Venture creation activities are shaped by occupational boundary work (Greenman, 2012)

These studies fail to consider the alliance power mechanisms affecting venture identity and, by extension, the category, and the role of boundary work in adoption (Santos and Eisenhardt, 2009). They did not consider that venture boundaries are in flux, affecting the category formation process (Glynn and Navis, 2013). Entrepreneurs espouse categories to design venture identities, so familiar categories are used to invoke taken-for-grantedness, and hybrid identities are enabled in order to invoke pragmatic legitimacy (Battilana and Dorado, 2010; Glynn and Navis, 2013). However, these studies do not consider the role of power and gatekeeping in determining category membership criteria. These gaps were partly addressed in the work on boundary work in professional services firms' adaptation to AI, where professionals adopted some new roles as part of the new boundary work (Faulconbridge, Sarwar and Spring, 2023). However, the impact of boundary work beyond the individual level is still underexplored.

Evaluators play an important role in the emergence of categories and identities. Their cognitive and normative processes can reshape the boundaries and membership criteria of categories (Durand and Thornton, 2018, p. 27). Some studies have explored the interplay between actors in boundary formation or boundary change. Contestation or controversy over labels forces actors to clarify meanings and sharpen category boundaries (Slavich et al., 2020). Researchers showed that symbolic boundaries around a category need to achieve a certain degree of strength and stabilisation before they are transformed into regulatory boundaries by discursive means by regulators, service providers, associations and interest groups, as in the category contestation of the home-sharing and short-term rental categories (Klopf, Fortwengel and Etter, 2025). Studies have shown

the role of regulators and market actors in boundary formation, but the role of consumers remains unexplored. Extant research does not consider the power relations and hierarchies as the category is created and evolves. Extant research does not consider the power relations and hierarchies at play as a category is created and evolves; studies of actor-led boundary work to demarcate or enable collaboration across domains similarly give little heed to power relations between actors (Slavich et al., 2020; Faulconbridge, Sarwar and Spring, 2023). The narrow boundary focus raises questions about generalisability to other sectors like IoT.

Across this literature, category is the outcome that a boundary encloses (Zietsma and Lawrence., 2010; Durand and Thornton., 2018). This is further supported by literature on boundary work in professions (Langley et al., 2019; Faulconbridge, Sarwar and Spring., 2023). While boundary answers the question 'What/Who can be inside and outside?', identity answers the question 'Who/What we are?', category answers the question – 'What kind of thing is it?'. Boundary is locative, identity is character based and category is classification. In the context of this thesis, a category is a classification of IoT specific products, technologies, or markets that emerges through the convergence of actors, narratives, and artefacts around a shared label (Zietsma and Lawrence., 2010; Rantatalo et al., 2024).

Considerations around power relations, category boundaries and multiple evaluators are crucial to IoT, since there are multiple labels and meanings associated with IoT and with the organisations developing services and products within this category. The boundaries of the IoT category and of the ventures developing IoT-based technologies are in a continuous state of evolution. This is further explored in Chapter 5.

2.3.4 Differentiating spanning, objects and artefacts.

Boundary spanners are individuals or organisations who occupy roles or perform activities at the boundary, enabling co-operation across boundaries of an organisation and its environment (Aldrich and Herker., 1977). In spanning, boundaries stay fixed and the actor moves across the boundaries. Boundary spanning studies show that technology, environment and power dynamics impact boundary spanning role creation, differentiation and formalization (Aldrich and

Herker, 1977; Friedman and Podolny, 1992; Ryan and O'Malley, 2016; Jesiek et al., 2018). By contrast, as discussed above, the role of power hierarchies in boundary work remains underexplored.

Boundary spanners use artefacts or boundary objects like BMs, forms, repositories, idea types , organisations and standards (Star and Griesemer., 1989; Guston., 2001; Jesiek et al., 2018, p. 388). Artefacts act as boundary objects if their meaning is co-constructed by relevant actors across boundaries (Thomas et al., 2007). Artefacts can be local or those that are shared between teams across boundaries called boundary objects. Artefacts facilitate identification, coordination, reflection and translation (Akkerman and Bakker, 2011). Use of artefacts for co-ordination may also create a hierarchy of legitimate work contribution, mobilise action or allocate authority among the different communities of practice or organisations (Bechky, 2003). Boundary objects can help overcome the challenges from porous and entrenched boundaries and are a tool for boundary work and used by boundary spanners (Houf, 2020; Clark et al., 2010). Boundary objects are said to provide a space for facilitating boundary work (Star and Griesemer., 1989). These tools possess the dual qualities of plasticity and robustness, allowing for adaptation across groups while maintaining their core form (Smith and Bijker, 1996; Latour, 2013; Shepherd, Seyb and George, 2023). Boundary objects can facilitate communication and translation across boundaries through institutional mechanisms, enhancing salience, credibility and legitimacy of the information being produced and exchanged (Cash *et al.*, 2003). Most importantly, active use of artefacts lends visibility to the boundary work being performed (Thomas et al., 2007). This strand of literature also suggests the needlessness of consensus as long as there are shared representations of boundary objects (Star and Griesemer, 1989). However, consensus is important in ensuring the legitimation of present and future knowledge and the artefact itself (Garud, Gehman and Karunakaran, 2014). In addition, any legitimacy challenge to artefacts threatens the legitimacy of the entity at whose boundary it is positioned (Garud, Gehman and Karunakaran, 2014).

2.3.5 Types of boundary work and legitimacy

There are different types of boundary work examined in the seminal studies on demarcations in science and non-science and immigration (Table 4 and 3) (Gieryn,

1983; Zolberg and Woon, 1999). More recently, studies have examined how professionals manage the disruptive effects of AI and shows that accounting and law professional service firms engage in creation, blurring and bridging boundary work (Faulconbridge, Sarwar and Spring, 2025). Creating boundaries was related to defining a new domain, bridging was done through negotiations and blurring boundaries was related to redefining boundary exclusions (Faulconbridge, Sarwar and Spring, 2025).

The organisational consequences of boundary work, particularly in terms of legitimacy, depend on whether the boundaries are blurred or sharp (Alba, 2005), porous or entrenched (Houf., 2020). When boundaries are blurred, evaluators struggle to assess the acceptability of the category, practice or venture within a category, leading to low cognitive legitimacy, but blurred boundaries can also allow hybrid identities and practices that can lead to pragmatic legitimacy. Existing literature highlights the legitimacy discount associated with blurred boundaries (Hsu., 2006; Battilana, Besharov, Mitzinneck., 2018; Durand and Thornton., 2018). However, isomorphism of the form legitimates and gives rise to a new category (Battilana, Besharov and Mitzinneck., 2018). Scholars also show that where organisational boundaries are blurred, ventures can acquire legitimacy and increase resource base as shown in the study on nanotechnology companies (Wry et al., 2014). Some studies contend that blurry boundaries can be productive for decision-making or lead to confusion or instability (Jasanoff and Primack, 1991, cited in Gieryn, 1995, pp. 435-439; Guston, 2001). This instability in boundaries is due to a lack of communication and collaboration between different groups. Technology entrepreneurship studies have shown that varied and distributed actors undertake process boundary blurring between design and production or planning and execution to co-shape new technologies (Garud and Karnøe., 2003). Studies on institutional logics suggest that blurred boundaries suggest a transient stage and identity in the making (Durand and Thornton., 2018, p. 23). Such ventures have the flexibility to keep adapting their offerings as identity and BM develops. This thesis shows that the organisations undertake boundary-blurring work to exploit the benefits of hybrid identities (Chapter 7). As noted in 2.3.4, consensus matters for legitimation and it is also important for the emergence of a sharply defined category, yet the process of consensus sometimes fails. Attempts to construct boundaries of the AR community and define field membership failed

because the involved groups could never reach a consensus leading to blurred boundaries and endemic boundary work (Liao., 2016). However, research does not show how this ambiguity might affect the field's legitimacy and those of the actors within it. This thesis examines the boundary work strategies undertaken to address similar ambiguity associated with IoT in Chapter 5.

Studies show that blurring can lead to continuous knowledge exchange and exploratory innovation while bridging leads to discrete knowledge exchange and exploitative innovation (Rossi et al., 2014; Evans and Scarborough., 2014). There is no consensus amongst scholars when it comes to boundary bridging and blurring definitions. Bridging is used to resolve syntactic (no shared vocabulary), semantic (no shared meaning), pragmatic (no common interests) knowledge boundaries (Huber et al., 2019). Some say that bridging reduces ambiguity and enhances trust between structurally different organisations and blurring involves high actor-led relational commitment (Rossi et al., 2014; Palmer, Owens and Doubleday., 2019). In contrast, other studies refer to bridging as relational, narrative mode of boundary work, for instance when it is used along with boundary repair by climate scientists in order to restore credibility after a controversy (Garud, Gehman and Karunakaran., 2014). Bridging can be used to connect disconnected communities of practice occurring at intrapersonal, interpersonal and organisational levels (Gustavsson and Safsten., 2017). Scientific jargons are replaced with narrative mechanisms and used by scientists to bridge across science and non-science boundaries (Garud, Gehman and Karunakaran., 2014). When used by weaker groups, bridging is used to co-opt the influence of stronger groups and fitting into incumbent systems (Langley et al., 2019). Bridging is undertaken because of structural separation like different time horizons across geographies, institutional demands that require co-ordination, need for information sharing with others and issues with traditional processes (Huber et al, 2019; Pemsel and Widen., 2011; Kimble et al., 2010; Gustavsson and Safsten., 2017). It is enabled by institutionalised trust, availability of information rich artefacts or narratives, legitimate intermediaries, recurring boundary encounters, formalization efforts through leadership change (Huber et al, 2019; Pemsel and Widen., 2011; Kimble et al., 2010; Gustavsson and Safsten., 2017). Actors undertaking bridging are motivated by a need for legitimacy (Kimble et al., 2010). Bridging can lead to joint innovation or product, creation of trust, change in authority hierarchy,

change in artefacts or narratives, reduction of stress. Boundary bridging allows a connection to be formed as a means for two sides that retain distinct identities, logics and interests to coordinate (Star and Griesemer, 1989; Quick and Feldman, 2014). In contrast, in crossing, the boundary persists but organisations change memberships (Akkerman and Bakker, 2011). In shifting, the boundary itself is relocated. Through boundary-blurring work, boundaries lose definition (Table 3). The distinction matters for legitimation because the four reconfigurations carry different implications for legitimate distinctiveness (Navis and Glynn, 2011). Start-ups that cross-over to other known categories lose distinctiveness. Category boundary shifting means that criteria for membership and therefore legitimacy changes. A venture that blurs, trades clarity for association, at the risk of incoherence (Chapter 7). Start-ups that undertake bridging preserves boundary and distinctiveness while aligning with stakeholder requirements (Chapter 6).

Boundary work also shapes identities (Zolberg and Woon, 1999; Paulsen, 2003; Santos and Eisenhardt, 2005). Organisational change leads to creation of new boundaries or changes to existing boundaries. This leads to creation of new challenges related to power, status and competition over resources (Paulsen, 2003). Studies show that boundary creation is accomplished through discursive means (Santos and Eisenhardt, 2009; Langley *et al.*, 2019). During periods of change, symbolic boundaries are used to form in-groups and outgroups in studies on group categorisation and identification(Paulsen, 2003). Further, resistance to change stems from a perceived threat to identity (Paulsen, 2003). This is echoed in other studies that suggest that identity boundaries constrain perception, protect territory and delegitimise newness (Santos and Eisenhardt, 2005; Langley et al., 2019; Rantatalo et al.,2024).Managers use boundary management strategies such as emphasising benefits of the new identities, acknowledging the strengths of old identity, improve the level of group identification during times of turbulence or change, avoid controversial categorisations, temporary spaces to protect new ideas and allow co-operation across different teams shielded from change detractors, (Paulsen, 2003; Zietsma and Lawrence, 2010; Kislov et al., 2017; Langley et al., 2019). It follows that boundary management is a means to manage the challenges that come from creation of new or changing of existing boundaries.

Boundary Process	Detail	Connection to Legitimacy
Boundary Crossing	Assimilation through movement across boundaries.	Demonstrates adaptability and responsiveness – strengthens legitimacy but can also weaken professional credibility if adaptation leads to loss of identity.
Boundary Blurring or Hybridization	Membership of multiple groups with mutually exclusive identities.	Enhance legitimacy by appealing to multiple audiences but can undermine legitimacy if identity is perceived as incoherent.
Boundary Shifting	Boundary expansion or reduction to include or exclude new groups.	Can enhance legitimacy if entity can successfully signal adaptability or protect legitimacy by sharpening value proposition and area of authority.

Table 3 Boundary Work and Connection to legitimacy (Zolberg and Woon., 1999)

Boundary Work	Goal	Mechanism	Reference
Expansion	To extend professional authority or expertise into new territories that are already claimed by other groups or occupations.	Actors contrast their own side's characteristics favourably against those of their rivals to justify their movement into the "other's" domain. This requires convincing an audience that the expansion is not a mere "territorial grab" but a legitimate enhancement of services.	Gieryn (1983, pp. 791–792).
Monopolization	To maintain exclusive control over professional authority, career opportunities, and the distribution of	Groups draw rigid boundaries to establish "social closure," ensuring that only those who meet specific criteria are granted the "right to rule"	Gieryn (1983, p. 792).

	material resources within a field.	or represent truth. This defines the rules of inclusion and distinguishes legitimate practitioners from "others".	
Expulsion	To protect the "purity" and status of a dominant group by casting out rivals from *within* the field who are deemed non-conforming	This is a primary strategy used to achieve monopolisation. Actors use labels such as "pseudo," "deviant," or "amateur" to define rivals as outsiders.	Gieryn (1983, p. 792).
Protection	To safeguard the autonomy of professional activities from external interference, such as political pressure or public regulation.	Actors construct boundaries that "exempt members from responsibility for consequences of their work" by placing the blame on "scapegoats from outside".	Gieryn (1983, pp. 791–792)

Table 4 Boundary Work Mechanisms (Gieryn., 1983)

2.3.6 Boundary Work Mechanisms Facilitated by Artefacts

Artefacts such as videos, stories, prototypes or sketches facilitate boundary work such as the case of 3D Tune in R&D open innovation project where knowledge related to the project was shared and used by a diverse set of users across organisational boundaries (Star and Griesemer, 1989b; Simeone, Secundo and Schiuma, 2017). Boundary work mechanisms facilitate new venture legitimacy (Akkerman and Bakker., 2011). Artefacts serve the function of translation and standardisation (Guston, 2001; Star and Griesemer, 1989). However, the problem with these conceptualisations is that they assume that entities on either side of the boundaries are similar in form and size. Most of the time, the artefacts are used to negotiate between entities engaged in an unequal power dynamic and this guides the standardisation and translation processes (Pandey and Stein, 2023).

Mechanism	Definition

Identification	Othering i.e. defining domains, fields, practices or entities against others and legitimating co-existence with other practices or entities through sensemaking. (Akkerman and Bakker, 2011)
Co-ordination	Herding the representative actors together to resolve shared problems through communication, translation, seamlessness and routinization (Kellogg, Orlikowski and Yates, 2006; Zietsma and Lawrence, 2010; Akkerman and Bakker, 2011)
Reflection	Reflection involves perspective taking and making (Akkerman and Bakker, 2011)
Translation	Translation | Enrolling others into a network by redefining their problems, interests and identities (Callon, 1986; Latour, 1987). See discussion below

Table 5 Artefact mediated boundary work mechanisms

Translation plays an important role in supporting joint innovation activities as well as legitimation. Translation involves a power dynamic where the translator positions itself as an "obligatory passage point" through which all others must pass to achieve their goals through interessment, enrollment and mobilization (Callon, 1986, p. 205). It involves many to one mapping where many problems are narrowed down into a single concern (Star and Griesemer., 1989, pp. 389-390). *It involves creation of consensus* through the imposition of identities onto the network of allies by the central actor (Star and Griesemer., 1989, pp.389-390). Through translation, mutual understanding is increased and tension is reduced. This served as inspiration for the concept of boundary work which at the time included knowledge brokering activities such as collaborating, informing, consulting, capacity building etc (Orsini, Louafi and Morin., 2017). The concept of translation was extended to achieve collaboration beyond simple understanding through the use of boundary objects and boundary organisations (Star and Griesemer., 1989; Orsini, Louafi and Morin., 2017). Scholars have drawn upon this work to discuss boundary bridging as the work enabled through boundary objects and boundary organisations where different groups collaborate without arriving at consensus (Star and Griesemer, 1989; Langley et al., 2019; Orsini, Louafi and Morin., 2017). Translation and boundary bridging are related but distinct. Boundary bridging is defined as a collaborative boundary work where firms developed legitimate relationships with external organisations, motivated by necessity (Faulconbridge et al.,2025; Langley et al., 2019). A key difference between translation and bridging processes is the goal, translation is for understanding while bridging is for collaboration. Therefore, translation is a necessary component of bridging. A venture might translate investor interests into

technical requirements while simultaneously bridging the cognitive gap between IoT affordances and investor expectations. In this thesis, *boundary bridging comprises the deliberate efforts of IoT ventures to actively span the cognitive, normative, and material divides between their own identity and practices and those of their evaluative audiences (investors, customers, and accelerators)*. It is an iterative process in which ventures adapt their identities, narratives, and artefacts to achieve alignment for legitimacy to be conferred. While the venture may adapt to align with evaluator's logic temporarily, it is not necessarily a fixed gatekeeping requirement due to the pluralist nature of start-up legitimacy evaluations (Fisher *et al.*, 2017). As a result, translation in the STI sense is different from bridging.

The bare minimum alignment needed for legitimacy can be negotiated through standards adoption (Zimmerman and Zeitz., 2002). Standards are a type of boundary object that specify the normative expectations and rules in a field as well as bridge the gap between the venture's innovation logic and the evaluators' commercial logic (Star and Griesemer., 1989; Bitektine and Haack., 2013). They provide the cognitive benchmarks against which an evaluator can assess the propriety of a new venture's practices. In the context of the Internet of Things (IoT), these processes of standard creation and adoption emerge as a central mechanism of boundary work, where ventures may selectively defend their distinctiveness while negotiating alignment with established technical norms to secure resources (Snihur., 2016).

In the IoT domain, technical standards such as those issued by ISO or ITU or IEEE, function in three distinct ways. Firstly, standards provide a shared context on the basis of which further boundary work can take place (Star and Griesemer, 1989, pp. 408–411). Secondly, standards serve as institutionalized templates that define the normative expectations of a field (Bitektine and Haack., 2013). Standard compliance can help ventures secure cognitive and regulatory legitimacy (Deephouse and Suchman., 2008). Thirdly, adherence to standards can provide ventures the license to operate in a specific industry or geography and improve interoperability with other ventures. Lastly, ventures can problematise standards at the artefact level such that other actors lend it pragmatic legitimacy and adopt it. In the previous two cases, standards lead to lock-in and subsumption of

adoptees role within the standard network. In this way, standards can be boundary objects that function as regulatory devices as well as obligatory passage points (Callon, 1986., p.205). In this thesis, specifically analysis in Chapters 4-5, standards emerge in all three roles. Here, standards are a means for start-ups to shape governance within a sector through boundary creation, demonstrate compliance and gain legitimacy through boundary management.

2.4 Synthesis and Conclusion

IoT has a legitimacy problem. IoT's interpretive flexibility and semantic confusion make legitimation especially difficult; evaluators lack established mental models. Novel IoT BMs lack institutional templates, and ventures must construct multiple legitimacies (venture, product, technology, ecosystem, industry) before multiple evaluative audiences simultaneously. Legitimacy is a crucial resource for IoT organisations, specifically start-ups due to added layers of complexity. Start-ups need to get legitimacy for their identities, their products, BMs and the venture itself (Figure 6). This research considers that IoT start-ups face challenges when they go about seeking resources from resource providers and they try to address these challenges through mechanisms of boundary work (Figure 4). Boundary work is a form of negotiation and interaction between various groups across boundaries. Entities can work through various mechanisms as discussed in the previous sections to influence identities, power, competence and efficiency. Further, there are multiple types of organisational boundary work that impact the formation and revolution of organisations and their entities (Langley *et al.*, 2019) This research specifically considers that boundary work is a form of organisational work undertaken by ventures in pursuit of legitimacy (Lawrence and Phillips, 2019). These organisations adopt various practices, strategies and mechanisms at organisational, institutional and artefact boundaries that lead to legitimacy.

2.4.1. Literature Review to Framework:

Neo-institutional accounts of legitimacy over-emphasise stability, conformity and diffusion and consequently under-theorise how new categories of actor come into existence and how institutional configurations are destabilised and reconstituted (Meyer and Rowan, 1977; DiMaggio and Powell, 2000; Abbott, 1992). For a study of ventures operating in an emerging, contested and poorly defined category such as IoT, this is a key limitation. Current studies on new venture legitimacy suggest

that start-ups employ conformance or selection strategy to gain legitimacy since they do not have the influence or resources to employ creation and manipulation strategies (Zimmerman and Zeitz., 2002). Furthermore, as new venture identity shifts across the venture lifecycle, so do the legitimacy thresholds and states. However, temporal and spatial dynamics of legitimacy remain underexamined (Fisher, Kotha and Lahiri., 2016). From an entrepreneurship literature standpoint, the processes underpinning investor, accelerator and customer impact on shaping ventures remain underexplored qualitatively (Mason & Stark, 2004; De Clercq & Manigart, 2007; Gordon, 2014). Studies on the legitimation processes start-ups undertake while engaging with accelerators is limited (Neuberger et al., 2024).

Existing studies on boundary work and legitimacy are largely single-case accounts of a particular role or sector (professional service firms; climate change, science-policy), showing *that* different types of boundary work relate to legitimacy without establishing *which types* of boundary work produce which legitimacy outcomes. By examining multiple venture cases, this thesis contributes to prevailing literature by showing the various triggers, enablers and mechanisms of different types of boundary work and legitimacy outcomes associated with each type. Boundaries are said to precede entities and change (Abbott., 1995). Limited studies have found that boundary work is a mechanism through which legitimacy is extended, defended or claimed (Langley et al., 2019). Creation of new boundaries leads weaker groups like new ventures to demarcate with bridging towards incumbents (Santos and Eisenhardt., 2009). Ambiguous boundaries are used to accommodate divergent constituencies sometimes destabilizing legitimacy (Langley et al., 2019). This thesis aligns with these studies on these accounts. These studies, however, assume the start-up is the focal actor in category creation. In doing so, they neglect the role of interactions with other actors, of alliance power mechanisms, and of venture boundaries in flux — all of which shape venture identity, category and adoption (Santos and Eisenhardt, 2009, Glynn and Navis, 2013, Durand and Thornton., 2018; Pandey and Stein., 2023). Role of consumers in boundary work is underexplored. Boundary work's impact beyond individual level is underexplored (Faulconbridge, Sarwar and Spring., 2023). In most other studies on boundary work and legitimacy, legitimacy functioned as a background condition for role survival or effectiveness (Palmer, Owens, Doubleday., 2019; Garud, Gehman and Karunakaran., 2014; Faulconbridge,

Sarwar, Spring., 2024). This thesis instead foregrounds legitimacy itself as the outcome of interest, showing how new ventures achieve or fail to achieve legitimacy. Existing literature examines boundary work within organisations that already possess an established, socially recognized template (Santos and Eisenhardt., 2005; Santos and Eisenhardt., 2009; Langley et al., 2019 ; Palmer, Owens, Doubleday., 2019; Garud, Gehman and Karunakaran., 2014; Faulconbridge, Sarwar, Spring., 2024). New technology ventures have no such pre-existing templates and legitimacy must be constructed from scratch and then managed. Current literature's boundary-work accounts are episodic (Palmer, Owens, Doubleday., 2019; Garud, Gehman and Karunakaran., 2014; Faulconbridge, Sarwar, Spring., 2024). This thesis instead follows ventures across their life, showing that different stages of venture lifecycle are characterized by different boundary work.

Drawing from these accounts, this thesis considers that ventures and the IoT category itself are outcomes of ongoing boundary work, conceptualising legitimacy as an emergent, iterative effect of boundary work performed by ventures in interaction with their evaluative audiences. This thesis will show how ventures change boundaries in interplay with evaluators and its consequences for legitimacy.

2.4.2 Selection, Prioritisation and Exclusion of Concepts

Concept selection was guided by explanatory value for the research questions, and ontological fit with the processual, critical realist orientation set out in Chapter 3. Five concepts are retained; each assigned a distinct analytical role (Table A). Legitimacy the goal, the outcome of the process where entrepreneurs, new ventures and audience take efforts in order to align and evaluate. It is attained through the process of evaluative judgement called legitimation (Suchman, 1995; Suddaby, Bitektine and Haack, 2017). Following the justification developed in Section 2.2.3, cognitive and pragmatic legitimacy serve as the primary analytical lenses, because the dominant challenges facing IoT ventures concern comprehensibility and demonstrable exchange value, while normative and regulative legitimacy operate as secondary lenses engaged where values conflicts and regulatory conformance surface empirically. The distinction between individual propriety judgements and collective validity is used when showing

specific evaluator assessments that yield deals versus evaluator assessments facing wider audiences and assessments in mainstream media like trade magazines (Bitektine and Haack, 2017). Investors, accelerators and customers are all key evaluators whose judgements are considered key in this thesis while mainstream media is considered a proxy for the targeted audience like industrial customers or users. Identity was a key theme emerging from the data However, it was later dropped in favour of boundary due to its prevalence in the data and theoretical position as a predecessor to identity(Figure 4). IoT ventures seek legitimacy by complying with pre-existing norms or creating new norms. They have to consistently manage evaluator expectations to avoid stigma or delegitimation. They need to collaborate at the venture and artefact levels in order to deliver value to their key stakeholders. That is where boundary work comes in as a sensitising device initially and then a central explanatory concept because it captures agency, process and relational negotiation in a setting like IoT where entities are constantly changing (Gieryn, 1983; Abbott, 1995; Zietsma and Lawrence, 2010; Langley et al., 2019). Boundary creation, management, bridging and blurring are core to the thesis and emerged through iterative coding of the data (section 3.6). These forms of boundary work are not new but anchored in literature (Gieryn, 1983; Zolberg and Woon, 1999; Langley et al., 2019; Faulconbridge, Sarwar and Spring., 2025) . However, there is no consensus on the definitions of these boundary work. Other types of organisational work include technology and values work as discussed in sections

Boundary work is an explanatory concept because it captures process, agency, power, and relational aspects that are key to legitimacy, especially in contexts like IoT where entities are constantly changing (Gieryn, 1983; Abbott, 1995; Zietsma and Lawrence, 2010; Langley et al., 2019). This thesis identifies the key mechanisms, triggers, and enablers that lead to legitimacy; boundary creation, its management, bridging, and blurring are central to this (Table 6). Boundary work involves activities carried out on, at, or through boundaries, a descriptive concept included here. The types of boundaries discussed across the literature are classified based on what is being worked upon, resulting in symbolic and objective boundaries, as well as qualities such as sharp, blurred, porous, or bright (Lamont and Molnár, 2002; Lamont, Pendergrass, and Pachucki, 2015; Zolberg and Woon, 1999), or by purpose, such as influence, competence, and identity (Santos and Eisenhardt, 2005). The boundaries examined in this thesis occur at three levels of

analysis: institutional, firm, and artefact. Ventures work on boundaries in interaction with their evaluators—namely, investors, venture development organisations (including accelerators), and customers. These audiences link the boundary work mechanisms to legitimacy outcomes. The concept of evaluators is selected due to the second research question, which investigates how these actors contribute to legitimation (Fisher et al., 2017). Artefacts are sensitising devices that include pitches, prototypes, proofs of concept, and BMs (Star and Griesemer, 1989; Bechky, 2003; Berglund and Glaser, 2022).

Concept	Role	Description	References
Boundary work (creation, management, bridging, blurring)	Explanatory	The central mechanism through which ventures act on boundaries to produce legitimacy outcomes; organises Chapters 4–7	Gieryn (1983); Abbott (1995); Zolberg and Woon (1999); Zietsma and Lawrence (2010); Langley et al. (2019); Faulconbridge, Sarwar and Spring (2025) (Sections 2.3.4–2.3.6)
Boundary (symbolic, social, objective; institutional, firm and artefact levels)	Descriptive	Classifies what is being worked upon and at what level; supplies the units of observation and comparison	Lamont and Molnár (2002); Santos and Eisenhardt (2005); Lamont, Pendergrass and Pachucki (2015) (Sections 2.3.1–2.3.3)
Legitimacy (cognitive and pragmatic as primary lenses; normative and regulative as secondary)	Outcome	The explanandum: evaluative judgements rendered by audiences, treated as a process rather than a static property	Suchman (1995); Deephouse and Suchman (2012); Suddaby, Bitektine and Haack (2017); Bitektine and Haack (2017) (Sections 2.2.1–2.2.4)
Evaluative audiences (investors, accelerators and venture development organisations, customers)	Linking	Connects mechanism to outcome: audiences render the propriety and validity judgements through which boundary work becomes legitimacy	Fisher et al. (2017); Bitektine and Haack (2017); Shane and Cable (2002) (Section 2.2.2)
Artefacts (pitches, prototypes, PoCs, BMs, standards)	Sensitising	Directs attention to the material and discursive sites where boundary work is performed and observed	Star and Griesemer (1989); Bechky (2003); Akkerman and Bakker (2011); Berglund and Glaser (2022) (Section 2.3.5)

Table 6 Selected Concepts

Isomorphism and diffusion are excluded because they are grounded in stability and settled fields while the key assumption here is that ventures are constantly changing and so is their legitimacy(Meyer and Rowan, 1977; DiMaggio and Powell, 2000) Second, the institutional logics perspective is only used as a vocabulary and not a central explanatory concept because the analysis is being conducted beyond institutional level, but also venture and artefact level (Thornton, Ocasio and Lounsbury, 2013) Third, categories are excluded since we assume that category is an outcome that the boundary encloses and boundary overarches category and identity within it (Navis and Glynn, 2010, 2011; Grodal, 2018) Boundary-spanning and boundary organisations are excluded because they primarily focus on individual roles and interstitial organisations (Aldrich and Herker, 1977; Guston, 2001). Instead, any intermediaries here are analysed as evaluators.

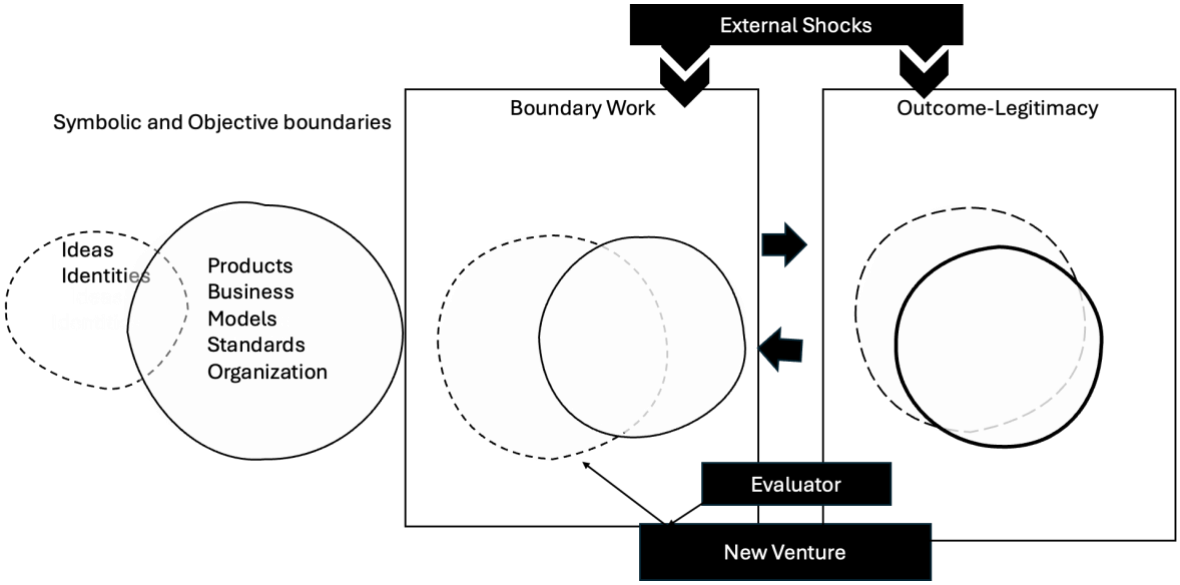


Figure 10 High Level Framework

2.4.3 The Framework

The framework is a three-layer configuration. The descriptive layer specifies boundaries of particular types (symbolic, objective) around particular objects (ideas, identities, products and technologies, BMs, institutions) at particular levels (institutional, firm, artefact). Boundary work is the explanation about how ventures act on those boundaries and the role played by the evaluating audience in this process. The outcome layer specifies legitimacy outcomes that are rendered by particular audiences. Both ventures and evaluators link the boundary work layer to the legitimacy layer since it is their judgement and actions that lead to further legitimacy or boundary work. Since legitimacy is essential for new venture survival, these ventures need to partake in this process time and again or

they might lose the legitimacy they have gained due to external or internal impact(Aldrich and Fiol., 1994). External shocks such as COVID-19, supply chain disruption and geopolitical instability are triggers of boundary work. A venture may lose its legitimacy because of the shock because of change in evaluative criteria (Tost., 2011). It can also be an enabler for legitimacy (Kimjeon and Davidsson, 2022). This framework is further developed empirically in Chapter 8.

The framework directs observation to kind of boundary work is being done, the boundaries being worked on, the role of the venture and founder, which audiences are evaluating the boundary and their role in the boundary work and last, what is the legitimacy outcome. These questions structured the additional literature review and secondary material in chapter 3. The twenty cases were selected based on purposeful sampling approach, their selection and analysis based on this framework are discussed further in section 3.3. and 3.4

2.4.4 Improving analytical focus.

Each element of the framework is necessary for the research questions. The first research question – "How do IoT-based ventures legitimise themselves and their BMs?", requires a process undertaken by the new ventures (boundary work) which can lead to legitimacy outcomes. Artefacts include BMs. BMs and products co-evolve (Figure 5). As discussed in 2.3.4., prototypes, pitches, documents are also artefacts. The boundaries of these artefacts are worked on and changed continuously.

The second research question focuses on legitimacy, evaluators and artefacts. Business Models (BMs) and products are themselves artefacts whose boundaries are worked upon. The second research question – "How do investors, enablers like venture development organisations and customers contribute to this process of legitimisation?" – requires the evaluators' concept. Moreover, new ventures interact with these actors who are outside the boundaries of the organisation. It is already known that legitimacy requires alignment with evaluators. It follows that IoT-based ventures would have to change in order to align and be accepted by the evaluators. Based on the research questions and the key concepts mentioned in the framework, the theoretical lens is narrowed. Chapter 2 reviewed multiple legitimacy types, sources, states and strategies, boundary types, boundary work types, categories, logics, identities, boundary spanning, boundary

objects, translation, among others. Only five selected concepts were used to further analyse the data. The rest of the concepts have been used as vocabulary, such as logics, translation, or subsumed under boundaries, such as category and identity. The cases mentioned in Chapters 4-7 all show instances of boundary work to gain legitimacy or as a response to the external environment, including key evaluators. For the first question, the focus shifts to the entrepreneur, the founder and the venture, as they work on boundaries at different levels to gain acceptance, assume power, and manage the external environment. For the second question, the focus is on the evaluators, their expectations, their actions and utterances, and the venture's responses through action or rhetoric. The legitimacy outcomes, as defined in the framework, include the types of legitimacy, propriety or validity judgements, acceptance, approval, taken-for-grantedness, as well as stigma, delegitimisation, legitimacy lies, legitimacy hacking, etc., which are failure outcomes of boundary work. These instances of boundary work failure are shown in Chapters 6 and 7 and consolidated in Chapters 8 and 9.

3: Research Design

This research adopts a critical realist philosophical stance to study the boundary work mechanisms and processes underpinning the legitimisation of IoT-based new ventures and their BMs. The research approach is qualitative and inductive. Multiple case study research design was chosen and data was collected in the form of primary semi-structured interviews, secondary documents and grey literature. The subsequent sections discuss the above-mentioned aspects in detail.

3.1 Research Aims and Objectives

The overarching aim is to show how IoT based ventures legitimise themselves and their business models and how investors, enablers like venture development organisations and customers contribute to this process of legitimisation. Based on this, the researcher has developed a theoretical model of the boundary work undertaken by IoT start-ups to achieve legitimacy outcomes. Boundary work is a form of socio-symbolic work and refers to the efforts undertaken by IoT start-ups to navigate complex and uncertain institutional environments and acquire legitimacy (Suchman, 1995; Zimmerman and Zeitz, 2002; Aldrich and Fiol, 2007; Lawrence and Phillips, 2019). IoT ventures are said to have a high mortality rate due to numerous obstacles in their endeavours to attain legitimacy. Further, start-ups developing IoT based products or IoT technologies need to undertake legitimation across venture, technology and sector levels due to their identity as resource constrained new ventures operating in a complex, multilayered sector with multiple moving parts and its potential for disrupting prevailing institutions. The questions this thesis is addressing are the following -

- How do IoT based ventures legitimise themselves and their business models?
- How do investors, enablers like venture development organisations and customers contribute to this process of legitimisation?

Further, based on the above questions, additional sub-questions are addressed - What are the legitimacy challenges faced by IoT based start-ups? How do start-ups manage these challenges? How do investors, accelerators and customers influence this process? How do IoT start-ups gain legitimacy or acceptance from investors, accelerators and customers? How are IoT start-up technology and BMs

legitimised by investors, accelerators and customers? What are the types of boundary work start-ups engaging in, in their pursuit of legitimacy? How do IoT based start-ups creating disruptive new technologies or new categories generate legitimacy? How do IoT based start-ups manage distinctiveness and conformance to prevailing institutional norms?

Expanding upon these research questions, this thesis shows how new ventures go about the boundary creation, management, blurring and bridging processes at sector, venture and artefact levels to gain legitimacy. The key constructs of the research questions are shown below.

Notion of Question	Constructs
Why	• IoT • Artefacts - BMs, Products, Technology. • Power - Collaboration • Founder Background • Role of investor/accelerator/partner • Role of Environmental Changes
What	• IoT • Challenges • Artefacts - BMs, Products, Technology. • Interviewee Background • Role of Environmental Changes
How	• Organisational Work • Narratives • Role of investor/accelerator/partner • Artefacts - BMs, Products, Technology.

	● Power - Collaboration ● Role of investor/accelerator/partner ● Role of Environmental Changes

Table 7 Research Question Constructs

3.2. Research Philosophy and orientation

A research philosophy is a system of beliefs and assumptions possessed by the researcher that guides their research process (Saunders, Lewis and Thornhill, 2019). These assumptions include those dealing with the nature of reality (ontological), the nature of knowledge (epistemological) and values held by the researcher (Saunders et al., 2019). Ontological assumptions about the nature of reality can lie within the continuum between extreme ends of objectivism (reality is external to the individual) and subjectivism (reality is based on an individual's ideas and actions). Objectivism embraces realism, while subjectivism embraces nominalism (Saunders, Lewis and Thornhill, 2019), between these two ends lie internal realism, and relativism (Easterby-Smith et al, 2010). Realism considers reality and our understanding of it to be one and absolute, internal realism views reality to be absolute but understanding of its structure is considered to be dependent on the individual's mind, relativism views reality as dependent on the eye of the observer, nominalism believes reality to be a creation of the human mind and as such there is no 'truth'.

Epistemology comes from the Greek word "Episteme" which means 'knowledge' and "Logos". which means 'science of'. Epistemological assumptions lie on the continuum between strong positivism and strong constructivism. (Easterby-Smith et al, 2010). Positivism is the idea that the knowledge about the external world can be measured objectively, social constructivism is the idea that reality is constructed by people and thus its knowledge can be inferred by studying their experiences and how they make sense of their reality. Positivists believe that knowledge can be acquired by examining evidence which is empirical and by testing hypotheses while constructivists believe that reality is too complex to be known. Strong positivism is linked to realism, positivism to internal realism,

constructivism to relativism and strong constructivism to nominalism. (Easterby-Smith et al., 2010).

Both objectivism and subjectivism have been criticised in the past due to their reductive nature, by reducing reality into smaller components or subjective experience (Carless-Kane and Nowell, 2024). Further, they do not contribute to explanations of causality. In positivist research, reality of something is established based on the measurement tools and methods, but not by researcher's interpretation or involvement (Alvesson and Sköldberg, 2018; Carless-Kane and Nowell, 2024). On the other hand, in constructivist research, the production of knowledge is based on experiences, limiting generalisability (Saunders, Lewis and Thornhill, 2019). Critical realism emerges as a response to these criticisms as it acknowledges the importance of both observations and interpretations. It occupies a middle ground between objectivism and subjectivism and has a focus on powerlessness or power (Easterby-Smith et al.,2010). Critical realism's structural ontology differentiates between three levels – Empirical, which comprises the experiences and perceptions that people have; Actual, which comprises the events and actions that take place whether they are detected or not and Real which comprises causal powers and mechanisms which cannot be detected directly but have real consequences (Bhaskar, 2013).

This research will develop a theory on the phenomenon of IoT based new venture legitimation and boundary work and the role played by key evaluators. It will look at practice and policy-based outcomes since it is focused on the work undertaken by start-ups and the role played by key evaluators which has important takeaways for practitioners and policy makers. It is grounded in the rich experiences of the interviewees as well as the data gleaned from podcasts, videos, texts and documents. It has been established that IoT based venture legitimation is a multilevel process as the start-ups need to establish legitimacy at artefact, venture and institutional levels. Legitimation is considered to be a multilevel process of propriety, consensus and validity (Bitektine and Haack, 2015). In addition, boundary work is a phenomenon of negotiation and interaction between various social groups and thus the role of power comes into play since groups in power dictate the evolution of the boundaries on which they work. Those seeking resources and approval need to align with those granting those resources and

approvals. This also dictates the creation of products and technologies that have a massive impact on users and adopters but also follow the processes laid down by expert groups who provide the resources to bring these products to reality. With this background, it follows that a positivist lens is not suitable since it reduces a complex and contextual process of IoT based new venture legitimation into performance metrics or qualification criteria. On the other hand, the use of an interpretivist lens is also not suitable since the research seeks to incorporate aspects of institutions, norms and power structures and not just accept the research participant's interpretations. This research follows a critical realist paradigm since by using it researchers can provide a deeper, more contextual explanation of the phenomenon under study, moving forward from describing it.

3.3 Research Strategy:

The research approach adopted was a qualitative, inductive approach. The thesis uses a multiple case study approach (Eisenhardt, 1989; Yin, 2003; Eisenhardt and Graebner, 2007). Data was analysed using thematic analysis (Braun and Clarke, 2022).

3.3.1 Data Collection Process:

The data was collected from start-ups that use or have used IoT for developing their products or those start-ups that have developed or are developing IoT technologies. Despite no consensus on working definition of IoT across standard bodies, the processes of connecting, sensing, collecting and processing are common (ISO/IEC 20924 and ITU-T Y.2060) (Atzori et al., 2017). Synthesising these, this thesis adopts the following working definition –

"an IoT-based venture is one whose value creation mechanism involves a combination of the following - physical hardware with sensing and/or actuation capability, networked connectivity, the collection or processing of data that bridges the physical and digital environments."

On this basis, the following venture types are excluded as non-IoT: pure software or SaaS platforms with no physical sensing layer; solutions that process existing

data without generating it through physical sensing hardware; general-purpose computing devices (smartphones, laptops) whose internet connectivity is incidental to sensing or actuation; and traditional internet or mobile applications without a hardware component.

Drawing from the research aims, criteria for cases were broadly defined as

1. Start-ups that use IoT technologies for building products and services and have been funded since investor funding implies that the investors find the start-up's offering appropriate and promising. This signals an endorsement of the venture's capability and opens it up to positive future propriety judgements (Bitektine and Haack, 2015).
2. Start-ups developing IoT technologies that have been funded as it indicates an investor's willingness to risk supporting the creation of a foundational technology that may have a longer return on investment time frame indicating legitimacy.
3. Start-ups developing or using IoT that have been strategically acquired as this implies that an established firm has evaluated and validated the technology leading to broader acceptance from the field.

All of these start-ups had gone through the usual stages of venture and product development including research, experimentation, idea validation and feasibility analysis, team building, prototyping, application and selection for funding and acceleration. Some were more advanced than others, having gone through processes of product market fit, BM design, creation of a board, pilot testing, partnership creation, business development and sales.

3.3.2 Sampling Strategy

Based on the established criteria, data collection followed a purposeful sampling approach (Yin, 2011). This study is based on 20 in-depth case studies of companies in Europe, Asia, Africa and North America (Table 8)(Table 9). Primary data in the form of interviews was collected from founders and senior leadership of the identified start-ups. In addition, primary data in the form of interviews was collected from investors and accelerators based on the research aims mentioned

in the study as well as IoT experts for context. Primary data collection took place between 2021-2023 while secondary data collection took place between 2021-2024.

The strategy for participant recruitment followed a three-pronged approach (Figure 11): gatekeepers, social media and in-person events. First, based on grey literature searches and prior knowledge, well-known tech accelerators, investors and start-up ecosystem players were approached through referrals, social media and in-person events, both as interviewees and as potential gatekeepers. Those who agreed to act as gatekeepers were asked to recommend start-ups meeting the pre-determined criteria and to make introductions to some previously identified start-ups. These recommendations were filtered against the criteria before the start-ups were contacted, producing a snowball effect: each gatekeeper is mapped to its signposted and portfolio start-ups in Table 8. In total, 14 of the sampled organisations were recruited this way. Second, where accelerators and investors agreed to be interviewed but declined to act as gatekeepers, their portfolios were examined, relevant start-ups were identified against the same criteria, and these start-ups were approached directly over LinkedIn or email. Third, some accelerators, investors and start-ups were approached face-to-face at technology events, based on prior research on key attendees published on event websites; further start-ups were identified through initial and follow-up conversations during networking sessions at these events.

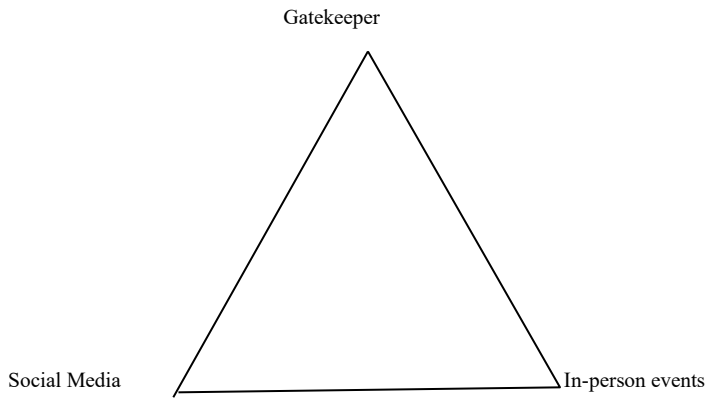


Figure 11 Approaching participants

Out of the sample, 14 organisations were recruited through gatekeepers.

A total of 50 start-ups, 15 investors and accelerators and 2 experts were approached in these ways. Out of these, 20 start-ups, 8 investors and accelerators, 2 experts agreed to be interviewed for the purposes of this research through face to face or online video or audio interviews over videoconferencing tools.

Gatekeeper	Signposted Organisations
Gatekeeper 1	Hardware Accelerator and Fund (1)
Gatekeeper 2	Accelerator (1)
Gatekeeper 3	Early-Stage Tech Investor (1)
Incubator and Investment Firm	Innovation Ecosystem Experts 1 and 2 (2)

Table 8 Gatekeepers to experts, accelerators and investors

Gatekeeper	Signposted Start-ups	Portfolio Start-Ups
Corporate Accelerator	CleanCooking (1)	Monitor (1)
Hardware VC and accelerator		HVACHealth, BabyCradle, Monitor, AgeMonitor (4)
Tech Investor		WaterSensor (1)
Hardware Accelerator and Fund		TrafficIoT, YourPleasure, WiseBees (3)
Not for profit Accelerator		BabyWearable (1)
Incubator and Investment firm	FullBattery, Nexum, TrackingParcels (3)	
Innovation Ecosystem Expert	RoboticMeasurement (1)	

AgeMonitor	AgeObserve (1)	
Accelerator and Innovation Platform	BabyCradle, MotherHealth (2)	
Gatekeeper 3	SkyTaxiInfra (1)	

Table 9 Gatekeepers to start-ups

For each case, a table of primary references was created including interviews and secondary and grey literature references that included blogs, newspaper articles, reports, policy articles, podcasts and videos available in the public domain. A total of 50 interviews were conducted with 35 interviewees. A total of 11 hours and 36 minutes of pitches, marketing videos, podcasts were analysed. A total of 74 secondary and grey literature *documents(blogs, news articles, other documents)* comprising 79150 words were analysed. Overall, a total of 812493 words across primary and secondary data were analysed.

Data Type	Pitch Transcripts	Podcast Transcripts	Video Transcripts	Blogs	News Articles	Other Documents	Total
No of documents	20	13	43	34	15	25	150

Table 10 Secondary Data Types

The composition of the case portfolio allowed for contextual variation, typological coverage and theoretical replication. Cases were considered based on venture stage allowing for comparison from pre-seed to publicly listed. Second, BM orientation (B2B and B2C) exposes ventures to different evaluative audiences and hence to different judgement dynamics. Domain of application varies in regulatory density, from lightly regulated consumer settings to heavily regulated marine, aviation and health contexts. Fourth, geographic spread is across Europe, North America, Africa and Asia. Fifth, outcome variation – includes two ventures that failed, ventures that were acquired and one that listed – these are the deviant cases. Comparison across the portfolio therefore follows a replication logic (Yin, 2011). All sampled ventures develop hardware-dependent IoT offerings, the design also permits practices tied to IoT's material specificity like management of the

hardware-firmware-software stack, blurring of physical and digital realms, data affordances and their panoptic potential ,to be distinguished from practices general to technology start-ups such as evaluator alignment, pitch adaptation and incremental validation.

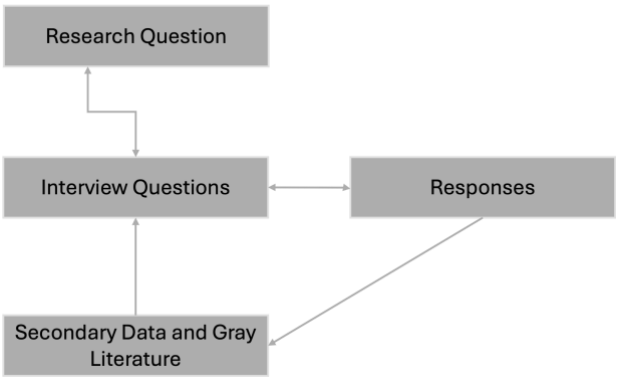


Figure 12 Interviewing process

Preparation is the first step in data collection (Yin, 2011). In line with the recommendations for preparation, the researcher followed the creation of interview schedules for the two different types of data sources, sought consent well before beginning the interview process and created pseudonyms to mask the identities of the organisations (Table 11)(Table 12). In some cases, the interviewer had to first engage with the participants over multiple meetings and emails to gain access to them. These meetings served as another source of information on the participant which helped with preparing prior to the interview. The interview schedule was centred around the themes of IoT, organisational work, BMs, governance, power, leadership and narratives/rhetoric. The questions were open ended that encouraged follow up questions. A corpus of the collected data was created with description of each file, URL links where needed, number of words and duration.

The semi-structured, in-depth interviews were started just at the end of 2022 when the world was still dealing with the aftermath of COVID-19 including the adoption of remote working practices such as video calling. Interviewees were experts and elites who were well versed and comfortable in using communication tools like Microsoft Teams in their daily work. Furthermore, the interviewees were all geographically dispersed. As a result, all interviews had been conducted on

video with the exception of 1 (IoTSecurity) where the interviewee had expressed a keen interest to have an in-person interview at their office.

Interviews were initially recorded and transcribed using Microsoft Teams, an institutionally provided tool with 80–85% accuracy that notifies all participants when recording begins; however, its transcripts required significant editing for interviewees with non-American and non-British accents. The researcher therefore switched to Otter, an AI-based transcription tool with approximately 90% accuracy that performed well across accents, and also used it to transcribe secondary and gray sources such as podcasts and videos where transcripts were unavailable.

While most of the interviews were conducted on video, in some cases the interviewees expressed challenges with bandwidth due to their location and the interview proceeded as an audio interview. Rapport was built during the interview through lexical reformulation and rephrasing (Prior, 2018). Secondary data and grey literature where available about each organisation was studied before the interviews to prepare for the interview and gain a better understanding about venture and the core offering (Yin, 2011)

3.4 Data Analysis

The choice of method of analysis was guided by the research questions, multiple-case qualitative research design and the data being collected. The data was textual. Thematic analysis relies on coding to identify themes within a text (Braun and Clarke, 2022). Data analysis was iterative. Data collection and analysis were undertaken in parallel. An emerging theme in the data set was boundary work. Literature on boundary work was then studied to establish the role of boundary work in legitimation. In subsequent coding rounds, analytic codes, descriptive and in-vivo codes were used, then grouped into themes.

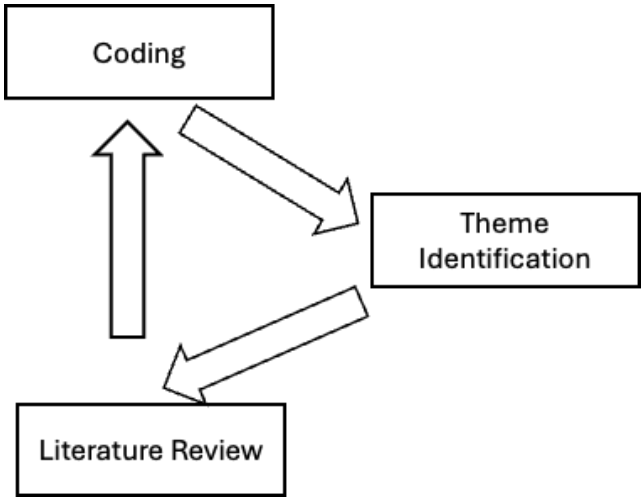


Figure 13 Iterative process of theme identification

Data was initially analysed using NVivo 12 and 14 software, but the researcher moved to Atlas.ti due to its speed, user friendliness and intuitive interface. The codes and data were exported to Atlas.ti and the coding process was resumed.

Coding and interpretation followed the following steps. First, pitches, prototypes, proofs of concept, BM documents, standards – and the activities surrounding them were identified in interview, secondary data and grey literature. Second, these activities were coded in vivo and descriptively. Key emerging aggregate themes were identified which were then contrasted with key themes in legitimacy literature (Gioia, Corley and Hamilton, 2013). Boundary work was identified as a common theme emerging from the data. So, the practices were aggregated into boundary work mechanisms. Based on further study of literature (section 2.3) and understanding of data, the mechanisms were classified into boundary creation, management, bridging and blurring. Fourth, evidence of legitimacy in the form of selection, funding, partnership formation, adoption, rejection or withdrawal was coded based on organisations' account, investor and venture development organisations' accounts and secondary data on audience responses. This was also recorded in memos (Example – Appendix - A1).

Consistent with the critical realist stance, the four forms of boundary work are treated as real mechanisms inferred from the observed events at the empirical level. Causal claims in Chapters 4 to 8 therefore take a processual form – trigger,

enabling conditions, work performed, changes in expectations, meaning, authority and power, evaluator outcomes.

Case	Interviewee Designation	# interviews	Founded Year	Company Status
BabyWearable	CEO and Founder	2	2017	Failed
Monitor	CEO and Founder	2	2013	Pre-Seed
YourPleasure	Co-Founder	1	2021	Seed
FullBattery	CEO and Cofounder	1	2016	Seed
WiseBees	CEO and Cofounder	1	2020	Seed
BabyCradle	Chief Growth Officer	1	2018	Seed
MarineMeasure	CTO and Cofounder	1	2005	Acquired
RoboticMeasurement	CEO	2	2019	Pre-Seed
CleanCooking	CEO and Cofounder	1	2021	Seed
Nexum	Business Development Head	3	2010	Series A
MotherHealth	CEO and Founder	2	2016	Seed
SkyTaxiInfra	CEO/ Business Development Manager	2	2019	Series A
TrackingParcels	CEO and Cofounder	2	2014	Acquired
AgeMonitor	CEO and Cofounder	1	2019	Seed
IoTSecurity	Founder	1	2015	Seed
HVACHealth	CEO and Cofounder	1	2016	Failed
AgeObserve	CEO and Founder	3	2019	Pre-Seed
AIBlockchainIoT	CEO and Founder/CTO (switched positions with organisational change)	2	2015	Exit

TrafficIoT	CEO	1	2016	Listed
Water Sensor	CEO and Cofounder	1	2016	Seed
31				

Table 11 Summary of Case Interview

Sr #	Pseudonym	Category	Designation	# interviews
1	Corporate Accelerator	Accelerator Corporate	Program Managers 1 and 2 Internal Mentor External Mentor	6
2	Early-Stage Tech Investor	VC	Partner	1
3	VC-Start-up agency	Platform	Director	2
4	Hardware accelerator arm of VC firm	VC and accelerator	Program Director Mentor	3
5	Hardware accelerator with seed fund	Accelerator and Fund	Founder Partner	1
6	Not-for-profit IoT accelerator	Accelerator	Founder Partner	1
7	Incubator and investor	Incubator and investor	Head	1
8	IoT accelerator, incubator and innovation platform	Accelerator and platform	Head	2
9	Intelligent Machine Ecosystem	Innovation Ecosystem funded by government	Secretary General	1
10	Imaging Ecosystem	Innovation Ecosystem funded by the government.	Head of ICT	1
	Total Number of Interviews			19

Table 12 Expert and Elite Interviews

3.6.1 Rigor

To assess the rigor of the analysis, trustworthiness criteria - credibility, transferability, dependability and confirmability were kept in mind (Lincoln and Guba, 1986). Along with construct validity, internal validity etc. To ensure credibility, the researcher used data triangulation as discussed earlier. This also ensured construct validity of the case studies (Gibbert and Ruigrok, 2010). To ensure internal validity, findings were qualified based on their applicability across multiple cases. This is also used to counter the issues with generalizability in critical realist research. In addition, there was a collection of similar and extreme cases across the sample. To ensure transferability, thick descriptions were used to describe each case in a tabular format as well as use of quotes throughout the findings chapters (Pratt, 2009) For dependability, memos (example - A1) were used during data collection and analysis and all the transcripts and files were stored in single location(Lincoln and Guba, 1986). For confirmability, rich quotes were used during the writing process. The analysis of 20 start-up case studies provides ample ground for generalization (Eisenhardt, 1989; Gibbert and Ruigrok, 2010). These firms operated in different industries, countries and markets. Further, the founders had a wide variety of experience - some were highly technically experienced and qualified, and some had no experience, some had experience in their chosen industry while some didn't. All these start-ups had different starting points. There are some commonalities between the cases, such

as B2B/B2C BM, recurring revenue model, funding, target market such as BabyWearable and BabyCradle or AgeMonitor and AgeObserve that justifies the replication logic requirement (Yin, 2013).

3.5 Ethical Considerations and Reflections

Any ethical concern was mitigated through the use of participant consent forms in accordance with the university requirement. In addition, anonymization of participant data took place. Participant and organisation names were pseudonymized and any labels that might betray their identities such as name of consortia were renamed. Furthermore, the participants were fully informed by email that while the data would be recorded, their data would be anonymized at the outset itself. Lastly, the research context, approach and design all point to low ethical risk.

The data collection process followed in this thesis was made smooth due to the connection to the start-ups through gatekeepers as well as the targeted email sent out to the prospective participants about the purpose of the research, the EU project which the research was a part of and the background of the researcher. Participants showed keen interest in the outcomes of the research and encouraged the researcher to share the research on completion. This highlights the potential of this research to have some application for practitioners. However, entrepreneurs previously associated with failed start-ups did not respond to repeated interview requests, understandably due to the stigma associated with failure. This additional category would have added to the richness of the data. On deeper probing, one of the start-up founders admitted to having been ousted from his own organisation as CEO and given the role as CTO based on investor demands due to the VC's disinterest in IoT. This brought in an interesting dimension to IoT legitimation and the roles the start-up founders play in order to manage their interests with demands of their stakeholders. During the research data collection process, two of the start-ups ceased operations due to change in ownership and bankruptcy, highlighting the precariousness of IoT based entrepreneurship and suggesting that even those that are legitimated within their ecosystems by virtue of funding and affiliation to known investors or accelerators, are struggling.

The research commenced during the COVID-19 pandemic, when the access to events for sourcing participants and seeking out in-person interviews was severely curtailed. In addition, in subsequent years as well, participants were wary of meeting in person unless absolutely business critical. The choice of research methods was also guided by this challenge. Additional circumstances temporarily limited collection and analysis of data between 2023-2024. Even so, the research has gathered rich data which leads to the conclusion that in specific contexts with the use of specific methodology, telephone or zoom data may work as well as in-person interviews without the additional costs.

Despite a mostly smooth data collection process, some of the research participants interviewed later, challenged that research on IoT had no future and suggested that the research shift focus to AI start-ups, alluding to the launch of ChatGPT in 2022. After much tension and consideration, it was decided to continue the research in the direction of IoT based start-ups since IoT's architecture both allows for the use of AI for presentation as well as feeds into AI. In addition, several of the start-ups interviewed claim to have used AI in their analysis of IoT data, so the findings from this study can also be compared against AI companies to assess if the findings still hold.

During the research process, reflexive iteration was adopted. Participant responses were echoed back to ensure correct understanding of the participant experiences. Further, memos during the interviews helped provide some additional context at the time of analysis. In some cases, the participants were asked for a second round of interviews to cover some outcomes and gaps from the previous rounds. The researcher found that the first two questions about the participant's own story and the origin story of the start-ups, laid a strong foundation for rapport building during the interview.

This research significantly benefited from its attachment to the EU project specifically with start-ups from EU or whose founders were originally from EU. In the other cases, the use of gatekeepers was supremely helpful.

4: Findings I: Creating Boundaries

4.1 Introduction

Ventures developing IoT based products need to legitimise IoT, the venture, the product, the BM and resulting changes in processes. They do this by drawing and extending boundaries around their frames and artefacts. In some cases, they also end up drawing boundaries around fields and redrawing boundaries around existing institutions. IoT start-ups undertake boundary creation to establish their authority and credibility. This chapter shows how IoT start-ups create new norms that establish new categories and fields and how they construct organisational boundaries. This chapter establishes the strategies used by ventures in creating institutional, ecosystem and practice boundaries. Industry boundary creation led to formation of new industry standards that dictated the rules of operation within a new category. Start-ups also contributed to the creation of new practices amongst adoptee organisations. Standards consensus and proliferation was achieved via the formation of an ecosystem either through ecosystemic BMs or consortiums where the start-ups served as central actors or complementors to central actors. The creation and evolution of IoT products developed by the start-ups also played a key role in the evolution of the standards. Start-ups were able to shore up power to contribute to the creation of new policies based on the role the start-up played in their respective ecosystem. In addition, this chapter shows how the triggers and enablers of boundary creation led to creation of venture identities, distinctiveness, opportunity recognition and status as technological credibility. Further, this chapter includes how the entrepreneurs perceive the role of their supervisory and advisory boards, and the roles played by boards and employees during the legitimisation process.

4.2 Creating Institutional Boundaries

Some of the start-ups constructed new institutional boundaries by leading or influencing creation of industry norms. SkyTaxiInfra was developing the underlying infrastructure for the nascent transport category of advanced air mobility and urban air mobility. By developing the central component for the air transport and through its efforts in engaging larger organisations from related aviation and automotive industries, the start-up was attempting to influence the evolution of

the new category. At the outset, the start-up focused on building consensus by providing an artefact used across industry groups.

> *"But the idea for us was to demonstrate that there could be a kind of concise and an integrated solution to the challenge, to demonstrate that and use that to inform the consensus process, to say - if you do this, this is what you get! And if it is not enough, let us expand on it and provide a valuable technological platform on which one could further develop." (SkyTaxiInfra CEO Primary Interview, 2023)*

The platform was meant to be a reference architecture for the members of the future air mobility ecosystem and fed into future decisions about design of other air traffic management systems. The founder claimed that the prototype would earn the venture entry into the industry's consensus process which was "the bet that we made when we started the company" (SkyTaxiInfra CEO Primary Interview., 2023). At this stage, however, the prototype carried no legitimacy of its own. The venture's claim to authority over a function historically performed by the state was actively contested by evaluators:

> *"People ask the same questions [...] who says that whatever you're doing will become the standard? [...] you're doing something as a startup and then, five years later, one of the big boys comes along and dumps money on it and overtakes you. So, all of those are valid concerns." (SkyTaxiInfra CEO Primary Interview., 2023)*

> *"People are still of the mindset and of the opinion that critical infrastructure is usually a national prerogative. And so it's quite hard to convince people that you are now doing something that used to be done by the nation state." (SkyTaxiInfra CEO Primary Interview., 2023)*

Propriety judgement came from a large OEM that was a dominant actor in the adjacent automotive industry. In late 2021, the urban air mobility division of the OEM admitted SkyTaxiInfra into its airspace management consortium to help shape common operating and design standards for the emerging category. The OEM's announcement disclosed the evaluative criteria on which the selection rested:

> *"[The OEM] sourced the three newest Consortium members independently because of their unique approaches, geographic presence and expertise." (OEM urban air mobility division press release., 2021)*

> *"Expanding digital infrastructure to accommodate new modes of aerial mobility is a challenge given all of the disparate airspace operating standards and geographies involved. It's important we convene diverse parties, such as [SkyTaxiInfra …], to explore safe and efficient integration of AAM and, more broadly, equitable access to airspace." (OEM urban air mobility division COO, press release., 2021)*

SkyTaxiInfra's offering was judged appropriate by the consortium leader describing it as - "a continuously evolving software/hardware solution for airspace management and air traffic control [...] based on the principles of system-wide information management and positive deterministic control." The trade press subsequently relayed this endorsement to the wider field, converting an individual propriety judgement into a validity cue available to other evaluators (Helicopter and Rotocraft Industry trade publication article., 2021). In the same year, the start-up was also admitted to a national advanced air mobility consortium in North America, providing a second positive propriety judgement. The "continuously evolving" solution functioned as a site of boundary negotiation as consortium members convened quarterly to share learnings, contribute strategic insight and finally simulating and flight testing. The start-up's platform was a negotiated input into the dominant actor's discuss, test and modify process through which the boundaries of the category were being drawn.

In 2023, SkyTaxiInfra led a consortium of its own, equipping an automated flight test site at a regional airport with co-funding from the regional government. Enrolled partners included the OEM's air mobility subsidiary, a technical university, and several aircraft and drone manufacturers:

> *"[SkyTaxiInfra] is validating and verifying its system architecture and service approach at [the airport], supporting the development of future certification processes by collecting and evaluating operational experience." (Unmanned aircraft trade news article., 2023)*

The funding commitment from regional governments, incumbent organisations enrolling as partners in the start-up's project, a university dedicating research capacity to it, and an airport authority negotiating an operating agreement for test flights alongside conventional traffic are all endorsements of the start-ups' offerings and its capability as a consortium leader in an emerging category. Within two years, the start-up had moved from being admitted into an incumbent's standard-shaping arena to convening its own. Legitimacy granted by the OEM had

enabled boundary work that produced further legitimacy claims. The start-up undertook significant boundary work to enable industry players to converge and engage in consensus activities, thus creating industry boundaries for a new category - advanced air mobility (Figure 15).

While SkyTaxiInfra focused on creating industry boundaries by bringing powerful actors together to shape the boundaries of a category reference architecture, CleanCooking aimed at contributing to the process of boundary creation set in motion by powerful actors. The founders of CleanCooking actively participated in several policy discussions led by private, public and government organisations to highlight the challenges pertaining LPG adoption, eventually leading to the creation of a policy document to encourage LPG adoption for clean cooking.

A key part of the venture was the financial infrastructure enabled by its technology platform which deployed $48,000 in trade finance to last-mile operators previously excluded from formal credit, alongside gross transaction volume growth from under $400,000 to $5 million within a year (CleanCooking blog post on first quarter traction., 2022; CleanCooking accelerator application video., 2022). The growth of CleanCooking as a lender for distributors continued well into 2023 as can be seen below.

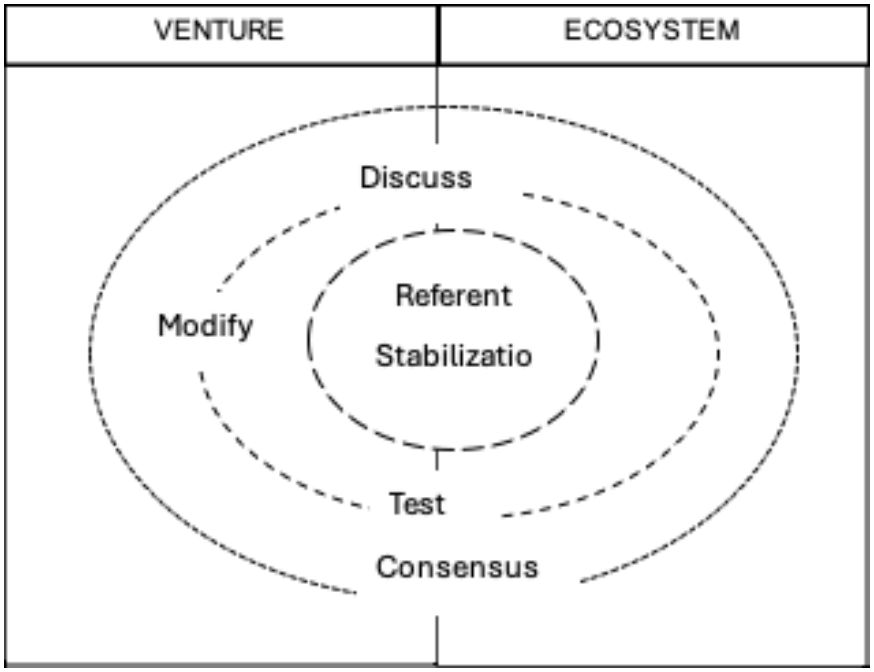


Figure 14 SkyTaxiInfra institutional boundary creation

> *"[CEO of CleanCooking] identified the high cost of purchasing LPG as a major challenge which was why his company introduced smart meters. Another challenge it faced was getting the fuel to last mile distributors and refilling of cylinders for consumers. This informed its decision to support its distributors with working capital. [CEO of CleanCooking] said his company has spent over $200,000 in loans to the distributors and repayment is about 98%"- (Report on Clean Cooking Policy advancement forum., 2023)*

A 98% repayment rate showed policy forum audiences that distributors accepted, used and followed the venture's financial norms. Following this, a midstream LPG operator signed a last-mile distribution partnership that its announcement explicitly grounded in "[CleanCooking]'s expertise in last-mile distribution and technology", at a ceremony attended by the country's Minister of State for Petroleum (CleanCooking blog post on distribution partnership., 2024). These show positive propriety judgements.

> *"CleanCooking joined the Clean Cooking Alliance and the IEA (International Energy Agency) to launch the Principles for Responsible Carbon Finance in Clean Cooking. This initiative aims to foster trust in the carbon market by promoting responsible practices across the board, benefiting buyers, households, investors, and governments."- (CleanCooking Blog post on clean cooking alliance event,2024)*

The success of the platform and financial infrastructure led to institutional boundary creation evidenced by appointment and enactment of the venture as shown above and of the founder, who served as a member of the government committee that drafted the country's first National Clean Cooking Policy, later approved by the Federal Executive Council (CleanCooking accelerator application video., 2022; CleanCooking blog post on clean cooking policy., 2024), CleanCooking thereby contributed to the creation of policy and financial norms shaping LPG adoption and carbon market practice in its chosen market. In parallel,

the start-up aligned its narrative with the national policy, framing itself as clean cooking infrastructure enabling distributors and users through financial support. This demonstrates CleanCooking's centrality within a last-mile distributor network sustained by credit relationships, access to policy arenas as one recognised participant among incumbents and state actors and as a platform for distributors and users.

While both CleanCooking and MarineMeasure provide solutions that have a broader impact on the natural environment, their approach to influencing institutional norms leading to the creation of boundaries are different. CleanCooking contributed to the creation of policy norms that further impacted the country's LPG industry while MarineMeasure's technology was the referent for a popular ISO standard in the shipping industry. In addition, CleanCooking exerted influence as a representative of its ecosystem while MarineMeasure's influence was co-opted from partners who led the creation of the industry standard. However, in both cases prior positive propriety judgements helped the ventures in the boundary creation processes. Specifically in the case of MarineMeasure, the venture had to build trust by repeatedly convincing customers who were not convinced by patents and artefacts and wanted the status quo. Followed by this, the venture was reported as the fastest-growing company in its home country (MarineMeasure Co-founder retrospective talk., 2023). A global market-intelligence organisation placed the venture on its top-100 list in 2014, an industry ship-efficiency award named MarineMeasure's speed-optimisation product the best ship energy efficiency solution of 2014 and the marine trade press showed the benefits for the venture's customers like $35 million in customer fuel savings and 163,000 tonnes of CO_2 avoided annually (Marine industry trade press feature., 2015). By establishing the performance of the digital twin technology, the venture was invited to contribute to a new ISO standard by customers who had rendered their own propriety judgements through purchase, use and verified savings.

> *"So, there we were, heavily influencing the process itself [...] The method we used for generating our digital twin, we were the most advanced guys in the industry doing that sort of thing. [...] Of course that would not have become part of the standard unless we pushed that. We managed to add another level of accuracy on the standard. So, we could say afterwards*

that our method was compliant with ISO 19030 standard, and we called it- ISO 19030 plus because we were exceeding the capabilities of the standard. But we could then use the same[standard] frame so people would know what we were talking about, except that ours was better than what you could achieve with the standard." (MarineMeasure Primary Interview, 2023).

The start-up engaged with industry partners to create new institutional boundaries around a new category of hull and propeller monitoring methods. The consortium (start-up and its partners) documented and standardized the new digital twin category for ship efficiency (Peer reviewed article on hull and propeller monitoring methods, 2018).This opportunity for boundary creation was a result of the start-up enabling their customers to blur ethical boundaries by using technology to manage new sulphur emission regulations (discussed in detail in Chapter 7). Leveraging the benefit of conformity, the start-up continued to adapt, further differentiating itself by claiming to exceed the capabilities of the standard. This was done by adding features to the solution which were previously not included in the ISO standard as discussed in MarineMeasure's whitepaper.

"While connected operations introduces a new level of transparency, they also have a downside – namely the ever-increasing amounts of information produced that is far beyond the capacity of a single person to process. With smart operations, a vessels automated data collection system uses cloud-based technologies to automatically analyse data in real time. Performance analytics are based on ML […] enabling accurate decision making."- (MarineMeasure and Acquirer whitepaper., 2018)

The standards document stated that alternative methods for hull and propeller monitoring while faster were not accurate enough compared to the traditional methods. MarineMeasure's product was adapted to incorporate additional layers of intelligence and data integration, significantly improving its digital twin technology which was a key disadvantage of the alternative methods in the standard specifications. This led to an institutionalization of the start-ups' technology leading it to becoming a powerful player in the shipping ecosystem (Figure 14). This can be evidenced due to the prevalence of the solution across

the shipping industry. By mid-2016 the venture's solutions were installed on over 270 vessels across cruise, tanker, LNG, container and ferry segments (Acquirer press release., 2016). The industry's leading marine equipment and services corporation acquired the venture in June 2016 at an enterprise value of EUR 43 million. To put it in terms that constitute a propriety judgement by a powerful incumbent- the venture's "world-class analytics capabilities" would give the acquirer "a solid lead in marine digitalisation" (Acquirer press release., 2016).

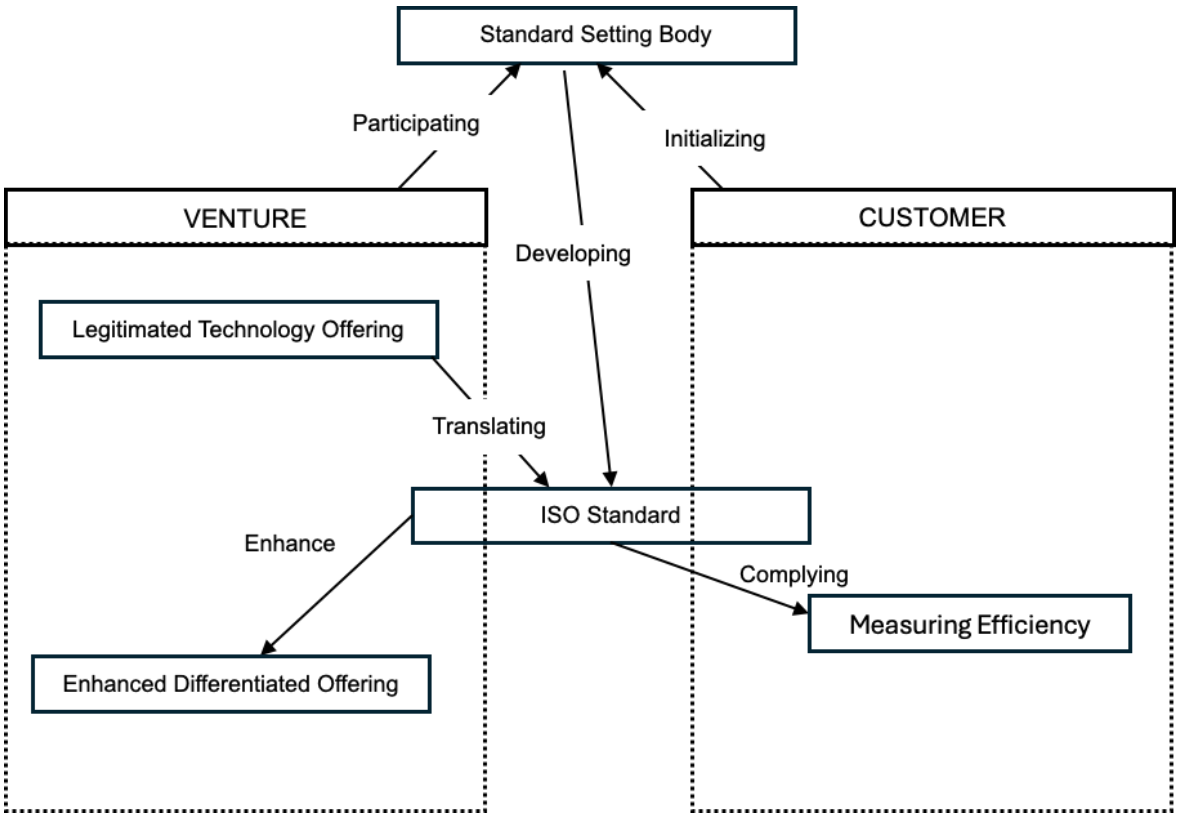


Figure 15 MarineMeasure institutional boundary creation

Unlike the other cases mentioned here, the start-up Nexum was the initiator of a technology standard that gave it a competitive edge over existing telecom players in the field of wireless deployments in the industrial sector. The status quo involved large telecom players controlling available spectrum which significantly increased entry costs for new technology providers, even those not needing to deploy or build large scale connectivity infrastructure.

> *"When I joined Nexum a few years back I had one question in mind: how to resolve the technology lock-in that exists in most of the spectrum globally?*

The regulations play a significant role in radio spectrum access. Together with my colleague [...], we recognised that [Telecom Standards Organisation] [Telephony standards] group was open for a major technology step to improve their radio technology. We knew that standardisation is a joint effort of interested companies [...] worked intensively for more than two years and were able to complete the work in June 2020 on the Technical Committee of [Telephony standard]"
(Nexum Blog Post, 2020)

"Three main obstacles stand in the way of extracting value from the current cellular-based 5G for IoT: Time, complexity, and cost. [...] Combining [Nexum's] decentralized approach with a license free and global spectrum means making these benefits mainstream for real. [...] Looking back at the evolution of cellular 5G, it was not built for industrial purposes. [...]. But if they are not addressing the issues of time, complexity and costs, in a sensible manner for industry use, the challenge for industrial IoT will be solved by others. IoT does not need antenna towers and masts, telecom does."
(Nexum Blog Post, 2021)

Nexum led the formation of new industry norms in the form of a new communication standard for use-cases not addressed by traditional cellular 5G for IoT. By creating a new standard, Nexum was constructing 'thematic identities and structures of expectation' that shaped what was feasible and acceptable within the industrial IoT communications space (Kim., 2025, p. 342). They commenced this through the identification of the appropriate spectrum and by enrolling and entraining partners in the standard creation process. The second motivation was to take the non-cellular IoT technology developed by Nexum and link it to an existing spectrum which was inaccessible to most new players developing communication solutions due to lock-in by large telecommunications companies. Lastly, this initiated a BM change from a proprietary solution to an open standard with wide adoption.

The start-up's leadership saw an opportunity in the telephony standard spectrum availability and worked with large partners to create a new radio technology

standard that aligned with their technology. To propagate the standard, the start-up brought up the standard at various conferences and highlighted the challenge with current cellular 5G implementations for IoT, de-legitimating it for broad IoT application especially for smaller players who could not afford the cellular 5G. In line with existing literature, the start-up's founders engaged in theorizations of change (Suddaby, Bitektine and Haack., 2017). Through their narratives, Nexum first challenged the status quo of prevailing 5G solutions for IoT use cases and thereafter provided the solution in the form of a new IoT connectivity standard. They also attempted to gain legitimacy by association, by positioning the new technology as a complementor and framing it as non-cellular 5G (discussed further in boundary blurring chapter).

Across all the cases mentioned here, the start-ups' challenged the legitimacy of status quo as they went about lobbying, collaborating and orchestrating the creation of new standards and policies that would impact their business.

4.3 Creating ecosystem boundaries

Nexum developed an ecosystem of vendors across multiple industries. These vendors included OEM's, consultants, system integrators, developers among others. The system integrators would procure devices using Nexum's software from the OEM's. A key feature of Nexum's BM was the use of software instead of a hardware device. By focusing on software, the incorporation of new features and customisation for specific use-cases became easier.

> *"So, we have chosen a strategy where we focus on software. And by doing that, we are exposed to many different problems in these different applications. And we are learning them and enriching our product for the benefit of our ecosystem that is working with us. So those are the two main principles, how we address the diversity and evolving requirements of IoT devices." (Nexum CEO Interview at IoT event., 2017)*

Product strategy co-evolved with the needs of the ecosystem. Nexum's clients could tap into the vendor ecosystem to fulfil all other expectations from a an IoT

provider – hardware and the integration capabilities to execute successful IoT projects.

> *"[Our clients] among the public business are in business services. [...] So they are a system integrator, targeting warehouses; it can also be offices or factories, and they are then sourcing OEMs from our open ecosystem for the tags, and **then** they deploy." (Nexum CEO Interview at IoT Event, 2017)*

The members of Nexum's ecosystem utilised the provided technology platform that enabled the IoT businesses to transact and interact with each other. The ecosystem revolved around Nexum's software offering. Clients/partners procured the hardware on which the software was to be installed from the OEM's within the ecosystem. The BM pivot is further discussed in section 4.6.

Like Nexum, CleanCooking utilised a platform BM that required the creation of an ecosystem of players – namely suppliers and buyers of LPG. They encouraged the growth of this ecosystem through favourable financing terms. Further, the use of IoT in the form of smart meters was meant to aid in the user adoption of the central application. The venture facilitated financing for retailers and collaborated with government agencies to capture data on clean cooking adoption (*CleanCooking Blog post on clean cooking alliance event, 2024*). Furthermore, while working with a corporate accelerator, the start-up planned to create a LoRa infrastructure that would be a game changer for their smart metering solution and could also be piggybacked upon by other IoT developers for their own use-cases, becoming an additional revenue stream (CleanCooking pitch at corporate accelerator IoT program , 2021).

In contrast, SkyTaxiInfra positioned itself as referent architecture for future advanced air mobility solutions as discussed earlier which led to negotiation and discussions between different players of a future air mobility ecosystem. Further by focusing on providing a centralized monitoring system for air traffic, the start-up positioned itself in a more central role within the air mobility category. The developing technology needed to be interoperable with multiple protocols and vendors -

> *"The project […] aims at improving common data communication technologies in aviation so that the open, automated and interoperable SkyTaxiInfra flight control system can also be operated safely in metropolitan regions" - (Unmanned aircraft news website, 2023)*

The participation of the OEM in the start-up's initiatives lends credibility not just to the organisation or the proposed technology but to the pilot itself. The formation of consortium establishes membership boundaries to include legitimate organisations. By focusing on the openness of technology infrastructure boundaries, the start-up is signalling the opportunity for players outside of the consortium, to influence the trajectory of the technology. At the same time, the start-up acknowledges the role of the consortium in shaping the standards of the air mobility ecosystem. The second quote illustrates the role the start-up is assuming as the technology provider/member of the consortium in validating and verifying system architecture, with partners from the consortium such as aircraft manufacturers testing unmanned flights at early stages of development.

Across all these cases, ventures created ecosystems as complementors or leaders and aligned with the existing standards or newly created standards to conform to industry expectations (Suchman, 1995). In some cases, they dictated the membership criteria for the ecosystems leading to boundary creation. Associations with known organisations and categorical conformity served as endorsement for the new ventures (Deephouse and Suchman, 2012; Snihur, 2016; Snihur and Zott, 2020). Other start-ups created boundaries

AgeObserve's solution allowed its customers to undertake remote consultations and monitoring which further led to improvement in speed and frequency of intervention and time utilisation (discussed in detail in another section). The start-up's founders and team saw an onslaught of demand for remote monitoring during COVID-19 and wanted to sustain the momentum without losing customers due to their pricing.

"I mean, one of the quickest things we did when COVID hit, was make a small tweak to our product, which then made it eligible for Medicare reimbursement. So, the big problem […] who was going to pay for the solution. […] We were figuring out how to address demand from COVID and, find BMs where there will be a third-party coverage on the product. Because working with retired people means really being able to tune into their sense price sensitivity […] we were able to get reimbursement through Medicare for the product." (AgeObserve Secondary Interview., 2020)

"[…] interoperability for us means […] working with the health systems or insurance payers to collect all the information about the patient. So, we work with integrated electronic medical records […] And our goal is to take as many sorts of signals and inputs that come from any number of devices and, it can then be used to better train our AI models […] we actually go into a little bit of what is called as mindful intervention for our patients where it's necessary. That intervention can be you need to change something, or you are doing fine or, you need to stop doing that." (AgeObserve CEO Primary Interview., 2022)

The start-up made minor changes to their products that would qualify it for insurance reimbursement. In doing so, the venture drew an ecosystem boundary where participation was defined by data interoperability. This enabled integration of data from AgeObserve and patient health history data from insurance providers and physicians to further train AgeObserve's AI algorithms. The goal was to provide targeted actions for patient health and safety outcomes. Similarly, AgeMonitor's BM evolved to include at home medical services provided by community paramedic programmes in response to the data collected by their device.

HVACHealth's partnership with service and maintenance organisations was a key part of their BM and incorporated as part of the product. Its mobile and voice applications formed the interface for a technology platform where users could order replacements based on the app's reminders and partners could use to access the HVAC performance data to narrow down on possible technical issues.

"We serve this data to users through our mobile apps and our Alexa Voice app. We send them alerts when they need to take action to change their filter. We also allow them to order filter replacements through our app and in the future, we will be allowing them to schedule service and maintenance. To our partners – we give them access to a backend API that allows them to see that data so that they can add and sell add on services." – (HVACHealth accelerator demo day., 2018)

Thus, HVACHealth, AgeObserve and AgeMonitor all created an ecosystem around their offerings, this led to the creation of new practices for their customers, partners and end-users. In contrast, one of the key drivers for Monitor's adoption was its partnership with Airbnb. In this case, Monitor was a *part of Airbnb's ecosystem*.

"Our new integration makes noise resolution even more seamless as it syncs your Airbnb reservations. [Monitor] will now be able to contact your guests about noise directly through Airbnb Messages. These messages will show up in your Airbnb Inbox, so that you can review all guest communication in one place. And you can make them 100% yours too, by editing the text." – (Monitor Website Blog., 2022)

It's offering led to the creation of new practices where Airbnb designated hosts did not need to communicate with the guests on their property if there was an alert from Monitor about some breach or concern. The product is integrated with Airbnb, and any violations are communicated directly to the guest with a reminder to follow host rules at the property. Furthermore, Monitor encouraged their hosts to inform the guests about the use of a monitoring solution on the property as a practice. While some start-ups undertook standard creation in pursuit of validity, some others created ecosystem boundaries that led to new practices and impacted prevailing institutional practices. While new practices are an inevitable outcome of new technologies and BMs, they also lead to negative propriety judgements from users and customers highlighted in next section.

4.4 Creating New Practices

The development, deployment and adoption of Monitor's surveillance device led to the creation of a new practice within the short-term rental community, that of automating communication with guests who were found to be in violation of accommodation rules such as low noise. The traditional practices adopted by the host would have been to call the guest in case they received complaints related to noise in the adjoining areas.

> *"The only difference is, the second time around, a [Monitor] device had been installed by the host. After excessive noise levels were detected by the sensor, [the journalist] and her friends received a text message reminding them to respect quiet hours. [...]The system worked exactly as intended: neighbours were not disturbed, and the host didn't need to interrupt their evening to call their guests and ask them to quiet down[…]."*
> *(Monitor's Founder and CEOs Blogpost, 2017)*

The use of Monitor's device led to an increase in communication efficiency between host and guest, but this change led to the negative evaluation of the new practice i.e. de-personalized, efficient, automated communication and the technology enabling it.

> *"The generic text from the host telling us that "noise MUST be kept to a minimum" made us feel like we were naughty schoolchildren being watched[…] We scanned the living room for the listening device but couldn't find anything. It made me wonder what else could be hidden, […] I had read about self-catering rentals where the owners had rigged up cameras to watch their guests." (Monitor's end user guest news article., 2023)*

Rules are symbolic boundaries that dictate group membership(Lamont, Pendergrass and Pachucki, 2015). In this case the lack of rules in the form of best practices for communication about the use of the device for guest monitoring led to the user forming an association between the solution and invasive monitoring devices such as camera. The start-up's claims focus on 'privacy-safe' monitoring to align with normative requirements of society and the pragmatic requirements

of their customer. But the lack of specific design cues or additional practices that can inform users leads to de-legitimisation. The start-up addressed this by emphasising the creation of boundaries through the rules configured by the host user which reduced the need for unnecessary communication between the guest-host and other actors such as neighbours.

While there are instances where new practices driven by new technologies may lead to negative evaluations and even stigma, the other case-studies demonstrate that customers can legitimise the new practice and the technology if it invokes feelings of nostalgia or association with tradition as in the case of BabyCradle, creates boundaries between teams or groups introducing some form of inequality as well as leads to expected performance and efficiency outcomes for all users as in the case of AgeObserve.

BabyCradle's founders created their first prototype using a piece of cloth and a wooden pole which was they adjusted and added on based on the growth of their own child. The cradle was positioned as an IoT enabled alternative to traditional swings but still mimicked the form of traditional cloth swings. This narrative led to optimal distinctiveness. Features such as organic fabrics, built in lights, audio and video monitoring extended the role of the crib to a caregiving tool for parents.

> *"One of the best things we like about this is that it replicates our time-tested cloth swings. It is very snug for the baby. It is a comfortable, safe and convenient place to rest when [baby] is sleepy or cranky. The audio and video monitoring are especially useful […] The kind of thought that has gone into the cradle [...]" (BabyCradle Early Adopter Review., 2018)*

The start-up introduced a new practice, that of parents using technology features to monitor their children, even at a distance. The association of the new technology with tradition helped create cultural acceptance for the new practice and the product. However, in new markets, the start-up had to change the product design in alignment with regulatory requirements and could not use the hybrid logic to gain legitimacy. The start-up appealed to the pragmatic interests of parents - i.e. ensuring their sleep as well as the sleep of their kids. More recently, the start-up has introduced new practices through its narratives, that of "utilising a few extra hours in the day" due to better infant sleep.

Similarly, the installation of sensors and application allowed AgeObserve's customers, the elder care and health organisations to create a new practice of proactively managing their customers' care, using the tool to analyse the activities of their customers throughout the day.

> *"If I know notice a decrease in movement or lack of movement the co-ordinator and I are able to prioritise that person and check on them quickly, much more effectively[...]I have had two Elders that were currently living with their children that were able to move out into an apartment independently because they and their family felt safe with the monitoring in their home[...]"*
> *(AgeObserve's customer testimonial., 202)*

There are a number of new practices that were implemented by service providers who used AgeObserve's solution. The creation of a new daily routine that enabled the care-providers to be more efficient and effective and at the same time the end-users in terms of the elderly and their families that could also create new practices for themselves due to the sense of security from remote monitoring by the care home. At the same time, the sensors and Alexa become crucial for caregivers to maintain the level of care for their customers. They move from being simply products to partners, blurring the boundaries between the technology and the care providers.

While new practices are an inevitable outcome for adopters of new technology, before the technology is even built, founders undertake in some pre-start-up boundary work i.e. they create symbolic boundaries drawing from personal and professional experience. These symbolic boundaries encapsulate initial ideas or segregate them from existing alternatives.

4.4 Symbolic Boundary Formation

In line with existing studies in entrepreneurship, many of the entrepreneurs identified opportunities based on their experience and knowledge (Shane, 2003). The creation of symbolic boundaries prior to start-up formation was grounded on the founders' personal or professional experiences, detailed in previous examples and in Table 25 and Table 22.

4.4.1 Founder experience as the seedbed of symbolic boundaries

Majority of the founders in this study had undertaken some form of higher education. Learnings from technical education and experience were applied to create product and technology boundaries which were crucial to identity formation. While founders from two cases were university dropouts, they acquired the necessary skills through informal training and self-learning, as well as through their roles as founders. Both the founders of BabyWearable and WiseBees acquired this expertise by identifying experts or businesses that could help them with the product development. WiseBees's founder looked for a cofounder who possessed the knowledge, BabyWearable leveraged her network to identify suitable contractors.

> *"[…]so, people might suggest these ones [app developers] are good and you have no idea, so you just take their word for it, so you make some expensive mistakes. I've learned as I went along. With the first prototype there was something that just wasn't sitting well with me, it wasn't kind of the finished thing that I wanted. I was getting lots of data sent to me every night and not being catalogued that way I wanted it." (BabyWearable Founder Secondary Interview., 2022)*

> *"[Cofounder Selection] was driven purely by the practicality of him being highly technical in a very niche specific field, which is critically important for us to succeed because I did not know anything about hardware. And he is very experienced as an electronics engineer. Having built IoT systems before […] We discovered that although we're very different, that's probably one of our greatest strengths […] we don't shy away from challenging each other […] So, if it's my field of expertise, then he doesn't question what I do and vice versa." - (WiseBees Founder Interview., 2022)*

> *"Since me and the other cofounder were both from a business background. We were very worried about how we are going to get people on the team who know AI programming and hardware, everything technical. Since we just know how to restart the computer […] Basically, that's our knowledge.*

So that's quite challenging to see how to solve this issue and manage your team if you don't have this knowledge. How to make investors trust that you will be able to evaluate if these people are good enough for your team?" – (YourPleasure Founder Interview., 2023)

"Investor: 'Always strikes me as a risk, the problem is, I'm investing in not just the concept but the team of people that have written the code, they're not even in the same building […] What code are they developing in?'
Founder: 'So there's a few that they're doing because obviously they're working with iOS and they're working with Android as well. I'm sorry I'm not technical. I only know a little bit of it […]'
Investor: 'When you invested in tech company, you're investing in a set of talented developers that are building the code and that's not what we are investing in here. We've got an entrepreneur who's found someone to build something. They're not part of the business. So, I'm asking myself where the value is?'" – (BabyWearable Founder Pitch, 2022)

"*When [Hardware VC and accelerator] invested, when we were very early as a venture. They looked at the quality of the team more than anything else." – (Monitor Founder Interview., 2022)*

At early stages, key criteria for getting legitimacy from investors included team experience, expertise and competence. The founders used failure narratives or reflexivity to demonstrate their learnings. WiseBees' founder created symbolic boundaries separating knowhow of the two founders by emphasising the importance of the co-founders' hardware experience. In contrast, the founder of BabyWearable contracted application developers through referrals. But due to the lack of technical experience, she took time to get to the 'right partner'. As a result, the evolution of the product was a waste of resources through relentless trial and error. BabyWearable's founder also faced a legitimacy challenge from investors who screened technology start-ups based on the quality of the technical team which the start-up did not possess. This challenge was reinforced by the founders of YourPleasure and Monitor. The findings concur with existing studies that founders' or team's relevant knowledge and expertise are an important

resource for venture performance, survival and sales (Delmar and Shane, 2006; Zhang, 2009).

Both failure and competence narratives undergirded the venture's distinctiveness, identity and lack of legitimacy. Symbolic boundary formation related to knowledge and competence, support founders in getting complementary inputs, but, to form these boundaries, some form of prior domain knowledge is needed. If these boundaries are not created, the complementary support needed cannot be identified. Besides this, symbolic boundary construction also helps in narrowing the problem as demonstrated through CleanCooking.

> "*I'm the second time founder in this space. Founded the first business in 2016 […] realised that penetration across Africa for clean cooking solutions using LPG is somewhere around 20%. You know 900 million people on the continent today still do not have access to LPG. The real issue is that they do not have access to financial products, right? […] Households do not have that money in bulk, they would rather purchase it in small bits, right? And that's where the idea came from."*
> *(CleanCooking Founder interview, 2022).*

Prior start-up experience in LPG sector helped the founders create boundaries segregating the households reluctant to adopt LPG for cooking and those with limited access to appropriate financial services. By framing the problem through the lens of economics, the founder creates a distinction between CleanCooking, and other organisations trying to solve the problem of clean cooking and enhance the usage of clean fuels, particularly LPG.

Similarly, AgeMonitor's founders constructed a narrative around competence underpinned by entrepreneurial experience in remote monitoring which is extended to the ageing industry.

> *"[I was thinking of] doing something that was a little bit more mission driven this time around and then looking at some macro trends, you know, […] and the aging population is one of the big buckets [where innovation needs to happen]and there's the rising healthcare costs. You know, based on our background in the previous startup, which was doing a lot of remote*

monitoring, although it was camera based and it was more for security. […]"(AgeMonitor Founder and CEO interview., 2022)

The founder creates symbolic boundaries between AgeMonitor and other start-ups due to its focus on monitoring the elderly and the team's experience in remote monitoring. The start-up's founders reframed their experience in the context of a mission driven use-case in an effort to gain both cognitive and moral legitimacy. CleanCooking, AgeMonitor founders undertook combined narratives of experience, social impact and sectoral shifts that lead to opportunity recognition.

Across cases, reframing the problem, continuity narratives, competence narratives and reflexivity served as mechanisms of boundary creation leading to the process of venture identity formation and legitimacy.

Other start-up founders had acquired business and functional experience as a result of their roles in other companies. Monitor's founder worked in a design team at Apple where he worked on IoT and machine learning. The experience at Apple laid the foundation for entrepreneurial identity creation.

"I hadn't quite finished my degree, but I got a job at Apple in Silicon Valley, and I basically grew up in that company. I spent seven or eight years in a small team called exploratory design where we were doing early-stage stage product development, we were doing different feasibility studies, due diligence, outright acquisitions and we were trying to make sure that the company had the core technologies then needed to build the strong product lines." (Monitor's Founder and CEOs Interview., 2022)

"I happened to meet one of the early employees of AirBnB, back in 2008. And one day we are at Y Combinator [...] they had issues with people putting up cameras in Airbnb's and so [...] I felt that the tech needed to build a product to help hosts with this use case - monitoring while preserving the privacy of guests, I saw that sort of coming together." - (Monitor's Founder and CEOs Interview., 2022)

Entrepreneurial identity association with a renowned technology company allowed the founder to create a boundary between their venture and other start-ups by invoking associations of technological exploration and excellence. Similarly to AgeMonitor and CleanCooking who combined their entrepreneurial experience and sectoral shifts, the founder of Monitor combined his own know-how from his experience at Apple, emerging technological trends and validated business problems to construct idea boundaries, leading to opportunity recognition around soft security as discussed in 4.6 and 4.4.

Similarly, the experience of being one of the first technologists in a corporate to work on an internal IoT project underpinned the expertise of the founder of AIBlockchainIoT.

> *"So, it was the beginnings of an IoT device, and we called it the smart rack […] And I used to demo it to people and folks from Kroger, Walmart, Barnes and Noble, all of them loved the idea! But the company [media] felt that IoT is not our thing […] That company could have been the leader in IoT, but they didn't see it the same way […] Kroger, partnering Microsoft and they introduced the product." - (AIBlockchainIoT Founder Interview., 2023)*

> *"[…] they called it the Smart Rack. All my guys and I just fell out fell off our chairs we had built the same thing nine years ago, but we did not have the sort of corporate champion or sponsorship for this and here comes a bigger company". - (AIBlockchainIoT Founder Interview., 2023)*

> *"We have always been ahead of our time […] you can have a good idea, but the timing must be good. This is one of those problems but also, we need in the corporates, sponsors to pave the way, to make the idea see the light of day. Same thing happened with Xerox […] You must have some someone with a little bit of vision to take an idea forward." – (AIBlockchainIoT Founder Interview., 2023)*

> *So, a couple other guys from that company left along with me many years later, and we said you know, the smart rack, let us build a platform like*

that. But let us not just make it for magazine racks. Let us make it for everything." - (AIBlockchainIoT Founder Interview, 2023)

AIBlockchainIoT's founder constructed the symbolic boundaries around the new venture identity, i.e. focus on IoT and including other experienced colleagues from his past organisation. Past failure to drive adoption and usage of IoT based solutions led to the creation of practice of sponsor or champion identification and timing of innovation. Further, this past experience was highly relevant for a disruptive new venture, differentiating AIBlockchainIoT from other start-ups. Similarly, the founders of BabyCradle and HVACHealth has significant technological and industry experience that would serve as a boundary creating mechanism, separating the start-up from other competitors. Thus, prior entrepreneurial and relevant work experience underpinned the boundaries constructed around entrepreneurial and venture identities.

The founders of BabyCradle created a symbolic boundary between their ideas and what pre-existed in the market ('Flimsy', 'Flat') based on their personal experience. They were convinced that their product idea was the only one of its kind. Similarly, personal experience indicated a lack of alternatives or solutions to the problems faced by the founders of BabyWearable and AgeObserve which led them to create symbolic boundaries. –

"As a parent, you feel that there is nothing like this in the market and this is going to be a high growth, VC fundable company from day one"- (Founder Secondary Interview, Case BabyCradle, 2024)

"So, it started when I was sleep-training her trying to go back to work and establish a routine, and then when I was looking online, there was nothing that was jumping out to me, that was telling me when she's tired." - (Founder Secondary Interview, Case BabyWearable, 2022)

"I live in California, my parents live in India, and remote caregiving was an order of magnitude complicated for me and the issue was hard. How could I become a better caregiver for my parents and maintain a fantastic

relationship with them as they were aging and be part of their life in a way that was not intrusive?" - (AgeObserve Founder Pitch, 2022)

These quotes illustrate the symbolic boundary formation process that the entrepreneurs undertook that resulted in the framing of legitimate problems or ideas. This was a precursor to venture identity creation and opportunity recognition (Navis and Glynn, 2011). Similarly, the other quotes suggest the same creation of boundaries drawn from personal or professional experience to frame the problem and even separate it from what was available in the market.

4.4.2 Discursive Boundary Formation

Some of the start-ups constructed the idea through a sensemaking process. For instance, IoTSecurity's founder elicited the problem from the head of department at the University where he was pursuing higher education, before starting up. Based on the discussion, the founder theorized a security solution for surveillance systems that could overpower jamming attacks. This led the founder to the creation of symbolic idea boundaries. With patent filing, the founder translated symbolic boundaries into objective boundaries.

"He asked if he should go and buy Verisure, which is an alarm system for houses. I told him that it is too easy to go around the whole support system. since you can buy a jammer and mess with the signals […] if somebody wants to steal something that does not stop them. So, then he asked if there was a way to stop that […] I thought about it over the weekend and called him up with a solution. So, in 2011, when I was still at the school, I made these patents for it. […] but the problem was that even though you know the solution in theory, how to make it reality?"- (IoTSecurity Founder CEO Interview., 2022)

The founder creates a symbolic boundary between the real and desired outcomes of implementing a home-security system i.e. enabled security versus actual performance. To achieve the expected outcomes, the founder designed an advanced system, meeting the required security threshold. Similarly, the founders

of YourPleasure had a casual conversation on the role of AI on sex and created symbolic boundaries around the idea.

"Basically, our business idea was born out of a joke because we also had an artificial intelligence course before specialization. I was talking to my course-mate [co- founder] and one of us made a joke that maybe, at least AI could finally find the clitoris." (YourPleasure Founder CEO Interview., 2023)

For MarineMeasure, the founders were set on solving the issue of safety aboard marine vehicles because they found "*there was so much talk about safety on ships*". They had zeroed in on safety after speaking to friends who worked in shipyards. However, while figuring out the product-market fit, they found that no maritime company was willing to pay for a safety solution. As a result, they started looking for other use cases on shipyards.

"*[…]one of our captains who we had on the team, and he had talked to some other captains […] one of them mentioned that there has been a captain who has tested on a ship whether it would make a difference if they changed the altitude of the ship, and how much that will change the fuel consumption on board. They were using a garden hose for measuring the trim […] so we decided OK, let's productize this thing. And [..] then quite soon it became apparent that just by measuring the trim that wouldn't be enough, we actually needed to model the ship and understand what the performance of the ship is because many things impact fuel consumption." (MarineMeasure Founder Interview., 2023)*

Symbolic idea boundaries were formed based on information exchange within the communities of practice (Captains). MarineMeasure's team translated this insight into a product, creating objective boundaries. This quote highlights the importance of team formation in the identity development process. Discursive symbolic boundaries between the initial idea of measuring trim for analysing fuel consumption and ship modelling with several other parameters analysing fuel consumption highlights the process of product boundary formation.

The founder of SkyTaxiInfra identified a broader problem of lack of innovation in aerospace industry and narrowed it to managing air traffic for commercial drone

and air taxis based on emerging trends. He then figured the solution of a digital infrastructure that enabled it. Moreover, like many of the other start-ups, he also engaged in conversations with his network in order to validate his initial thesis.

"[Aviation] is still a very elite and remote form of transport [A few years ago] it appeared that electrically powered vehicles could become viable, and we could build air taxis and drones and that kind of area transport vehicle […] I found that an exciting kind of opportunity to democratize aviation." – (SkyTaxiInfra founder Interview., 2023)

"There was an absolute dearth of […] digital infrastructure that guided this whole system. And I started kind of casting around and talking to business, acquaintances agreed with the fact that that could be a commercially viable to […] develop this type of digital infrastructure for a new form of transportation." (SkyTaxiInfra Founder Interview., 2023)

The founder draws symbolic boundaries between the current state of the aviation industry and the future state being enabled by drones and air taxis enabled through a technology infrastructure. The founder further highlights the boundaries between the technology they are developing and the available alternative solutions. Finally, the founder engaged in sensemaking with other experts in order to mitigate founder bias and developing a boundary between new and existing forms of air transportation. These examples also highlight the importance of founder networks in the process of boundary creation, not just for resources but also for sensemaking.

4.5.6 The cases of university spinouts

The university spinouts represent contrast cases to the existing cases mentioned in previous sections. TrackingParcels, Nexum and RoboticMeasurement are university spinouts from the same university. Here the university and researchers played a role in the formation of boundaries by first framing the problem in context of the present and future outcomes. The university sought funding for projects which had the potential to become businesses. In doing so, the university and researchers creating boundaries between projects that could be commercialized and those that were research focused only. By visualising and

framing their hypothesis, the researchers created symbolic boundaries around their ideas such as high-density communication networks, robotic testing platforms for composite materials and asset tracking solutions.

> *"Professors at the university were wondering - there will be a time when there's an endless amount of sensors around us […] how on earth can those be connected […] how to manage the scale and especially if you have a large scale in in small location, that density becomes a problem as well and how will there be enough spectrum to connect all those millions of sensors and […] how to make it low power so that they can be battery operated"- (Nexum CEOs presentation at Industry Event., 2022)*

> *"So, the research for our technology it started even before Bluetooth or similar existed. So, it means that our technology has been designed and developed towards industrial IoT from the day one minute for a whole new scale, but like industrial scale use cases." -(Nexum Business Development Head Interview., 2022)*

> *'Back then, there was a project with the goal to develop testing mat or testing platform for this kind of [micromechanical characterization of composite materials] measurements and […] it was a […] government funded project where you aim to seek new information about in such technology' (RoboticMeasurement CEO Interview.,2023)*

> *'[…]in the later stages of the project, when we were participating in a large exhibition in France […] there were two[companies]-now there are our competitors - who said that what you are doing is quite interesting and they were really interested to know more and then there was also other industrial players who said that […]they are interested." (RoboticMeasurement CEO Interview., 2023)*

> *"[…]in university we were in a project course with the founding team members, and it was in 2014, and we had a challenge in this project course from a customer and we implemented the initial prototype of the solution in that project course and the project went well. The customer liked the*

software, the solution and we realised at that point that there could be potential here to further develop the solution […] basically agreed to be our first customer." (TrackingParcels CEO., 2022)

"There is a publicly funded […] project instrument called R to B, from research to business that is funded […] by national innovation agency […] The university is kind of picking up those cases […] applying for those teams funding." (Intermediary Organisation at University Interview., 2023)

Once the project outcomes had been tested and evaluated and received positive feedback from industry representatives, the university sought the resources to commercialize the project, translating from the objective boundaries of a platform or product to venture boundaries. Here, the project's success coupled with researchers' expertise and background along with university resources drove the translation of objective boundaries. These examples also show that the university would have played an important role in the founders' network during the early days of the venture.

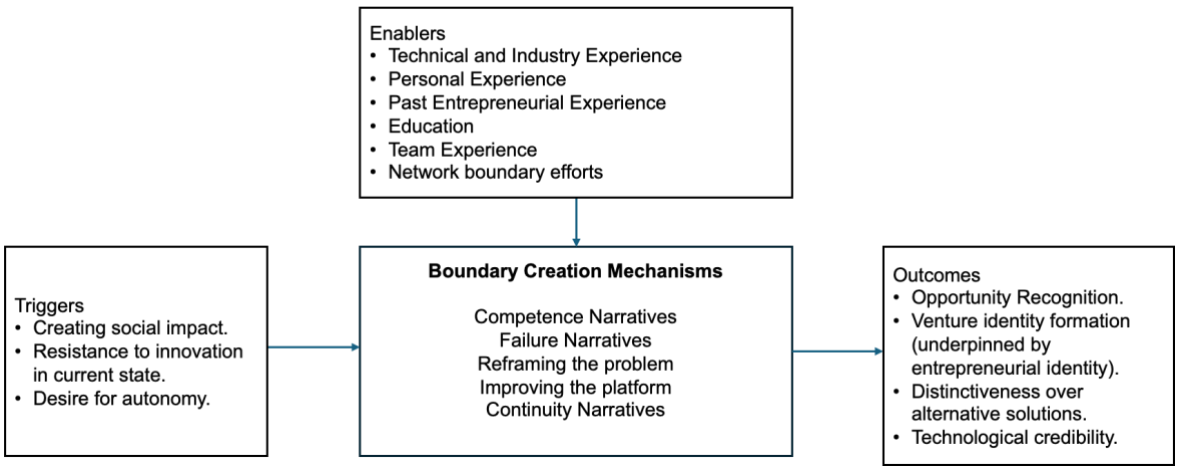


Figure 16 Triggers, Enablers, Mechanisms and Outcomes of Boundary Creation

4.6 Creating Objective Boundaries – through validation and verification

In the previous examples, start-ups translated symbolic boundaries to objective boundaries in the form of commercialisation or product development. In the

following examples, the validation and verification process undertaken by the start-ups is demonstrated in their endeavour to seek legitimacy.

In the case of MotherHealth, the research conducted before starting-up was crucial since it established the boundaries segregating accurate and inaccurate patient monitoring, this knowledge acquired through research fed into the venture identity. The monitoring parameters and monitoring practices uncovered during this exercise later guided the development of the product and related services.

> *"Before I started […] I have actually travelled to more than a hundred hospitals across India and spent a lot of my time in the labour wards […] If you look at the numbers - 250,000 mothers and 2,000,000 newborns die during delivery or during the labour process. Unfortunately, more than 99% of these deaths occur in developing countries like India, Africa and across Southeast Asia. So, during the intrapartum phase, foetal heart rate and the uterine contraction, these are important parameters to get to know the status of both mother and foetus. But unfortunately, more than 85% of the time these parameters are monitored inaccurately or ignored because of several reasons" - (MotherHealth Founder Pitch., 2018)*

In some cases, founders such as CleanCooking and MotherHealth also used artefacts such as pitches to create discursive symbolic boundaries to highlight inequality or systemic problems. For instance, MotherHealth's founder drew the boundaries between the quality of maternal and foetal health monitoring conducted in developing countries and the same processes in developed countries. In doing so, he demonstrated the magnitude of the scope of the problem as well as the addressable market.

The founder of Monitor undertook research on his own, as well as some feasibility studies and developed a prototype that in his words '*didn't look very good*'. Thereafter, they attempted to seek consumer feedback through crowdfunding to validate the product and market. The product was validated through pre-purchases. Demand exceeded the founders' expectations as "it took on a life of its own [...] we had to switch out the factory and [...] do all sorts of things with the supply chain to be able to deliver thousands of [devices] instead of a few

hundred, which we had set up for" (Monitor Founder Secondary Interview., 2019). So, the market was larger than they had initially thought. Most of the investors were not short-term rental hosts - "we had prepared the wrong product for the right market [...] we went back to the drawing board [...] and actually designed for the people we sold to rather than the ones we had intended to sell to" (Monitor Founder Secondary Interview., 2019).

Thus, the campaign also helped them to better define who they were going to serve and what the target market expected from a similar solution through feedback. This process helped them to define part of the venture identity.

> *"It is interesting that we had low expectations. When we started out we had this idea that people were renting out their homes on Airbnb. They had a higher monitoring need […] but at the same time, they couldn't use the existing home security appliances because they are very invasive." (Monitor Founder Podcast Interview., 2019)*

Monitor's founder had created symbolic boundaries between what was available in the market and what was needed when listing the idea for a Kickstarter campaign.

> *"[Monitor's sensor] was to be small, beautiful, unintrusive and deliver peace of mind. You'd be able to see whether people had arrived at home, notified if a window broke, if there were loud noises or an alarm had gone off. Security, but without surveillance. Given the resources at our disposal, [it]was the closest we could get to the concept of Soft Security." (Monitor Founder's blog., 2017)*

Monitor's founder emphasised the creation of a new 'soft security' category. This boundary work led the start-up to claim a market niche which was focused on a specific customer segment who wanted the benefits of surveillance without having to consider the regulatory and ethical consequences. The focus on design features of the product contrasts it against the more obvious and bulky surveillance solutions available in the market. To gauge market demand, the start-up decided to launch a crowdfunding campaign to test willingness-to-pay among consumers and narrow down the initial target audience. The campaign allowed the creation

of a community of early adopters who legitimised the product, funding it and offering feedback for adaptation. Interestingly, the founder describes crowdfunding revenue as "a potential trap" for hardware ventures, noting peers that "achieved amazing crowdfunding success and then failed to deliver even the first product" (Monitor Founder Blog on hardware resilience, 2020). The campaign's propriety judgements were provisional, conditional on delivery , requiring ongoing communication with the customer/investors.

Similarly, the founder of MotherHealth, undertook product development and pilot studies at various clinics for product validation. His focus at this time was to raise some financial capital and he did this by applying for grants. He created a pipeline of grant applications, and the process of application selection or rejection took about a year for each application. By demonstrating the feasibility and validity of their solution, the MotherHealth team was further able to legitimate the solution and won further grant awards for increased roll-out across multiple hospitals. The pilot helped the founder figure out the how the venture's offering would work.

> *"So, when that problem statement was clear to me, then the next objective was to raise fund or grant, which can help us in terms of development of the product doing clinical trial pilot, so we started applying for grant such as government grants, Gates Foundation grant and Government of Canada grant." (MotherHealth Founder Interview., 2022)*

> *"[MotherHealth] was chosen by the Government of [county] as part of its […] scheme for startups. The government also funded a pilot to […] test [MotherHealth's technology] in [district]. After the six-month trial, [MotherHealth] won a pilot project to implement the app at all government and associated hospitals and medical centres."*
> *(Article on MotherHealth, 2019)*

BabyWearable's founder undertook hypothesis testing and concept validation to prove to funders that the idea was feasible. Based on this, the founder then created an initial '*buggy*' prototype to show a PoC. Based on her research she found that there was 'big bucket of nothing' on her hypothesis. She had also done

a patent search where she didn't find any other similar ideas. This helped her establish the distinctiveness and the operational identity.

> *"We did our literature research to see if there was anything on this […] so we are going to have to create our own study, design the data and study how we are going to go about it. Open it to as many people as you can including small children and there was a very crude study, but it was enough evidence and positive correlation to then go back to [Funder] and ask for a larger grant because I had significant evidence there that it was a feasible concept." (BabyWearable Founder Interview., 2022)*

WiseBees founders developed the prototype for a hardware enabled beehive monitoring system while participating in an IoT hackathon. This prototype won the hackathon and helped them enter an accelerator which provided funding to portfolio entrepreneurs. The prototype and subsequent acceptance into the accelerator demonstrated the feasibility of the product.

> *"[Founders] met at an IoT Hackathon event held in Riga, Latvia. They ultimately won the competition with a prototype of their Smart Scales, which they created in a mere 36 hours." (Magazine Article on Startup., 2022)*
>
> *"When we won the hackathon, one of the jury members basically was VC - and accelerator, specifically focused on hardware. So of course, straightaway, I realised the opportunity and we established the concept and then once we applied to their program, having improved the product in a short space of time. Then yeah, we have gotten into the program." (WiseBees Founder Interview., 2022)*

TrackingParcel's offering had already been validated based on the problem statement given by the customer during the university course project. They were further able to assess the feasibility of the business based on feedback from the customer. RoboticMeasurement participated in a conference where they got feedback from prospects on the commercial viability of the solution, and they also found that there were some companies were willing to pay the university for these measurement services.

For Nexum, business feasibility was tested in its initial days as an operating enterprise. The researchers who worked on the university project were also the founders of the organisation and they lacked the business know how. Their focus was end to end IoT development and sales. These presented problems related to scalability and later they had to introduce a new CEO who decided to narrow down the "How we do it" to just the technology.

> *"[Nexum]was first focusing on hardware, actually sensors and this protocol and gateways and back-end applications and actually even sold as a service measurement to the real estate market in in Finland" (Nexum CEO Speech at Industry event, 2022)*

> *"[…] but then in 2014, We made a turnaround in a company and made it to focus completely on software." (Business Development Manager Interview., 2022)*

BabyCradle's founders had created a wooden cradle for their own children which was their first prototype. In the founders' own words, they sought "after all the sleeplessness, some ROI for us". Traditional cultural boundaries around parenting and infant sleep practices involved using nannies or family support to address sleep challenges. New parents losing sleep was an accepted norm. The founders reframed these boundaries by automating a hammock to rock their infant, similar to how a parent or caregiver would put the infant to sleep. This prototype made for the founder's convenience was further refined once it was made available to other users.

> "*We had like a wooden prototype[...]we sold to friends of friends [...] out of our living room [...] those parents continued to use it even when the child had almost grown out of it when the legs were sticking out. So that was a very strong indication that if it solves for sleep, parents are ready to use an ugly looking prototype too[...]* ***before we had a company" -*** *(BabyCradle Founder Secondary Interview, 2024)*

This new practice of using an automated hammock to put a baby back to sleep, was accepted by parents since it performed its designated function (Deephouse et al., 2017). The positive propriety judgement on the hammock, rendered in the

form of acceptance, legitimated the founders' own beliefs that there was an unmet need. This was bolstered by customers' willingness to pay for even an 'ugly looking prototype' as long as the infant and parent could sleep. However, prior to opportunity discovery, the founders had undertaken boundary creation through creation of a wooden prototype and, their own information search. Customer acceptance encouraged the founders to leave their jobs and start a company with the identity of 'helping parents and children sleep better'. Founders of both BabyCradle and BabyWearable went about idea validation by engaging with parents as well as undertaking research through surveys and focus groups.
BabyWearable's study on the need for a solution, convinced resource providers that this was a real credible opportunity. Funding on the basis of the feasibility study enabled the development of the prototype. Thus, the creation of initial boundaries led to further boundary creation as demonstrated below (16).

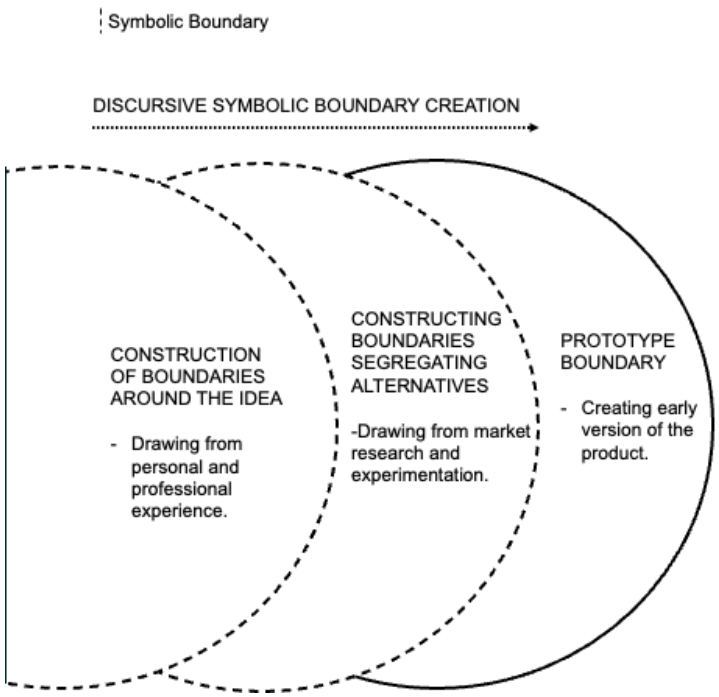


Figure 17 Boundary creation from symbolic to objective

To address any confirmation biases from their own experiences as parents, the founders of BabyCradle first legitimated their initial beliefs about the market's need for the product, once the company was founded, by engaging with sleep experts. The founder claims that she "*snooped around an outpatient department"*

trying to collect data and information from parents and experts. In addition, the founder ran an official sleep survey with a specialist.

> *"I contacted a Paediatric Sleep specialist which was very rare in the first place. But I did manage to convince him [to let me conduct the research] and I sat in his OPD, and I interviewed 200 people myself [...] infant sleep survey which is done by medical professionals and [...] helped us understand that sleep is a problem, [that] parents are doing 'hacky' stuff and it also gave us a conviction that there is a white space."*
> *(BabyCradle Founder Secondary Interview, 2024)*

While the founders had drawn objective boundaries by creating an actual product, they continued changing the symbolic boundaries around venture identity based on their market studies and feedback. Despite their success amongst a limited set of adopters, their research led them to the conclusion that cultural and cognitive boundaries around prevalent child rearing and sleep practices in India would prevent them scaling up. The founders identified the US market as a better business opportunity due to the institutional constraints around maternity leave policies and high propensity for technology adoption. Secondly, their assumption was that a product accepted in the US, would easily gain acceptance in India. This was followed up with subsequent rounds of idea and prototype validation through interviewing parents based in San Francisco, further shaping venture identity and product boundaries.

Founders shape venture identities by differentiating it against market alternatives. The distinctiveness of the venture serves as a crucial signal for evaluators particularly investors. Feasibility verification determines the likelihood of successful commercialisation for an idea, product or business. Activities such as undertaking market research, prototyping and gaining customer feedback, acquiring resources for building prototypes are practices which help transform symbolic boundaries to objective boundaries that provide further proof of the venture's technological credibility and its authority within its category.

4.7 Creating product boundaries

Identity creation and shaping was impacted by the development of prototypes and their evolution. However, product boundaries were also adopted based on design choices and capabilities of the venture and the feedback from the external environment. For instance, in the case of AgeObserve, the design choice was to make the device independent of the people being monitored.

> *"One of the decisions we consciously made was to not use a wearable […] it's very hard for an elderly person to change their daily lifestyle habits which a wearable would demand from them, right? You know the fact that Fitbit users tend to drop their Fitbit usage within the within week six of purchasing the gadget? […] And the second thing is also a large number of people who sort of at age of 80-85 tend to start developing cognitive issues" – (AgeObserve Founder Interview., 2023)*

> *[…] We also did not make it a video-based solution because […] there's a lot of concern on the privacy and dignity. […] So how do we craft the solution?" – (AgeObserve Founder Interview., 2023)*

These aspects guided the initial bounds of the product which was then developed to be privacy aware and installed within the facility of the elderly being monitored. Development of products was also limited by the access to manufacturing resources. In some cases, start-ups were able to gain access to these manufacturers through venture development organisations or investors. This was also crucial to keep costs down while still ensuring high quality.

> *"[Monitor prototype] started as a vague concept of security for Airbnb hosts. The wider idea of Soft Security took form when we participated in the [Hardware Accelerator arm of VC], under the mentorship of […]. [Hardware Accelerator arm of VC] is based between Shenzhen and San Francisco which gave us access to both people in Silicon Valley and the Shenzhen ecosystem for prototyping and manufacturing. This environment enabled us to quickly iterate on and explore different designs."- (Monitor Founder Blog., 2023)*

These founders also discuss the role of emerging technologies in product shaping. AgeObserve incorporated AI and 5G to improve product performance. Similarly, MotherHealth incorporated additional features into the product and developed different versions based on feedback from customers. Thus, after the creation of the prototype and product, the subsequent versions of products are an outcome of iterative development.

4.8 Professional boundary work as boundary creation

It is well researched that the formation of supervisory boards signals the legitimacy of a start-up as well particularly if the membership includes renowned individuals (Møller., 2020). In line with existing research, the research found that supervisory and advisory boards also constituted with improving the profile of the start-up in the eyes of the evaluators. Through the inclusion of known individuals and organisations in the board, the start-up creates a boundary signifying its legitimate authority in its domain compared to other competitors. In addition, as boards are an extension of venture identity, reflecting the competence of the individuals monitoring and advising the start-ups, the formation of boards is a part of venture boundary creation. MotherHealth, BabyCradle, TrafficIoT and HVACHealth, supervisory boards comprised of early investors and the founders. Specifically, in HVACHealth's case, an early investor was also an early customer.

> *"Our first board member outside of my cofounder and myself was our initial corporate VC. With the initial investment that they made, they asked for a seat on the board, at least until we do an equity investment round. So, these were convertible notes […] One of those guys that came over was the CTO of a large company […] and then later he assigned someone else to sit on the board in his stead. Just those three, form the board today."- (HVACHealth CEO Interview., 2022)*

> *"[…]it took about eight months to close that [corporate VC] investment, and that experience sucked […]. Since [initial VC investor] makes hundreds of investments every year, they were like, how can this be taking so long?" - (HVACHealth CEO Interview., 2022)*

HVACHealth was unable to influence the selection of the representative in line with their own requirements. The exertion of control over the organisation as shown by the investors' demand for a board seat at an early, convertible debt stage as well as the assignation of a CTO instead of a business or finance expert as the corporate representative on the board, and time taken to close the investment reflects their desire to influence the product trajectory, lack of trust in the investment outcome or the capabilities of the founders. Paradoxically, the replacement of the CTO also demonstrates a lack of commitment from the organisation. The effort and resources the start-up put into securing the investment compounded by the corporate's exercise of power indicates a misalignment between the start-up and corporate interests and between internal and external stakeholders. While the start-ups' legitimacy can be associated with the presence of a customer organisation on the board, it came at a cost. The lack of founders' own entrepreneurial experience despite their extensive work credentials was also one of the main causes of this misalignment.

Similarly, WaterSensor discusses the role of power relationships with key evaluators as a key criterion in the formation of the board.

> "*One of the water utilities companies was part of our owner group and they required a very stringent governance setup so that's how the board was formed. And to this day the chairman of the board has been the owner of that utility" (WaterSensor CVO Interview., 2023).*

The start-up acknowledged the power of the utility, nurturing trust and legitimacy. Such cooperation ensured minimal friction with a key partner and alignment with the utility broader goals. TrafficIoT's external board members included seed and angel investors. In line with existing research and in contrast to HVACHealth's case, the board of directors support by mediating the power relationship between TrafficIoT and the acquisition target during negotiations.

> *"I got immense help from my supervisory board, it's top-secret, but there was a demand from the subsidiary, when it wasn't a subsidiary, that they could overturn the purchase within one year or something like that […]my*

supervisory board immediately said that, you know, it's not going to happen." (TrafficIoT CEO Interview., 2023)

The subsidiary held the negotiation power since without the share swap-based acquisition, TrafficIoT would have gone bankrupt. The supervisory board's intervention shifted the existing power dynamics in favour of TrafficIoT. The difference between the two start-ups mentioned here (TrafficIoT and HVACHealth) was the opportunity to exercise ownership in their choice of the board members. In the case of TrafficIoT, in line with existing literature, the board member expertise was complementary to the founders' own prior experience and capabilities. Most importantly, there was a rapprochement between the investors and founders before the investment took place which continued after the investment. This is illustrated by the following statement made by the founder during the interview –

"[…] *most important help an entrepreneur can have IS to have a very sound supervisory board, not full of people,* ***friends*** *and […]to have one generation ahead of experiences." – (TrafficIoT CEO Interview., 2023)*

Monitor's founder also exercised control to select the supervisory board members resulting in the alignment of the expectations between the board and the organisation

"We actively sought out people that could essentially fill the role up on the board, even before there was any reason to get the right governance and to get people with authority that could, be a counterweight […]a person who doesn't have the experience of running a business isn't going be able to tell you very much[…]the person who had our first three rounds, those people became very close to me […]its quite crucial for the organisation that they are perfectly aligned"(Monitor CEO Interview, 2022)

In the case of Monitor, board members were selected based on their entrepreneurial experience, not industry experience, even though the founding team did not have industry experience in the real estate or hospitality industries. CleanCooking identified individuals with complementary specialized skills, such as fundraising or IoT business development experience, Like Monitor, Nexum's board

of directors included individuals from significant investors with little to no industry specific experience. These findings are in contrast to existing research on high tech ventures board composition where lesser industry experience amongst the founding team was complemented with higher industry experience amongst the board members (Bjørnåli and Gulbrandsen, 2010; Kor and Misangyi, 2008). The founders' projected willingness to learn from the experiences of other founders specifically the investors on the board serves is a form of soft power that influences support from board members and serves as a positive signal for future investors.

For advisory boards, some start-ups stated that accelerators introduced advisors with suitable expertise to the start-ups such as the case of Monitor, AgeMonitor and MotherHealth. However, AgeMonitor did not formally constitute an advisory board because of the perceived disingenuous nature of the practice, that of attaching a name for the sake of legitimacy, without any real engagement.

> *"An example of fake progress would be like I got a bunch of like advisors on my deck that don't really know much about the company, aren't really that engaged, but it looks like we have all these people helping us that have a lot of letters behind their […]you're just throwing maybe some of your stock options out the door for nothing to just stick a bunch of props on your […] not a bunch of like Cambridge professors that can say that the radar sensing is cutting edge and it's not going to prove the business." (AgeMonitor CEO Interview., 2022).*

While the founder acknowledges the necessity of an advisory board for the company, he does not consider pursuing legitimacy by including prestigious experts on his board. This is despite the start-ups' industry focus on enabling care for the elderly, like AgeObserve. The founder prefers commitment over prestige from board members, expecting their role to be an extension of the management team rather than passively acting as a source of legitimacy. This is in contrast to existing literature that discusses the importance of prestigious advisory boards in imparting legitimacy to start-ups (Mitteness, Baucus and Norton Jr., 2013). In a similar vein, SkyTaxiInfra also takes a more pragmatic approach to recruiting board members and looks at it as a management challenge.

"[…]an adviser itself has no value at all. He's a nuisance because he'll come up with ideas that you have to answer to, and you have to explain why you are not doing what he suggested. […] the only way to make use of advisors is by managing them very concretely, and the challenge is that when you're starting out, you don't really know what to ask them." (SkyTaxiInfra CEO Interview., 2023).

A start-up's legitimacy dictates its ability to attract quality talent (Zimmerman and Zeitz., 2002). In addition, start-up teams impact funding decisions that influences the strategic performance of firms and new firms emergence. Early employees at start-ups are recruited based on recommendations from investors, accelerators, universities and often times from the founders' own connections. This contributes to legitimacy building, as start-ups utilise available resources and networks to build their teams. The recruited employees contribute new values in the organisation that can better align with the external environment, strengthening legitimacy or create internal conflict. This process influences organisational boundaries, shaping the organisation's capabilities and consequently impacts the organisation's capacity to adapt and evolve. It influences the perceived credibility, competence and legitimacy of the venture in the eyes of investors, customers, and partners.

WiseBees' early employees were recruited from personal connections of the founders and their relationship with their alma mater. The founder explicitly states that they aligned their employees with the long- term vision of the start-up through "*having conversations, exploring a working relationship, and making sure we're all aligned for the long term. The key thing is to enjoy working together and having a mission that's meaningful to us all.*" (WiseBees Founder Interview., 2022). Similarly, BabyCradle's founders too repeat the start-up's vision of ensuring sleep for infants while 'pitching' to prospective employees, ensuring they understand the goals of the organisation as well as develop an empathy for the customers. This ensured congruency between values of the employees and founders increasing internal legitimacy. Further, WiseBees' employees undertook effectuation during their engineering efforts to overcome the uncertainty with respect to the components supply chains. They supported

through product boundary management - by adapting the product to constraints in the external environment as discussed in section 6.2.

FullBattery, Monitor, IoTSecurity, MotherHealth all recruited the first set of employees through their universities. The founder of MotherHealth recruited individuals through a combination of networking and by tapping into his alma maters' resource base. "There are a couple of my own people, from the same university, in the team." This indicates high levels of trust and values alignment between the founder and prospective employees. Similarly, AIBlockchainIoT, WiseBees, CleanCooking, all recruited individuals from their prior roles and experiences or recommendations from their network. This is in line with research which suggests that affiliate-based hiring is important due to assured cohesiveness, and thereby, internal legitimacy. Specifically, since the start-up is a reflection of the founder in the early stages, actors that have a similar background such as a common educational or industry background, share similar values with the founders, that makes for greater internal legitimacy and greater agility in an uncertain environment. (Drori and Honig, 2013; Leung, Foo and Chaturvedi, 2013). However, research also suggests that early stage hiring practices set the stage for homophily at later stages of the organisation as well, preventing the start-ups to gain the benefits of creativity and innovation observed in diverse teams (Brymer and Rocha, 2021)

In the case of BabyWearable, early employees were exclusively hired through serendipitous encounters after starting up and had no prior ties to the founder. This can be attributed to the fact the founder did not have any pre-existing mental schemata or biases (due to lack of relevant experience or qualifications) that could influence decision making in this regard. In addition, having gone through multiple government and independent start-up advisory sessions where the founder faced challenges in getting stakeholders to understand the value proposition *"I spent a lot of times going back and forward with [advisory service]. They didn't really know where to pinpoint me because I had an invention as opposed to a solid business-like plumbing or hairdressing and there's not a lot of information out there for an IoT business"*, finally meeting actors who expressed an interest in and understood the value proposition, who had relevant experience and networks, was another reason for these hiring decisions.

Post hiring, start-ups employees enabled boundary *bridging* through engaging and adapting products for customers. In the case of MarineMeasure, the start-up was installing 'half- baked products' on customer premises and testing them onsite. The specific issue around hardware debugging required employees who could engage in legitimacy repair work by helping bridge the gap between the start-up's product and technological capabilities and the demands in a production environment at the customer site. The expertise and efforts of the employees is crucial to ensure continued start-up legitimacy as perceived by the customer. During the initial stages, with early adopters, primarily cruise ships, the start-up employees, some of whom moved to a port city, were able to test and maintain the equipment once the ships came to port. As the product was refined and the start-up found a new customer segment in cargo ships, there were delays in testing and maintenance of equipment which could take place only a few weeks after any problems were discovered, undermining the efficiency of the solution. As mentioned in section 6.6, a project manager functioned as the bridge between the hardware product and customer environment. The advice offered by the organisation's CTO on installing ready products in customer environments is contrary to commonly accepted lean start-up approach which focuses on getting an MVP to market and adapt it based on validation tests (Ries., 2011).

> *"I mean, even in the end it was a big headache. We had project managers whose only job was to make sure that they would know when a certain ship is on board or on port, where to send the hardware, how to make sure that you have guys in the right place to do the installation. The schedules changed all the time. So, you may need to resend the stuff to the next port and that sort of thing. So, it was a big, big headache." (MarineMeasure CTO interview., 2022).*

The start-up had employed project managers that could bridge the gap in their value chain between development and installation as well as between the start-ups existing capabilities and the industry context. This was important to ensure continued product legitimacy and affirm reputation as a reliable service provider after sale. At the early stages and later, these employees played an important role as a bridge between the start-up and the customer, as well as the customer needs and product capabilities. Nexum, MarineMeasure, BabyCradle and WiseBees

all highlight the importance of the employees for a start-up in getting to market, particularly in legitimation of the start-ups products and capabilities.

4.9 Conclusion

Boundary creation starts before a venture is created. This chapter highlights the different boundaries i.e. institutional, venture, practice, ecosystem and product created by the efforts of the founders and their teams. Founders draw symbolic boundaries from personal, professional, and discursive experience that demarcate legitimate problems and distinctive ideas. Through validation and verification, these symbolic boundaries are translated into objective boundaries around product development, venture creation and hiring and board creation. At the field level, ventures created ecosystem boundaries as platform leaders or complementors, and institutional boundaries through standards, policies, and consortia.

This chapter has shown how start-ups create boundaries across multiple levels of analysis. Figure 16 synthesises the findings on boundary creation. This is set in motion by triggers i.e. the desire to create social impact, resistance to innovation in the current state, and the pursuit of autonomy. It is enabled by founders' technical, industry, entrepreneurial, and educational experience alongside that of their teams. The mechanisms include competence, failure, and continuity narratives, reframing of problems, and iterative improvement of platforms and prototypes. Their outcomes are opportunity recognition, venture identity underpinned by entrepreneurial identity, distinctiveness from alternative solutions, and technological credibility. Propriety judgements from customers, investors, and incumbents enabled further boundary work, which in turn generated validity cues available to wider audiences. Yet the created boundaries are provisional. New practices attracted negative evaluations, consortium membership-imposed obligations, boards introduced power asymmetries, and standards invited imitation. Once drawn, boundaries must therefore be maintained and adapted as evaluators render new judgements. The next chapter examines this ongoing work of boundary management.

5: Findings II : Boundary Management in IoT Ventures

New ventures overcome liabilities of newness by seeking legitimacy from resource providers. They do so through symbolic actions like signals of competence, credibility, achievement and network relationships. These signals are embodied in venture attributes of competitive positioning, endorsements, certifications and team composition that reduce uncertainty for evaluators and buffer ventures against adverse judgement (Zimmerman and Zeitz, 2002; Khoury, Junkunc and Deeds, 2013). In doing so, ventures adapt their organisational boundaries, conceived through competence, identity, power and efficiency, to the requirements of different legitimating audiences (Santos and Eisenhardt, 2005). Boundaries govern access to material and symbolic resources and are continually redrawn in response to individual effort and environmental change (Gieryn, 1983; Abbott, 1988; Langley et al., 2019). These dynamics are acute for ventures in the Internet of Things (IoT), a category that, despite four decades of development, lacks a settled definition and exhibits significant interpretative flexibility across and within stakeholder groups (Pinch and Bijker, 1984). This chapter will show how IoT's contested category boundaries generate distinctive legitimacy challenges, and how ventures manage their boundaries in response

5.1 The ambiguity of Internet of Things (IoT) as a category

The Internet of Things does not have a singular definition (Pandey, Chalmers and Gordon, 2024). IoT comprises a number of heterogeneous technologies whose functions and meanings keep shifting depending on who is being asked the question. Even though IoT “technologies” and their variants have been under development since the 1980s, many legacy IoT systems run on conditional logic. Without data analysis or machine learning, presence and use of legacy IoT systems show how the label ‘IoT’ can be used to describe technologies that are functionally hollow. The IoT ambiguity documented in this chapter is, in part, a product of incomplete standardisation, the absence of a settled thematic identity for IoT that would otherwise constrain and guide ventures' self-definitional claims (Kim., 2025)_

This ambiguity raises two important questions - First, who has the authority to define what counts as IoT and what does not. Definitions can be dictated by

several actors- ventures themselves, who define IoT through their product narratives; investors and accelerators, who apply their own evaluative frames; standards bodies (e.g. IEEE, ETSI, ISO)(Atzori et al., 2017) that codify technical specifications; and regulators, who determine which IoT applications are permissible in specific jurisdictions. These actors are not aligned, and this incongruency is itself a source of legitimacy challenges for IoT ventures that must simultaneously satisfy multiple definitional criteria. The following sections denote the various frames based on which actors in the scope of this study such as investors, accelerators and ventures define IoT (Table 22 & Table 23). The second question is whether the ventures in this study, self-identify as IoT from inception or only retrospectively, and how this affects their legitimacy. The empirical evidence in this thesis reveals both types of start-ups. Some ventures like Monitor, Nexum, MotherHealth, identified as IoT from the outset because their founding proposition was explicitly built around connected device ecosystems (Table 18) others began with a narrower product identity (e.g. sensors, data analytics provider, AI driven monitoring solution) and only used the IoT label retrospectively. This retrospective adoption implies a shifting of category boundaries and carries legitimacy risks i.e. if key evaluators had perceived the IoT label as opportunistic rather than a genuine technological identity, ventures may have been delegitimated early on. The following subsections unpack this ambiguity due to semantic fluidity of the category and shifting boundaries.

Case	Initial Label	Retrospective Label
BabyWearable	"The [device name] as a wearable device that I have created for infants that will give parents and caregivers the upper hand"(BabyWearable Investment Pitch., 2022)	"[…]there's not a word to describe it and it's wearables, it's tech, but it's not super techy, but it is doing something. So IoT fits right in there[…] (BabyWearable, CEO Interview., 2022)
YourPleasure	"[…]I will present the idea of AI sex toy, robot whatever…" (YourPleasure Secondary Interview., 2022)	"[…]these early-stage startups graduated from our traditional intensive program focusing on hardware and IoT -[…] YourPleasure" – (Hardware Accelerator and Fund Blogpost., 2023)

FullBattery	"We provide battery intelligence as a service" – (FullBattery CEOs Accelerator Pitch., 2017)	"The company is developing IoT and analytics solutions for industrial batteries – (FullBattery CEO Secondary Interview., 2023)
WiseBees	"We want to enable bees to share climate knowledge with humans" – (WiseBees CEO secondary interview., 2021)	"That [IoT] would be the hardware which consists of multiple components. The first device that we launched is smart beehive scales" – (WiseBees CEO Interview., 2022)
MarineMeasure	"We are a data analytics company" – (MarineMeasure CEO Pitch., 2014)	"I think that [IIoT] quite well explained what we were doing"- (MarineMeasure CTO Interview., 2022)
CleanCooking	"We set out to provide meters to the cylinders of every home." – (CleanCooking Blog Post., 2021)	"Gas 360 is an early-stage start-up using IoT to […]" – (CleanCooking Accelerator Demo Day Pitch., 2022)
SkyTaxiInfra	"We are creating a network for internet of air mobility" (SkyTaxiInfra CEO Presentation., 2021)	"[…] our system has two components […] The Airborne segment is […] if you want to use the IoT language, it's a smart edge device." – (SkyTaxiInfra CEO Interview., 2023)
AgeObserve	"[…] a monitoring system that provides privacy for loved ones and peace of mind for caregivers." (AgeObserve Explainer Video., 2021)	"[AgeObserve] provides a hardware enabled service […] That[IoT] to me implies there's a BM that's wrapped around hardware" – (AgeObserve CEO Interview., 2022)

Table 13 Examples of ventures retrospectively referring to IoT

5.1.1 Semantic fluidity of IoT

Semantics of IoT differs across industries and within standard-setting bodies (Pandey, Chalmers and Gordon, 2024). Depending on context, IoT is framed through the lens of privacy, security, safety, and ambiguity. Instead of denoting a stable technological category, IoT is a malleable construct Its identity emerges only in relation to context and interpretation. This was also reflected in participant responses. Actors who control resources (investors and accelerators) offered divergent accounts of IoT, revealing inconsistencies across and within groups. These definitional struggles matter because IoT based ventures depend on

evaluators for legitimacy and need to align their organisational identity with these different interpretations.

Analysis of the data revealed five frames through which IoT was defined(Table 26). These frames show that IoT is a contested category where meaning is negotiated. For IoT based new ventures this requires navigating these different dimensions while aligning with evaluator expectations. These efforts of the new ventures reshape the norms and values underpinning IoT.

One of the common frames used for IoT was context yet its meaning shifted depending on the situatedness of the organisation. Respondents used their own or partners' organisational context to define IoT such that it reflects the institutional boundaries of the respondent rather than standing as a coherent technological category. This frame or even just a reference to context was absent among investors and accelerators underscoring a disconnect between those building IoT solutions and those allocating the resources. Another recurring frame included IoT subcategories such as wearables, industrial IoT or telematics. Here the respondents drew symbolic boundaries separating the parent category of IoT. These subcategories like Fitbit or wearables were mobilized to make ventures legible to external audiences.

Respondents also drew on adjacent technology categories like AI/ML/cloud computing or 5G to explain IoT. This was particularly common among accelerators as one of them admitted that in 2016, IoT was the 'most fashionable' term that eventually expanded to include everything branded as 'deep tech'. The tendency to define IoT through whichever technology happens to be popular reveals the flexibility in IoT's category boundaries but raises questions about whether IoT has a substantive identity or latches on to the legitimacy of more clearly defined fields.

5.1.2 The risks of shifting category boundaries

Entrepreneurs and evaluators continuously redraw symbolic boundaries around the category not to clarify what IoT is but to make it momentarily comprehensible to legitimate their own product and venture to the audience (Also discussed in 5.1.1,

5.6, 6.3 and 7.1). Thus, IoT's category boundaries remain fragmented, malleable and dependent on the politics of explanation (Latour., 1988). This leads to risks for the ventures as well. Ventures might find it difficult to use IoT to appear distinct from others as IoT could mean anything from wearables to industrial sensors to cloud applications. 5.1.1 discusses the frames used by IoT start-ups. IoT as an anchor in defining venture identity reduces funding opportunities for the start-ups as investors and accelerators do not prefer to a context frame when defining IoT. In IoTSecurity's case, an investor dismissed interference detection because 'his use case is not critical enough… he doesn't have the experience of a manufacturer who would use wireless technology for his processes' (IoTSecurity Founder Interview., 2022). This negative judgement was rendered due to a lack of context frame. HVACHealth received 'a lot of negative feedback' from accelerators in a life-sciences-focused ecosystem that 'didn't understand the technology or the HVAC market,'(HVACHealth Founder Interview., 2022) and for BabyWearable, advisory services 'didn't really know where to pinpoint me because I had an invention as opposed to a solid business like plumbing.' (BabyWearable Founder Interview., 2022). Conversely, evaluators articulated the frames they used such as choosing problems 'you have to be able to explain to a layman… a broader perspective than just solving one lens, one problem,'(Early-Stage Start-Up Investment Firm Partner Interview., 2022) and an accelerator mentor reduced the category to 'cost and output.' (Hardware accelerator arm of VC's mentor's interview., 2022). Ventures whose identities remained anchored in context frames had to reframe to be evaluated positively. This is consistent with incorporation of AI labels among BabyCradle, AgeObserve and FullBattery. These changing discursive boundaries around IoT make it challenging for IoT based new ventures to gain and maintain legitimacy. In addition, IoT start-ups also face a number of legitimacy challenges that are discussed in the next section.

5.1.3 Category legitimacy challenges and their impact on IoT start-ups

Founders struggle to explain what IoT is to evaluators and while engaging in collaborative boundary work find it difficult to establish common ground for mutually beneficial outcomes (Langley et al., 2019). Many of the participants expressed disillusionment with IoT arguing its failure to live up to the hype despite being promoted for nearly two decades by a number of agencies. One interviewee

spoke about the time when IoT companies were as prevalent as “mushrooms from the ground” only for most- including those backed by large corporations to fall short of their aims.

The founder of HVACHealth said - “Too many CEOs back IoT when it's not needed, and it ends up getting a bad reputation”. Another interviewee echoed the same sentiment as “IoT failed to deliver on most of its promises.” The founder of ‘MarineMeasure’ attributed the failure to IoT’s inability to deliver tangible end user value. Others highlighted the gap between expectations and delivery. They emphasised the limits of IoT as a data extraction exercise - producing a large amount of information that was limited in usability and integration. These performance challenges result in frustration for adopters: technical value rarely matched the expected economic value (Deephouse and Suchman., 2008; Deephouse, Bundy, Tost, Suchman., 2017).

The respondents rendered the propriety judgement that IoT and organisations that develop IoT have failed in their purpose. At the collective level, the lack of explainability of IoT coupled with the emergence of newer technologies including machine learning, deep learning and generative AI resulted in a decrease in validity. A respondent who was interviewed at the end of 2022 when ChatGPT and GPT3.5 had been released, highlighted the decrease in relevance of IoT.

> *“I don't think people talk about IoT much these days[...]everybody includes machine learning technology in their products and services, and IoT [...]In the future, more things will be connected than ever before. I just don't think that IoT in itself will continue to be this particular subject in the same way that artificial intelligence or machine learning is [...] Whether you put it [IoT] in a cloud, whether you put it on a phone, whether you put it on one unique laptop, whether you tokenize it, nobody cares. But people care about the cost and output.”*
> *(Hardware accelerator arm of VC’s mentor’s interview., 2022)*

This was supported by the change in labels used by the interviewed companies (BabyCradle, AgeObserve and FullBattery) that had first associated with IoT labels and more recently transitioned to using AI. This shows that start-ups that are IoT

based need to reposition themselves within more popular categories or use hybridization i.e. straddle multiple categories. Companies developing IoT technologies (like Nexum) need to focus more on performance for legitimacy.

5.1.4 IoT based ventures' legitimacy challenges

IoT start-ups face immediate pressure to prove that their solutions work. Investors hesitate to commit funds till ventures secure their first customers, yet developing prototypes requires precisely that initial funding. This creates a dilemma in which both customers and investors demand proof for their evaluation processes.

> *"You know what an investor looks at - Can I scale it up? How are my returns going to be? Now, if there's hardware you have an inherent bottleneck there. Hardware means how many [units] can you provide? Somebody must go deploy it, install it [...]Obviously, scale is a challenge. Second challenge, is how do I see a return on investment unless a motor actually fails? [...]And even if it fails, before it fails, [startup] is going to order that expensive bearing, which may have taken 15 days to come from somewhere."(IoT accelerator and innovation platform's directors interview,, 2022)*

Founders manage this dilemma by showcasing prototypes early on in engagements with evaluators and provide initial customer references where PoCs have been tested without any promise of scale or even payment in some cases. However, in industrial IoT, benefits are only visible if an exception occurs such as equipment failure, making it difficult to generate tangible returns. This indicates another performance challenge - success contingent on technical utility as well as events beyond the start-ups' control. These challenges intensify as ventures transition from minimum viable products to full stack solutions. Each hardware development iteration requires new production processes and co-ordination with third parties creating greater risk of delay and failure. Even when performance is proven in controlled settings, field deployments expose vulnerabilities: sensors malfunction, environmental conditions demand costly casings and supply chain disruptions require redesign and lead to further delays. These performance challenges undermine the claims on which the IoT start-ups seek support, putting their survival in jeopardy.

IoT venture founders also face meaning challenges (Deephouse, Bundy, Tost, Suchman, 2017). Interviewees highlighted a lack of shared meaning - customers faced difficulty in comprehending what IoT meant. HVACHealth's founder mentioned an anecdote where a past employer who had invested billions of dollars into IoT was unable to explain what the technology was. Potential IoT customers found it difficult to comprehend IoT and this made it difficult for IoT based ventures to align with expectations of their customers. The founder of FullBattery discussed the technical challenges, namely IoT sensor lifecycles have a major impact on the start-ups BM due to the periodic maintenance cycles-

> *"We can get data from it [IoT]. But when can we take advantage of it? That's one of underlying problems […] the biggest challenge is that the real life of a sensors is simply ruining many business cases because you pretty much will find a case where you can save some euro here and there, but then every three years you need to send maintenance technician to replace batteries. Your case, it's gone. […] Really like a seamless connectivity or like seamless data integration because now you can have like data from here or from there, but this whole automation of - you get the data at your hand whenever you need it, is still a bit of a challenge" - (FullBattery Founder Interview., 2023)*

From a business challenge standpoint, the founders highly experienced in IoT and technology development and found it difficult to align with the expectations of investors who did not have the same know-how. Some other founders did not have any experience in IoT or technology development and found it difficult to open the IoT black box for evaluators.

> *"The problems you solve, you have to be able to explain to a layman, like me. What is the advantage of whatever you can do with your IoT, if it does not solve an actual problem [...] for a lot of people? Then it is mostly interesting for the inventors themselves and not for investors. That storyline of [...] produce a broader perspective than just solving one lens, one problem."- (Early-Stage Start-Up Investment Firm Partner Interview., 2022)*

These meaning and value challenges prevent the venture from gaining access to much needed resources and stymies its legitimisation journey. This lack of explainability i.e. the ability of the entrepreneur to explain the technology and its functionality in a way that makes sense to them causes evaluators to question the new venture's identity and the competence of the organisation leading to negative propriety judgements. This is echoed by start-ups as WiseBees founder spoke about IoT complexity causing investors to not “understand many of the moving parts”. This issue of explainability is accompanied by the need for quick returns by impatient VC (Zuboff., 2019). Investors want software because hardware companies have additional costs and are unable to provide precise support as opposed to ventures running a traditional business. Early-stage challenges include a lack of funding that limits the development of prototypes. At any stage, manufacturing hardware requires significant investment before companies can see returns and scaling a business which requires hardware manufacturing is considered a drain on financial resources. In addition, new ventures need funding to develop customized versions of their prototypes to gain an initial set of customers.

Interviewees mentioned that installing IoT is a secondary concern compared to the core business requirements of the customer to increase revenues. It falls upon the start-up to convince the customers of the benefits of using IoT by directly tying it to their business performance to increase the cognitive legitimacy of the product. External shocks like COVID-19 and Ukraine war further reinforced IoT’s perception as a non-essential investment compared to new machinery. Start-ups adapt boundaries of identity and establish competence as discussed earlier, but they also need to manage organisational power dynamics by spending significant time convincing key stakeholders within the organisation who see technology as a threat to their jobs. Besides this, start-ups need to manage the boundaries of their alliances for faster customer access, reducing time spent to acquire customers since ‘investors will not wait for something to be adopted.’ Outside of Industrial IoT, in the case of homes or buildings, start-ups need to demonstrate the benefits that their technology will bring to build task legitimacy (Ren., 2019). They need to recruit technically knowledgeable customer service teams thus improving organisational competence. According to the director of the accelerator and

innovation platform, funding will enable the start-up to assure customers that 'if you don't like [the product] within three months, I will take everything back.'

The founder of AIBlockchainIoT highlighted the importance of timing in IoT. If the product is too early for the market, customers struggle to see the benefit leading to meaning and value challenges early in the venture's journey. Lengthy certification cycles constrain start-ups by delaying its product launches and availability to customers. This creates concerns related to pragmatic and cognitive legitimacy. In each case, start-ups need to focus on sense making for the customer to ensure alignment with customers and reduce the risk of rejection from potential customers.

Another challenge is to prove enduring value to different sets of evaluators i.e., customers and investors. IoT BMs like subscription based or data driven require customers to share information and commit to recurring payments. As mentioned earlier, promising returns to reassure hesitant customers also means ventures putting themselves in a precarious position. Even when customers agree to start-up pilots, maintenance cycles erode margins, replacing or servicing sensors every few years consumers scarce resources. Exogenous shocks such as supply chain breakdowns, geopolitical tensions or component shortages further increase challenges and require boundary management with partners.

To conclude, the success of the start-up is not just contingent on whether IoT can create data or insights but whether this value is realisable in ways that satisfy both investor and customer expectations. When customers cannot see actionable value from the IoT systems and when investors demand faster adoption than customers will allow, start-ups are trapped in a conflict. Failure to reconcile these expectations undermines the venture's legitimacy.

5.2 Addressing issues stemming from COVID-19 through boundary management

Many of the start-ups stated difficulties in getting access to supply chain components due tothe COVID-19 crisis and subsequent geo-political ramifications on global supply chains. In the case of BabyWearable, the start-up was supported by their accelerator in getting certified remotely for their products but still had

to delay launch due to supply chain issues. Despite these challenges, the start-up founders still moved to the US in the middle of 2020, to launch and get enough pre-orders before debuting at one of the biggest consumer electronics events in the US the following year. The start-ups' founders employed their ecosystem of developers, designers and manufacturers to develop a ventilator splitter during COVID to support the paucity of ventilator devices.

> *"COVID derailed a lot of things for lots […] supply shock in terms of like components' […] we were forced to for example, unfortunately, disappoint a lot of our early supporters because we couldn't procure the thing on time. […] We are one of the first companies to get certifications remotely. I don't think it's been done before it was just something that came out […] [Hardware accelerator arm of VC] helped us out." (BabyCradle Chief Growth Officer Interview., 2022)*

> *"This is a simple mechanical device, permitting one ventilator to ventilate more than one patient simultaneously. […] Such splitters are not entirely novel […]. However, their utility in the context of COVID-19 is uncertain, since ventilatory support of various patients may not be similar, and the risk of cross-contamination is significant. Nevertheless, several Indian innovators imitated the design with wide media publicity, although none have been clinically validated. (Secondary Journal Article mentioning BabyCradle., 2020)*

However, the start-up did not undertake clinical validation of the ventilators which is a crucial part of the healthcare product development process, before releasing it to the market. The process for product development in healthcare was eschewed in favour of speed to launch. BabyCradle's team managed the challenges through COVID-19 by seeking support of their resource providers, adapting to external constraints through remote certifications and creation of products in the healthcare space. Similarly, another start-up developed a product for COVID attestation at the workplace.

> *"We created a product called COVID [product name]. Thousands of people across North America use it. It has three functions: the self-attestation for*

workers to make sure they are not sick, testing, and contact tracing. We introduced that product because there is a market need, and it's a humanitarian function where we're trying to reduce the spread of this infection." – (AIBlockchainIoT Founder Podcast Interview., 2021)

"Even though a lot has been happening digitally, and we have been actually able to complete a project which we started pre-pandemic. But we were not able to start a new project because most of the companies backed off and said that they have a lot of internal problems to solve and we did not really progress anywhere."- (FullBattery CEO Interview., 2022)

"We had a little bit more on our commercial evolution. We started out targeting residential applications, homes in the US. But we struggled in finding a partner that could move as fast as we needed them to move[…]we had a base in Shenzhen and we started getting a lot of inquiries from commercial companies that would come to visit [Hardware accelerator][…] we put all of our resources into going after the commercial market […]we lined up 12 or 14 big pilots with massive companies, Sumitomo in Japan, Singapore Resorts World Hotel." – (HVACHealth CEO Interview., 2022)

"And then COVID hit […] Honestly, our Japanese partners, they could not even have a conversation like this because their companies didn't allow teams or zoom or anything. So, we weren't even able to communicate, and they weren't going to the office. […] we had to take a major reassessment of what we were doing and kind of retrench and redo everything that we had done, here in the US to find those types of customers here." – (HVACHealth CEO Interview., 2022)

Start-ups like HVACHealth, BabyCradle, AIBlockchainIoT adapted to COVID through temporary pivots such as creation of a standalone product tailored to specific use-cases at that time while others such as HVACHealth had to re-configure their entire BM and pivot multiple times in order to manage the fallout from COVID. Some start-ups viewed COVID-19 as an opportunity and developed products that

were a pressing market need, some like FullBattery focused on their projects but were only able to successfully execute ones which had started pre-pandemic. This was a common phenomenon across geographies, another accelerator advised start-ups to focus on business development and get purchase orders in place and move to execution when the customer facilities were opened.

> *"And we told these guys, look, you cannot really deploy right now, but make sure that you convince these CXOs to take a decision. You are very close to getting a purchase order signed whenever the factory opens, […] you go over there immediately and deploy it. And that exercise […] is a very long process of convincing a corporate why they should, you know, engage with this. And that exercise was done during the COVID situation very well." – (Accelerator and Innovation Platform Director Interview., 2022)*

The venture development organisations supported start-ups from their portfolio through advisory and connection to corporates and customers such that the start-ups gained and maintained cognitive and pragmatic legitimacy. Start-ups engaged in relational work for offerings to get adopted. In a similar way, BabyCradle was supported by their accelerator through remote certification. Some other accelerators also mentioned the work, hardware start-ups had to put in for product development especially when COVID-19 related restrictions were in place.

> *"It wasn't easy, but it's possible […] I mean, when you work with hardware, it's more self-work they have to put inside, so they have to be more proactive, and they have to work and be more hustling, on the final results that they can obtain. We cannot control that we don't see them. So, it's more about the attitude." (Corporate Accelerator Program Manager Interview., 2022)*

Another major outcome of COVID-19 was component shortages and supply chain issues. Start-ups faced a number of challenges as in the case of Nexum that saw its revenue hit due to the component shortages in 2021 and COVID restrictions in 2020. Other start-ups prioritised their survival through bricolage, by procuring sensors and devices from multiple places and re-designed their products to keep their product development timelines

“I'm sure you are aware that in the past 12 to 24 months, there has been a, let's say, significant issue with the component shortage. […] We don't make any devices, but it's our device manufacturers who makes the devices. So obviously, if our customers are not able to get the components, they are not able to make the devices […] for the for the year 21, our revenue was hit 30%, because of the component shortage […] So during the lockdown, there's no installations.” – (Nexum Business Development Head Interview., 2023)

“What could be done in China in terms of prototyping, in a week, would take you a month anywhere else. So, there was a huge speed and price advantage in terms of just component prices. […] you can really cut down the amount of time it takes to get your engineering samples and manufacturing pilots, getting it off the ground. Things have slowed down because when they have lockdowns, it is difficult getting components out. That said, it is naive for people to like, think you can just replace China entirely. Like they're so integrated into the supply chain […] Our first priority is just to survive, to be quite honest and prove out the market […]” - (AgeMonitor Founder Interview., 2022)

“We have been affected by a lack of availability of certain components, but that suddenly forced us to iterate fast and to just create multiple configurations, which slows down the whole process, which is the main reason why we haven't had stock like most of the time, actually. But now finally, we are reaching a point where we have stuff to like we have hardware to sell.” – (WiseBees Founder Interview., 2022)

Another start-up faced challenges in seeking funding, particularly after COVID-19. They realised that they would need to look at short term commercial viability to get funding after COVID-19 and started looking at immediate applications for their technology in an existing sector. They zeroed in on drones.

“It was that kind of with the shift in the financial market, there was a requirement to become more and more concrete with regards to product development and also, kind of more imminent projects, so an 8-year time

frame didn't work anymore. You needed more like an 18-month time frame." - (SkyTaxiInfra CEO Interview., 2023)

"That was literally when COVID started, so everything went remote. So, we kind of had this right in our DNA right from the beginning, the remote work, so yes, still you have to turn up on time. […] And of course, they get feedback from all the mentors. So, if the mentors like you, then of course, you have a higher chance of getting the investment."(WiseBees Founder & CEO, Interview)

SkyTaxiInfra integrated their system into heavy drones that would allow them to operate simultaneously in small airspace and provide services such as monitoring and analytics to the end customers. This integration was tested with partners for media and news use cases and used to demonstrate the feasibility of the solution in the drones sector. In the case of WiseBees, they found they still had to follow similar practices as pre-COVID, just remotely in order to get funded by their accelerator. During and after COVID-19, start-ups managed their boundaries through adaptation and pivoting of their practices, products, processes and BMs. Where COVID-19 represented an episodic trigger, evaluator scrutiny is a continuous one. The next three sections examine boundary management directed at the three principal evaluator audiences: investors (5.4), venture development organisations (5.5) and customers (5.6).

5.3 Seeking legitimacy from investor audience:

The challenges mentioned earlier lead to difficulties in securing funding as investors prefer shorter return on investment duration and fewer liabilities related to heavy assets, as a result hardware based IoT start-ups struggle to appear attractive. To overcome this bias, founders engaged in boundary management practices to convey competence, credibility and capability. These included crafting and rehearsing pitches, attending conferences and events, exploiting their network, creating investor funnels and deploying fundraising teams. These practices are accepted by the entrepreneurship community as necessity in their pursuit of resources and organisational survival. However, they are also boundary manipulations as ventures reshape and stretch venture boundaries to be perceived

as investable for a limited duration of time and contract when the window closes or when their requirements are met. The key practice themes that emerged from the data were profiling investors(5.3.1), changing contexts(5.3.2), investor funnel creation(5.3.3) and event participation (5.3.4). 5.3.5 and 5.3.6 examine the impact of feedback and post selection dynamics on the venture boundaries.

These findings show that investors' dominance defines boundaries of power and competence that start-ups have to manage but despite these efforts, leads to negative propriety judgements. To temper this dominance, start-ups create investor profiles and take a programmatic approach to fundraising. Creation of investor profiles defines the start-ups' investor outreach strategy which includes practices such as participation in events, pitching to investors, reaching out to networks for references, and contextual reconfiguration. These are common across entrepreneurs as they go about seeking legitimacy from resource providers for their ventures.

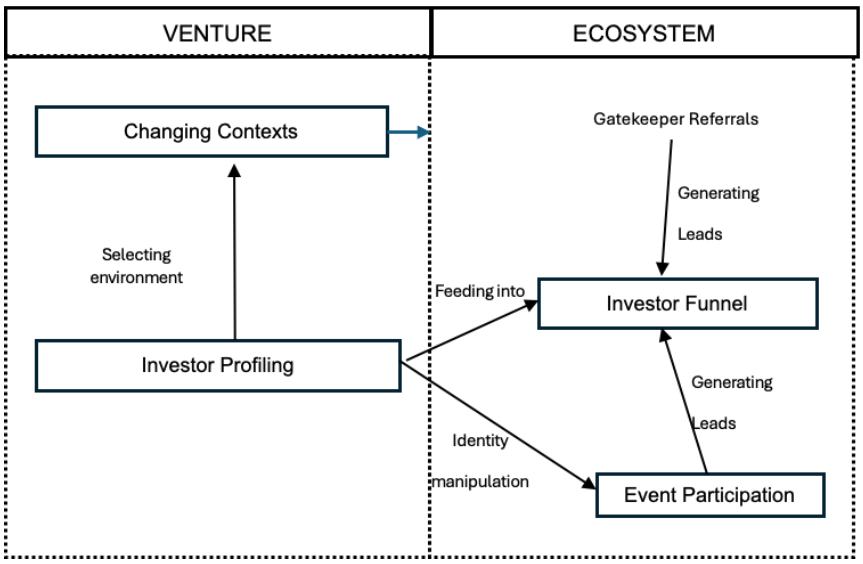


Figure 18 Seeking legitimacy from investors through boundary work

5.3.1 Profiling Investors

Founders identified the prospective investors' theses and expectations and reshaped their narratives and pitches. They also typified the prospective investors in order to better manage the investors' propriety judgement process through their performance and content. This strategic reconfiguration of discursive organisational boundaries is critical to achieving legitimacy (Glaser and Lounsbury,

2021). However, it also reflects an asymmetry of power and an adverse selection problem as ventures try to gain resources at all costs by mimicking investor expectations.

> *"But some of the investors are still quite an old school mentality, like older white men particularly. So having me go away and find out who's on the panel, and who am I pitching to is quite a lot easier to get something to engage with them and kind of know whether to come in strong or to come in on a kind of low level." (BabyWearable Founder Interview., 2022)*

> *"It's basically also dependent on the profile of the investors, they are more risk-taking and have deeper pockets. It doesn't matter to them if they don't get revenues as of tomorrow." (SkyTaxiInfra Business Development Manager Interview., 2022).*
>
> *"So, somebody who has that sort of patience for a long-term return, somebody who understands that there's an impact, which is also going to come, apart from the financial return, who himself or herself […] understand that path also. […] (MotherHealth Founder Interview., 2022)*

The desired characteristics of high-risk tolerance, patience for long term return, social impact awareness, the level of financial resources and type of resources offered by the investor allowed the founders and their teams to identify and select the investors who they could align with to maximize their legitimacy outcomes. Besides this more strategic boundary management, founders also evaluated investors when presented with fundraising opportunities in the form of demo days or pitch days. This evaluation of investors, such as the case of BabyWearable and MotherHealth, led the start-ups to shape their identities through the narratives that they communicated to the investors. New ventures symbolic boundaries are adapted during pitches and presentation since this knowledge is shared with evaluators who categorize the venture and render propriety judgements. These practices allow the start-ups to gain some control over the outcomes of the evaluation process.

In summary, founders' and teams' were managing the boundaries between the ventures and the investors through target and event specific investor profiling to construct the venture's legitimacy claims This indicates both selection and

conformance legitimisation strategies at play. Selection criteria also included specific geographies and contexts discussed next.

5.3.2 Changing contexts

In certain contexts, start-ups faced a legitimacy challenge where venture's current identity and future identity did not align with their evaluators' criteria requiring them to change their geographical boundaries to contexts where they could align with evaluator criteria - markets like US where investors had greater risk appetite. In so doing, entrepreneurs hoped that their boundary work efforts would yield favourable legitimacy outcomes. For instance, in the case of SkyTaxiInfra, the venture attributed its failure to secure funding as a symptom of the risk averse EU investor ecosystem.

> *"We will be looking strongly at the US for investment. So the European investment market is non-existent right now […]an equivalent fund in Europe and the US has a factor of 10 to 100 in volume between them, so you know, a hundred million fund in Europe is a billion fund in the US and […]there is a very little appetite here to really invest into ground-breaking […] We had a fabulous team [...]of industry experts. We did our homework but at the end of the day the investment opportunities that presented themselves here in Europe just didn't work out." (SkyTaxiInfra Founder Interview., 2023)*

> *"We talked to a lot of investors, did some start-up conferences in that area, and I heard things like this is a stupid idea. I hope you did not leave a good job to do this and just very, very negative comments. And finally, I was talking to a guy who was just an attendee because he was curious and he said he said what you guys are doing is pretty cool[…] He said you're going to get a bunch of no's here in North Carolina and then you're going to get frustrated, take a trip to California or something and get a deal done on the back of a napkin […]And so I went out to California, and we met with plug-and-play ventures." (HVACHealth Founder Interview., 2022)*

Where fundraising efforts failed, founders redrew physical boundaries of the organisations by changing headquarters or areas of operation. Investment climate

formed a key criterion for investor selection. This shows that credentials and competence were insufficient in gaining legitimacy in Europe or North Carolina, the structural environment played a role in the start-ups perceived propriety causing it to choose a different environment where investment in a new category was considered acceptable or appropriate (Suchman., 1995). While these examples present a more strategic boundary management approach undertaken by start-ups, FullBattery engaged in a more passive boundary work. The start-up was scouted by an investor-accelerator program. Their selection into the program as well as the investment resulted in several other positive propriety evaluations by investors in the Finnish ecosystem.

> *"[...] in Finland we have gained acknowledgement or credibility because somebody else selected us and you probably see that if somebody else acknowledges[...]a brand, others are more likely to follow." (FullBattery Founder Interview., 2022)*

Association with a prestigious program transferred credibility to the start-up. This legitimacy by association indicates that acknowledgement by a reputed investor sped up legitimation for an early-stage start-up that had just spun out from university. The founder stated that it was easier for them to access investors which otherwise would have been a longer and more difficult process.

For BabyCradle, the US market was an intended part of its identity and support from a US based investor was crucial in pivoting due to additional resources the investor provided related to marketing, distribution and sales.

> *"We needed that support to pivot because we always wanted to launch in the US. They were very impressed to see that we had hustled through making 30 prototypes and it's not just a pitch deck." - (BabyCradle Secondary Interview., 2024)*

The founders competence was made visible through material artefacts i.e. prototypes rather than abstract pitch deck, signalling technical and business credibility, leading to positive propriety evaluations. This also highlights the

importance for new ventures to prove their adaptation and mobilization capabilities through artefacts prior to seeking investment.

In the case of MotherHealth, the founder focused on product development and survival for the first five years and relied on grants aimed at encouraging local innovation and impact businesses. This was primarily because the domain of MedTech lacked cognitive legitimacy in the local context. Private investors engaged with the venture when the product was near to completion.

> *"Unfortunately in India, there are very few investors who understand MedTech, fortunately there were a lot of grants coming up, the government of India wanted to support [...] On the impact front, lots of foundations wanted to support [...] when we were very near to the launch of the product, then the investors started to show interest [...] in 2020 we raised our first round, that too from Singapore, not India." (MotherHealth Secondary Interview., 2024)*

The venture's selection strategy allowed it to secure funding from an investor familiar with the MedTech sector, instead of local investors with the more pragmatic interest without any of the familiarity. Further, this quote also highlights the use of multiple logics of local innovation and social impact to gain non-dilutive funding from multiple governments and social impact foundations, making it a very attractive proposition for private investors.

Legitimacy is a conditional resource. Where ventures failed in their local fundraising efforts or needed specific local support, they identified geographies where they could seek funding. Boundary management across these ventures included geographical boundary work to find a suitable investor. Similarly, BabyCradle's founders realised that India wasn't a suitable market for their products due to the strong foothold of alternative traditional solutions and registered the company in the US where prevalent maternity leave policies and strong early adopter ecosystem provided it with a suitable market. They had sought a VC investor known to invest in hardware start-ups and their past efforts in idea and product validation proved to be key in their fundraising success.

The respondents identified prospective investors' thesis and preferences to adapt their pitches accordingly and changed their context to seek favourable investment opportunities. Another practice used to manage the boundaries between the venture and external environment was investor funnel.

5.3.3 Investor Funnel

Some start-ups accessed potential investors through the creation of an investor funnel, but the interviewees admit that this is not an efficient approach. This transactional boundary management approach highlights the precarious nature of legitimacy as the ventures had to first, expend significant time in both identifying suitable investors and second, wait for long lengths of time for a meagre number of responses. Creating investor funnels required the ventures to tap into social networks and undertake extensive pre-qualification. The founder of MotherHealth created a funnel based on his participation in events and leads from his referral network. Using these different approaches, the founder took a year to find the one prospect that eventually invested in the company.

> *"When people started connecting [me] to the investors, angels, VC's and I started pitching to them, that was the funnel. You need to start creating the funnel when you start pitching to competitions. […] Mostly, referrals work, because if somebody is connecting you with someone, at least the first one or two calls will happen." (MotherHealth Founder Interview., 2022)*

> *"I think [accelerator] has been very crucial in our funding. So, they are very well connected in Silicon Valley and really helped us to get in front of the right investors at the right time." (Monitor Founder Interview., 2022)*

> *"They organized events for investor introductions throughout the program, though we haven't secured any investment from this. They gave us some visibility through this demo day" (FullBattery Founder Interview., 2022)*
> *"You can get a warm intro to these people if it's high net worth individuals you're after. But if it's syndicates […] you just put in an application […]" - (BabyWearable Founder., 2022)*

This highlights the founders' embeddedness in the ecosystem from which they seek support. Gatekeepers played an important role in identifying the investors who constituted the venture's investor funnel. These gatekeepers (in some cases accelerators) were used to manage the external boundaries of power and competence established by the investors. The credibility association with the gatekeeper allowed the venture to exploit opportunities for legitimisation. This also shows the boundary management mechanisms of using referrals, accelerators and demo days to navigate the divides between start-ups and resource providers. These instances highlight the importance of understanding the benefits and drawbacks of the means of accessing investors - applications, referrals and pitches - as well as the ways in which founders use these to increase their chances of favourable propriety judgements.

SkyTaxiInfra's team used a highly structured process to prequalify and pitch to over 120 investors yet could not get funded. The following cases reveal that even with a programmatic approach to fundraising through investor funnels and scaled outreach, the rates of conversion remain extremely low.

> *"[…] we prequalified about 600 investors. We had a very professional sales funnel with qualification stages. My board colleague and myself in the last seven or eight months, we pitched somewhere between 120 and 150 times […] entirely to pre-qualified investors […] the result was dismal." - (SkyTaxiInfra Founder Interview, 2023)*
>
> *"You just have to have a massive pipeline and just understand that you'll have a one or 2% success rate. So, if you want to get a win deal, you have to build a pipeline of 100 in your funnel. And that is just it." - (AgeMonitor Founder Interview., 2022)*

The efforts put into seeking investment were disproportional to the outcomes as well as the stage of the venture and this is reflected in both responses. The boundaries of power and selectiveness limit the translation to positive legitimacy outcomes for entrepreneurs. However, the founders' adept use of boundary management to navigate the boundaries of their networks plays a role in desired outcomes i.e. gaining access to desired investors. The practice of creating an

investor funnel to achieve funding success, was followed by highly experienced founders and team, even though the outcomes were dismal. It follows that this practice was a vestige of prior experience. This also indicates that most propriety evaluations deem the ventures to be unfit.

5.3.4. Event participation

All start-ups attend events with the goal of networking, working up to getting resources in the form of expertise or investment or visibility. However, many of the founders stated that participation in events did not lead to positive outcomes. Their responses bring out the problem of cognitive and cultural alignment, highlighting their frustration in dealing with individuals or investors who didn't possess technical knowledge.

> *" I was getting exposed to the arrogant kind of the VC or angel investor. And he was dumb as s*** [...] We were saying that we can identify and pinpoint the interference sources. And he's saying that, yeah, nobody needs that [...]So that means that his use case is not critical enough [...]he doesn't have the experience of, let's say, a manufacturer, who would use wireless technology for his processes and doesn't get the product right because of the interference"- (IoTSecurity Founder Interview., 2022)*
>
> *"I usually look for the healthcare-related event because then […] people interested in healthcare are there. Otherwise, there are a lot of very general startup-related conferences that I do not prefer […] So, if it is something related to healthcare, where a lot of CXO level people attend […] healthcare investors attend. So that makes more sense for me."- (MotherHealth Founder Interview., 2022)*
>
> *"We got a lot of very interesting feedback from […] some of the biggest HVAC companies in the world. One of them ended up making an investment […] We submitted an application to [investor 3] […] they ask a lot of good questions. They didn't just say - oh, this looks neat, how are you going to take it to market? They said, hey, have you thought about all these other applications?" - (HVACHealth Founder Interview., 2022)*

"The VC that ended up funding us, they were keen from very early on and were kind of following us there. Of course, we also took part in various [...]presentations or whatever pitch events, but that has really not been very efficient that's been more show than anything else"- (WaterSensor Founder Interview., 2023)

The founders describe the existence of both epistemic and symbolic boundaries due to the absence of cognitive frames, failure in translating across domains and incorrect or missing category associations without which propriety valuations cannot occur (Gieryn., 1999; Lamont and Molnar., 2002). Some start-ups like MotherHealth engage in selection to control the problem of *"Not knowing what others don't know"- (IoTSecurity Founder Interview., 2022).* Some others like HVACHealth managed these boundaries through geographic reconfiguration by identifying investors in other locations as discussed previously. They engaged with gatekeepers whose targeted audience focus led to them getting an investment. As mentioned in 5.4.2, HVACHealth's location enabled participation in multiple events that led to further product and business development. Others like IoTSecurity identified investors who invested in the team and not the product or specifically developed a profile for an investor well versed in technical jargons. WaterSensor's team had engaged with a VC from the beginning of the start-up's life. Throughout the responses, the importance of strong ties and domain familiarity is evident in the boundary management efforts.

The use of selection re-appears throughout the boundary management efforts undertaken by start-ups. For instance, MotherHealth's founder and teams qualified investors through direct referrals (discussed previously) but also indirectly through participation in healthcare industry-focused events. HVACHealth's founder's criteria for engaging with an investor were centred around experience in the industrial or technical domains and the quality of feedback and questions asked by the investor. Thus, the investor selection criteria include the investor's industry knowledge, technical know-how as well as prior experience as an entrepreneur in the same industry. More specifically, someone who has been in the founders' shoes and can provide useful input. Other selection criteria included the risk appetite to invest in a venture operating in a completely new field as evidenced by the responses from the SkyTaxiInfra team.

Experienced founders adopt more strategic efforts such as creating an investor funnel and targeting domain specific events-gatekeepers-investors instead of a more generalized approach. However, the ventures that got funded had expended significant efforts in embedding themselves within entrepreneurial ecosystems and had developed strong ties with gatekeeper organisations. By engaging with gatekeepers, venture boundaries get knotted with those of the gatekeepers, leading to legitimacy by association. Even a single positive propriety judgement by reputed entities leading to investment causes the venture to get legitimated by the local innovation ecosystem especially where network ties are much closer such as India or Finland. A programmatic approach to fundraising is more efficient for ventures in managing the boundaries laid out by different investors and resource providers, but it doesn't translate to investment. Founders also manage discursive boundaries by manipulating their identities for the purposes of pitching based on profiling individual investors during the course of the event to increase the chances of gaining legitimacy. Another way in which founders managed their identity boundaries was by attributing their failure to fundraise as a symptom of the local investment ecosystem, suggesting that by changing contexts their offerings had a higher likelihood of getting legitimated instead of re-evaluating their BM.

Entrepreneurs and their teams manage the investor's symbolic and epistemic boundaries as they pitch to evaluators. They profile investors and accordingly choose to share contextualized information They adopted practices that helped them gain some control of the power relationships with investors. However, organisational boundaries get further impacted as new ventures take and work on feedback provided by prospects whether or not they get funded. The role of feedback in organisational boundary change is further elaborated in the next section

5.3.5 Investor Feedback

Start-up narratives are adapted to the feedback provided by their audience, i.e. investors (Garud et al., 2014). Feedback in the form of questions or recommendations provide a signal to start-ups on the evaluator's comprehension

and categorisation of the venture. Founders can resist, conform or selectively use the feedback but are constrained by the need for access to resources and existing power relationships (Bojovic et al., 2018). In some cases, BMs or pitches are adapted based on feedback or recommendations regardless of the selection by the evaluating audience since it can lead to positive future fundraising outcomes. In other cases, the advice or feedback is rejected (Bojovic et al., 2018).

After several unsuccessful pitches to individual investors, the founder realised that the investors were categorizing her start-up as a medical device company and consistently asked for medical certifications. To avoid this, she changed her pitch to align with the consumer technology category and distance the product from the medical category. By doing so, the venture influenced the symbolic boundaries around the venture.

> *"If you come up against a recurring question again and again, you're going to have to address that. That is your wall there, so I needed to find a way to head off that question and make it clear in the pitch that this isn't a relevant question, so we cannot waste the time or the feedback on that one. So, it is about manipulating your pitch as well and slipping it in there" (BabyWearable Founder Interview., 2022)*

The founder clarifies the framing of the offering, this serves two purposes. First, it signals to investors interested in medical technology that this isn't a relevant prospect and, second, it provides an opportunity for the start-up to have discussions about the venture with other investors. While the start-up could have pivoted and adapted the venture to become a med-tech solution, the feedback was rejected by the start-up. This was important because if the founder had gone ahead and applied for certification it would have resulted in a waste of organisational resources and a marked change in her value proposition. By addressing this at the outset instead of clarifying this at the end of her pitches, she utilised the duration accorded to her for other relevant queries that the investors might have and saving thousands of pounds she would have needed to invest in certification. Further, she also asserted her role as a founder to dictate the evolution of the product versus following investor feedback blindly. While this start-up did not need to change its value proposition, there are examples of ventures that have changed their BMs based on feedback from investors. For

AgeMonitor, the feedback from investors was related to the BM change from B2C to B2B2C

> *"We flirted with maybe direct to consumer, but we got a lot of feedback from the venture community that you would likely have a really a big uphill battle like direct to consumer companies have really largely fallen out of favour […] it's tough to prove our customer acquisition costs […] it's a lot easier to prove out the business if you just have a channel partner and they're responsible for all the level 1 support […]And your revenue could be a lot more predictable"(AgeMonitor Founder Interview., 2022)*

The founder realised that there were specific reasons why running a B2C BM may be more difficult than running a B2B2C BM. He was advised on the same transition by a number of investors. The lack of legitimacy given to B2C companies led him to make the decision. So, the feedback coupled with his own observations of the B2C sector was responsible for his making that change. However, later in the interview, the founder cautioned against adopting all kinds of feedback. A prospective investor had recommended the start-up to move from a hardware and software model to a software-only model which the founder felt did not work for the problem he was trying to address.

> *"The big thing with VC is or accelerators is they're just picking what they think is the best one. It's not really like your business is bad or wrong They're just going to take who they take. And what's your feedback? They didn't take you, but your feedback isn't necessarily actionable" (AgeMonitor Founder Interview., 2022)*

The founder is referring to evaluating the appropriateness of the investor feedback. He gives the analogy of not getting through to Harvard because of limited acceptance, not because an applicant is destined to fail. For him, not being perceived as a legitimate venture by an investor is not a concern particularly because he judged the investor's feedback as not actionable. While moving to a software-only model seems easier, the hardware and software combination gives the founder greater control over the performance of the solution and the value proposition of privacy-safe that it offers customers. Therefore, founders adapt new venture boundaries based on feedback provided by investors if they judge it to be relevant. The founders of BabyWearable, AgeMonitor and HVACHealth

provided examples of direct and indirect feedback, which they found relevant and were able to use to adjust organisational boundaries. However, incorporating that feedback does not necessarily mean that the venture be legitimated by other investors. So, the founder must exercise discretion and reflect on why the feedback may or may not be relevant. After funding takes place, the story changes and the ventures end up incorporating a lot of feedback against their own judgement as discussed in the next section.

5.3.6 Post Selection Engagement:

After funding takes place, investors may or may not engage with their portfolio companies. Engagement takes place through queries on return on investment, feedback on specific queries, access to social networks and follow on funding. In all instances, the boundaries of the new ventures may be impacted. As discussed in the earlier sections, new venture boundaries are fluid and are changed based on their participation in events and the use of network resources. In addition, new ventures also adopt selection criteria to categorize investors, increasing the likelihood of getting funded. In this process, ventures get a lot of feedback which also requires a change in their boundaries. Once the ventures are legitimated by an investor and start receiving their funding, the investors continue providing feedback.

The investor provided valuable feedback to apply lean start-up principles to product development, which was adopted by MotherHealth. This investor has had previous experience as a founder and investor in the same domain as MotherHealth. However, the advice related to the BM was taken into consideration together with the response from the market or customers.

> *"Launch the product you know, let's not wait for the ideal things to come out because as a founder, you generally think we can improve this […] But I think it's better to launch as early as possible as soon as you have the first MVP, the minimum viable product that is one of the things. […] definitely, we had a lot of discussion on price point or pricing strategy or hardware plus SaaS model or only hardware model […] But ultimately, it's the market who tells you the truth" (MotherHealth Founder interview., 2022)*

Thus, the founder exercised his discretion in making a boundary decision to apply the investor feedback to the BM based on the market adoption logic. In this case, customer feedback trumps the feedback from the investor. Other interviewees spoke about the post-selection engagement through the exchange of knowledge with resources of the investor who had experience in areas lacking in the venture team's overall experience. The investor specifically is an early-stage investor and also an accelerator for hardware technology companies. Thus, the boundary of the organisation was extended to include additional resources provided by the investor organisation.

> *"[Investor 3] said, hey, have you thought about all these applications because they were based in Shenzhen. They knew about mini split HVAC systems and things like that […] They're in Shenzhen because it is what you'll need in the very earliest stages of building a hardware product. […] so the prototyping was so fast. We did 13 full iterations of the product in 11 weeks of a hardware product. […] what we were from when we started until when we came out of [investor 3] it's really quite a an evolution." (HVACHealth Founder Interview., 2022)*

In both cases, the founders took advice related to product development from investors due to their prior experience and expertise. By adopting lean start-up principles and using the available engineering support, thereby organisational boundaries are arranged to maximize available resources. However, there are also occasions where the investor's feedback or advice is not always beneficial.

> *"Six months after we took the initial investment we needed to pivot away from residential and into commercial HVAC. And we had an investor that adamantly disagreed with that […] I guess because we obviously wanted to make them happy. We wanted to take another investment from them down the road […] Also they are a well-known company […] I thought they got to be right, that was a big mistake. We should have pivoted much earlier" (HVACHealth Founder Interview, 2022)*

In this case, the founder made a boundary decision of not pivoting away from their existing market segment and found that the feedback was not useful because adoption in the commercial HVAC segment was faster. Thus, despite being

legitimated by the investor, the company wasn't successful in the beginning because the investor didn't agree with the market signals. Therefore, while taking boundary decisions, ventures need to consider both investor and customer signals. In another case, to raise further funding the founder had to adhere to the conditions of investment set forth by the investor to spin off the Blockchain and AI organisation separately and roll up the IoT part of the organisation.

> *"So, we were okay, we're muddling along as a start-up, they put in $4 million and then they said, you know, we want to go faster, but we don't want to invest with you. So, we are going to bring in an entrepreneur that exited to MasterCard, Microsoft, to former US ambassador. More of a businessman, less of a technologist and so they said we will fund him. My VC was not interested in the IoT business but I had customers and goodwill, so I spun it off as a separately […] I am the CEO of [AIBlockchainIoT] and I am CTO of [the funded company] in USA" [AIBlockchainIoT Founder Interview, 2023]*

The IoT organisation was already considered legitimate by their customers, whilst the AI and blockchain part of the organisation was legitimated by their investors. The investors were looking for a way to exit the venture. He lost legitimacy in front of his investors due to which they recruited someone with proven business expertise to be CEO of the AI and blockchain entity. In this case, the founder listened to both investors and customers and spun off the IoT part of the company separately creating a new organisational boundary and adapting the boundary of the old organisation.

Boundary decisions on venture identity, power and competence are made constantly to define venture boundaries. Boundary decisions are made as ventures go about seeking funding, engaging with investors, getting feedback and after getting funded. These decisions cause a constant change in boundaries. As certain changes are temporary, boundaries revert to their original forms. This management of boundaries enables ventures to gain legitimacy as they can rapidly adapt to evaluator expectations with changes to organisational activities and practices, spaces and geographies. The venture's own practices play an important role in adaptation of boundaries. In addition, feedback from evaluators including investors and customers also plays a role in boundary changes. While the practices

employed in seeking funding ultimately legitimate the venture in the eyes of the investors, the advice by the investors post-selection may also result in the legitimation or delegitimation of the venture as mentioned by some of the examples in this section. Here the venture founder needs to exercise their own judgement to ascertain if the advice is relevant for the future of their organisation. Besides investors, there are also several venture development organisations such as incubators and accelerators that impact the legitimacy of the venture because they can influence boundary decisions and therefore organisational boundary change. The next section explores how new ventures go about seeking legitimacy from venture development organisations and the impact on their boundaries.

5.4 Overcoming liabilities of newness by getting resources from venture development organisations

Venture development organisations such as accelerators are meant to help new ventures gain valuable resources with access to investors, mentors, and experts. While not as stringent as investors, accelerators also undertake an evaluation process to legitimate new ventures. Once selected to be a part of the accelerator's portfolio, the ventures gain linked legitimacy in front of other evaluators. This is because the best accelerators provide validity to a new venture's product, technology and market and develop a reputation for selecting the ventures that are most likely to succeed (Drori and Wright., 2018). In the case of technology-focused venture development organisations, they provide new ventures with resources in the form of infrastructure and technology experts. They also play an important role in organisational boundary change.

5.4.1 Seeking legitimacy from venture development organisations. (Opportunism by VDO, Performing for VDO)

New ventures are pre-qualified by accelerators based on their reputation before they are selected. For example, in the case of BabyWearable, the founder had already been working with the IoT accelerator's parent organisation which is a product design and development firm.

"So, my hardware was already kind of ready basically, and the design again, we're working with [product design firm], so they already knew that that was how it was going good." (BabyWearable Founder Interview., 2022)

The accelerator's management team already knew about the start-ups progress in hardware development and had experience working with the founder. Other start-ups that are part of the venture portfolio were also prequalified based on their engagement with the parent firm of the accelerator. Therefore, the accelerator had already influenced the identity of the organisation based on which it was selected. Other examples are that of WiseBees and YourPleasure that were prequalified because the founders had won an event where the accelerator head was a jury member. The founder of WiseBees participated in a hackathon where he met his co-founder. Through hackathon participation, he came upon an opportunity to take part in a funded accelerator programme organized by one of the hackathon jury members.

"[…] when we won the hackathon, one of the jury members basically was VC fund. That is also an accelerator, specifically focused on hardware. So of course, straight away, I realised the opportunity and we […] applied to their program. "(WiseBees Founder., 2022)

The funding was contingent on the performance of the venture and the achievement of the milestones set by the accelerator.

"[…] but for this particular accelerator, just getting into the program did not necessarily mean investment. So, we still had to perform and show […]for them to make the investment decision, which they did." (WiseBees Founder, 2022)

In both cases (YourPleasure and WiseBees), the participation in events led to the creation of organisational boundaries as the founders established venture identities in front of the evaluators. In these examples, the product design company and the events bridged boundaries between the venture and accelerator organisations. Another start-up identified points of contact within accelerators that could help them understand the best application responses to gain acceptance –

"For us having as a point of contact to the accelerator program is crucial. And having X amount of time discussing about […] what kind of start-ups you would be looking at […] markets we have to take on to get in, […] what

you can deliver to the decision makers, without filling the form" (IoTSecurity Founder Interview., 2022)

In this way, the venture can manipulate their identity to get selected. Some of the other accelerators had specific themes they focused on such as space, medical technology, energy, and climate based on which they selected the start-ups to be a part of the portfolio, which was the case with AIBlockchainIoT, FullBattery, MotherHealth, RoboticMeasurement and BabyCradle. The new ventures had to translate the potential of their new venture in the form of themes specifically called out by the accelerators in order to get selected. This impacts the identity and boundary of the venture.

5.4.2 Feedback and Post-Selection Engagement - venture development organisations: (Impact on organisation boundaries and legitimacy)

Selection in accelerators doesn't require ventures to adhere to very strict criteria since accelerators are meant to serve as support organisations. There are different types of accelerators based on their purpose. Some of them are focused on developing a start-up ecosystem within a region while others serve as innovation hubs for private entities. As start-ups undergo acceleration they received feedback and mentoring on pitching, administrative, legal, HR and accounting, product development, and BM design. This enables the ventures to improve their competence and tailor their identities. Besides this, accelerators also enable new ventures by connecting them to a wider start-up network that includes investors, peers, and potential customers. Many of the start-ups interviewed did not find accelerator feedback particularly useful before their selection in the venture portfolio. However, after selection new ventures received valuable feedback. For example, in the case of BabyWearable, the start-up founder wanted to adopt a direct-to-consumer model, but the accelerator advised her to also focus on partnering with retail and distributor organisations and eventually move from direct-to-consumer to distributor sales. In the case of MotherHealth, the accelerators provided access to potential customers which helped them refine their BM. Most of the other start-ups felt that the accelerator didn't have much of a role to play in the development or change in their BM. In fact, the founder of Monitor said that because of their existing reputation, the accelerator needed them more than they needed it.

"[…] this was a collaboration with [corporate accelerator] where we made a cellular version of our of our sensor and we were much more mature as a company and it was more that [corporate accelerator] needed us than us them" (Monitor Founder Interview., 2022)

Monitor's relationship with the accelerator was more of a client-vendor relationship. In this case, there was no change in the organisational boundary. Monitor had already been through multiple acceleration programmes that were specific to the technical domain that they were operating in. Moreover, they had a highly experienced team who were part of the venture. Early-stage companies find the support more useful, and the power relationships are definitely skewed as they receive sponsorships, and network connects to suppliers and customers. Accelerators and their network may temporarily form a part of the venture's own boundary.

Accelerators might provide some tactical support with respect to the BM but don't have influence over the BM ultimately designed by the venture. Any change in the venture identity is a result of the tactical support and not direct advice on BMs. Some important feedback and support were related to product development after selection. Incubator and Investment platform helps ventures develop their product with the lab equipment provided at a nominal or free charge, in addition to opportunities for funding, mentorship and networking.

"[…] we onboard them with the technology stack and schedule […] we identify like the groups of mentors who will be working particular projects, and then they decide together, OK, how do we want to do this? What do we expect to have at the end of the program? And then we just check in what do they do, how they progress. […] We would help with the support of deck, pitching experts who know how to get the attention." (Incubator and Investment platform partner interview, 2022)

Similarly, Accelerator1 provides electrostatic-free heavy test and measurement equipment infrastructure. Broadly, an incubation space is provided for start-ups along with funding, acceleration and mentor connects. Besides helping innovators, another goal is to get these innovations adopted by end-users or corporations including private, public or government organisations. Other interviewed accelerators provided different types of hardware development focused support in addition to advisory and mentorship.

The use of organisational space within the accelerator premises also indicates a change in physical venture boundaries. The venture operates the equipment and makes use of the working spaces for a limited period of time thus adding these additional spaces within the confines of the venture boundary for that duration. Other support includes that of mentorship including technical and warm introductions to prospective suppliers or customers. For instance, in the case of CleanCooking, the accelerator helped with technical modules and networking such as the CEO of a test network, invitations to industry events and connects with suppliers and demarcates between accelerators focused on technology versus general purpose accelerators.

> *"There's a lot of emphasis on. The technicalities, you know. Trying out all the communication modules, more on the technical side, while the other ones focus more on distribution, marketing side of things […] Mentorship, access to other companies […] CEO of the test network, even introduce some suppliers as well that we use, invitations to events, […] benefits are soft" (CleanCooking Founder Interview., 2022).*

The technology-specific accelerator supplied more technical support and access to relevant connections compared to the go-to-market focus of other accelerators. In exchange for support, accelerators expect collaboration and in some cases financial remuneration. For example, using the accelerator's working spaces and equipment may require them to pay a minimal fee except in cases where accelerators also take an equity stake in the company. Some of them expect regular reporting from the new venture to assess progress on some previously agreed-upon milestones.

> *"We do have one of the mentors that we check in with like every I don't know three months or something […] he just wants to see how our development process is going […] we know we still can approach him at any point. […] They [Incubator and Investment platform] ask us for reports and then financial statements […] just reporting our progress to them." (YourPleasure Founder Interview., 2022)*

In this case, the accelerator was providing funding contingent on the start-up's progress. Other programmes which are driven by customers and customer-led projects also follow a more structured reporting schedule. However, many accelerators without funding have a laissez-faire approach during the programme. They have monthly or bi-monthly meetings and only discuss issues that are brought

up by the venture. While this gives the venture more control over the relationship, it also limits any guarantees on what the venture can expect from the accelerator. Many of the ventures spoke about the benefits they got from being part of the start-up community nurtured by the accelerator. Throughout the acceleration process and after, these ventures reached out to peers and alumni for support or advice. Some of the accelerators also provide support related to customer interaction and creating win-win customer contracts so that ventures don't end up working on unpaid engagements and waste resources they could have utilised elsewhere. These tactical inputs help the ventures in managing their organisational boundaries when engaging with customers or suppliers.

Accelerators played a minimal role in influencing the identity of new ventures. Most of the start-ups discussed that while accelerators provide resources such as access to a broader network and availability of a peer group, feedback is sought for day to day running of the business and when the venture hits some snags in their development process. HVACHealth attended an event in Raleigh in US, a location focused on innovation in life sciences but lacking in institutional knowledge of IoT. As a result, the founder got a lot of negative feedback from accelerators that didn't understand the technology or the HVAC market - *"I didn't put a lot of validity behind their comments because they didn't have much to back it up"*.

Another venture, AIBlockchainIoT found the advice by the accelerators to be valid but didn't take it.

> *"that's what everyone says focus on one thing, don't try to do too many things. Focus on one thing, try to get that successful […]I guess I'm the outlier. […] My people who focus on my project, they only focus on one thing. So, I try to get them to do one thing and one thing alone, and I can hop around them." (AIBlockchainIoT Founder Interview., 2022)*

Some start-ups like RoboticMeasurement felt that accelerators didn't provide enough information or mentorship for them to use any advice.

> *"[There was] discussion around the topic, but it wasn't so detailed it was, kind of 130 minutes to an hour […] I wouldn't say that was kind of a mentoring or I didn't get any." (RoboticMeasurement CEO Interview.,2023)*

On the other hand, companies like BabyWearable, MotherHealth, BabyCradle discussed the benefits of mentorship received from the accelerator and their broader network that they used to adapt their product and their operations.

Like investors, the selection of new ventures within an accelerator cohort takes place as evaluators judge the new venture based on their established identity and their creation of symbolic boundaries. Some ventures were pre-qualified by the accelerators since the reputation of the accelerators is dependent on the performance of their start-up cohort. So, accelerators adopt a strategy of taking in companies that are well-known, have working prototypes and have had experience engaging with the accelerator. Some ventures try to get legitimated by providing the exact information to the accelerator. Accelerators play a role in helping ventures overcome the liabilities of newness and gain legitimacy since they provide infrastructure using which ventures develop working prototypes and provide inputs that help them develop their identity and improve competence. However, the accelerators have no or negligible impact on the BMs. New ventures also utilise the physical space offered by the accelerators which affect their organisational boundaries temporarily. Accelerators provide inputs on how to manage power relationships and thereby organisational boundaries when engaging with suppliers or customers. Therefore, venture boundaries get changed due to the resources provided by the accelerator and not due to the accelerator's direct influence. Accelerators and investors, however, ultimately evaluate ventures on their prospects with the third and most consequential audience – the customer.

5.5 Seeking legitimacy from customers.

Customers are one of the most important evaluator groups for new ventures. As discussed in earlier sections, IoT-based new ventures need to get customers to show feasibility of the venture to investors and procure further resources. They have to continue demonstrating the value of their solutions to their customers even after initial adoption takes place. Most venture resources are expended in identifying the best strategies to drive customer adoption within the target market. The respondents went about seeking legitimacy from customers by conducting market research, validation tests and getting early feedback from

small focus groups. Thereafter they adapted their idea, product, and BMs. Some ventures such as Monitor began a Kickstarter campaign to gauge customer interest.

To avoid stigma from product delays, Monitor shipped out crude prototypes showing their investors tangible progress in the product development. However, they faced significant challenges as early adopters of the buggy prototype came back with several concerns. As the start-up team managed several technological boundaries including the device as well as the remote networks on which the functioning of the device depended. The teams also had to manage the expectations of the community, treading the boundary between the identity of an early-stage start-up building a product or an incompetent team.

> *"Once [Monitor's device] started arriving with backers we encountered the next serious issue. Another bug in the network stack prevented our automatic firmware updates in many network environments. Fixing it required a flawless transfer of a small patch leading most backers to have to repeat the sequence several times. We worked hard getting the package size down to kilobytes to improve the chances of success. In the end, the vast majority of users were able to update their [devices]. This bug, affectionately called "Firmware 0", remains a cause of frustration. "(Monitor's Founder Blogpost., 2017)*

The audience response shows mixed propriety judgements as some investor-customers co-operated with the venture in performing update sequences despite inconvenience. Yet, the bug led to dissatisfaction. Practices like iterative updates, reduction of package sizes for interoperability, managing customers in the dual role of users and testers, and public transparency about the shortcomings enabled maintenance of legitimacy the venture had gained during crowdfunding phase. Post the Kickstarter, the venture raised $2.5Mn from named venture investors, showing a positive propriety evaluation (Trade report., 2017). In 2018, the venture went for a second Kickstarter campaign for new version of the device and used that campaign to begin signalling its future transition to a subscription model (Monitor Founder Blog on subscription transition, 2020). Despite the bug with the first version of the device, successful Kickstarter campaign and customers support of the subscription model shows that the propriety judgements continued to be positive. Under-delivering to customers still led to positive propriety evaluations

due to enactment of transparency. Even though “learnings from this group [*crowdfunding audience*] don’t transfer well to broader market” (Monitor Founder blog on hardware resilience., 2020), the venture was able to sustain its legitimacy, beyond the initial crowdfunding audience as shown by the series A funding. It raised $7.2 million from new investors, showing support for the venture notwithstanding the crowdfunding issues and macroeconomic challenges (Monitor Founder Secondary Interview., 2019). The founder acknowledges that “every product launch effectively relaunched the company”, required renewed evaluation, audience alignment and transparency which is specific for hardware companies.

AgeObserve started showing early versions of the prototype to prospective customers trying to understand the uses the customers saw for the solution. This early feedback was used to adapt the organisational boundary, namely product features and BMs. This was also followed by MotherHealth who categorized essential requirements after pitching to and feedback from doctors. By developing a more customized version with lesser features, the product saw an uptick in sales. Interestingly, the conflict between investors and customers when it came to the monthly recurring revenue model, led the start-up to prioritize the customers’ choice of a hardware and annual subscription model.

Similarly, WiseBees spoke to customers and were able to incorporate the additional feature of weight capture into their solution after initial feedback. HVACHealth changed its BM to hardware as a service model to adhere to customer expectations of putting that expense on the operational expenditure line rather than a capital expenditure line. Nexum, a B2B start-up, on the other hand, focused on asking customers what their requirement was and were transparent with those whose requirements Nexum’s product couldn’t match. Here Nexum clearly categorized their venture as something that would not be relevant for the prospective customer, resulting in the formation of symbolic boundaries in the minds of the customer. By being transparent, they were also able to circumvent future issues that may have arisen if Nexum had been deployed for the customer. Legitimacy is also acquired through the association of the venture with an investor or an accelerator. For example, in the case of HVACHealth, they worked out of their investor's office where a lot of prospective customers in the commercial

HVAC space would visit. The HVACHealth team gave four to five presentations every week that resulted in a "lot of opportunity." Similarly, MotherHealth also got access to the initial set of customers through accelerators.

Once the initial set of customers starts using the product, the subsequent adoption and continued usage depend on customer relationship management and customer references. In the case of Nexum, customers would ask Nexum why they would need to pay a licence fee in the case of Nexum when Bluetooth or Zigbee was free. Here, Nexum would have to de-legitimate the competition by making customers understand the added hidden fees that came with using the "so-called" free networks. The initial set of customers were hesitant to recommend it to others since they saw it as a competitive edge. Moreover, to avoid explaining what Nexum was, customers would call it a Bluetooth network. To manage this, Nexum had to set up a marketing strategy for Nexum customers requesting them to refer to Nexum by its name, instead of the name of its competitor. Nexum also appealed to customers by explaining that they wouldn't need to justify the use of Nexum in the future if they would just spend time explaining it now. Further, Nexum would explain the additional value they gave to the customers over simple connectivity. A similar strategy is followed by TrackingParcels as well. They acknowledge that there are plenty of companies with a similar value proposition. So, when speaking with customers, they speak about the unique benefits they provide over what the competitor can provide. Similarly, HVACHealth also discusses the importance of showing value to customers that they hadn't already seen before. They did this by educating the customers about the cost of HVAC filter replacement, how frequently it was needed and how much they could help the customer save. To maintain legitimacy with existing customers. New ventures like TrackingParcels and MotherHealth provide customer support services.

The frames BabyCradle used included "just like a mom", trying to invoke a sense of familiarity with the tech. However, the start-up and its technology had some negative associations

> *"[...] will bounce a restless infant "just like a mom". It could be useful for new parents... if you're up for spending almost $999 (about £763). Perhaps it would be an investment if you had more than one child planned. The BabyCradle (reminds me of the 'It' demon character, Pennywise, who*

happens to hunt and eat small children, not soothe them to sleep) [...]It can sense and spot sounds, cries, movement, startle reflex and eyes opening. What is this thing?! Some kind of stalker? Seems more like Pennywise than I initially thought." (Magazine Review on BabyCradle, 2020)

The price and the features position the product in the category of premium childcare segment meant for affluent families or those planning more than one child. The product's AI based caregiving features lead to the creation of a new practice i.e. outsourcing of soothing. However, the replacement of parental care and the monitoring features of the product also raise concerns about the broader implications of such a product, hindering its adoption and acceptance amongst new parents. The association with pennywise highlights the intrusive aspect of the technology and also raises concerns about the efficiency of the product in accomplishing its key function.

"When we first saw the price, we thought you could go to Ikea and buy a crib[...] It is like, three in one kind of a thing [...] we can take all of this stuff off the registry. The price went out the window for us (BabyCradle's Customer Testimonial., 2021)"

Even when the price sits outside taken for granted expectations, the multifunctional aspect of the product and its replacement of multiple baby products resulted in the justification of higher price by the customer. In this way, BabyCradle introduced a new multifunctional category.

The biggest stakeholders in the adaptation of new venture identity are customers. During the venture creation process and after, founders undertook various types of activities to gain customer feedback including market research, pilot studies, PoC development and testing and crowdfunding. In the case of MotherHealth, using B2B2C model, the founder engaged in comprehensive market research to zero down on the offerings provided by the company. In the initial days his offerings were focused on only contraction monitoring, but he got feedback from doctors and nurses that foetal heart rate and maternal heart rate were also important parameters to monitor during pregnancy and labour. This was incorporated as additional features into the product and in subsequent pitches he mentions all three parameters as equally important. Similarly, B2B start-up

TrackingParcel had to build in a maintenance management module atop their existing offering of asset tracking based on numerous customer requests. AgeObserve's founder gives a lot of importance to customer feedback and adopted an experimental design approach to building the complete solution. Once a version of the product was ready, she went out and asked the customers to use it and let her know what they did with it. The feedback was incorporated over many iterations. She says, she wasn't looking to "make a sale". Similarly, B2C company BabyCradle shipped early and optimised for early feedback from customers which was incorporated iteratively.

In contrast, B2B start-up experience was focused on accepting/rejecting customer feedback based on their willingness to pay for adapting the offering to customer suggestions.

> *"The feedback […] when you go one customer, they say that it has to be offline. Yeah. And the other one says that it has to be connected. […] And then when you go to the next one, they want a hybrid of those two, and then you go the next one. So basically, since there isn't any right answer […] And then you have to make like, product development plan." (IoT Security Founder Interview., 2022)*

> *"If you want to exploit the feedback what you were getting, even though it might be wrong. […] They were giving a free advice, and they were not buying it [the solution]. […] also, the question how much you want to trust with somebody's advice, if they weren't willing to buy, if that happens. So, it could be basically bullshit."." (IoT Security Founder Interview., 2022)*

These sentiments were echoed by FullBattery and MarineMeasure as they found that feedback was not always helpful and many times customer would not like the demos. It was also difficult to elicit customer feedback. In contrast, WiseBees in the beekeeping industry found customers helping them in crafting their value proposition.

New ventures go about establishing legitimacy in the eyes of the customers by pursuing practices that help them understand customer requirements and adapting their identities in accordance with those requirements. This is affected

by a change in BM, pricing or the addition or removal of new features. Some ventures do this by conducting an early launch of the product or prototype for a limited group of customers or through crowdfunding campaigns. Even if the venture cannot fulfil customer requirements, establishing trust by being transparent also enables building a customer relationship for the future. When competing with others, new ventures try to create a separate category for themselves in the eyes of the customer by explicating benefits that competitors do not have. Legitimacy is maintained by getting customer references and providing customer support services.

5.6 Conclusion

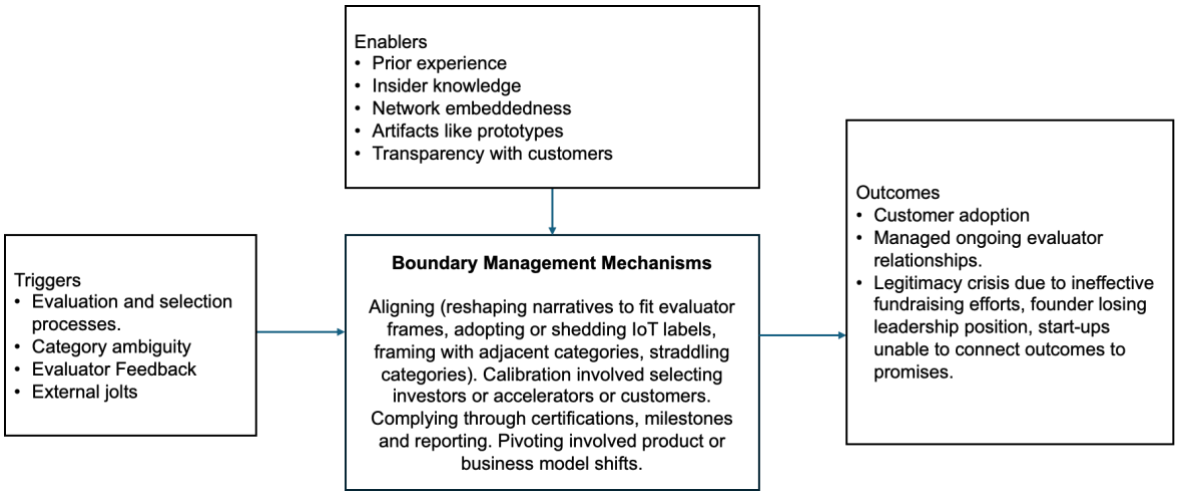


Figure 20 Enablers, Triggers, Mechanisms and Outcomes of Boundary Management

This chapter has shown that boundary management is the central means by which IoT ventures pursue legitimacy under conditions of category ambiguity. Boundary management episodes were set in motion by four recurring triggers. First, evaluation and selection processes, namely, investor pitches, accelerator applications, demo days, compelled ventures to render themselves legible and investable. Second, the ambiguity of IoT as a category, contested across ventures, investors, accelerators, standards bodies and regulators, forced continual definitional and framing work. Third, recurring evaluator feedback like persistent questions, category misattributions, BM recommendations, all prompted adaptation of pitches, offerings and identities. Fourth, external jolts, most prominently COVID-19 and its supply-chain and geopolitical aftershocks, disrupted product development, funding markets and customer engagement, demanding

rapid change. Ventures responded based on the following enabling conditions - founder entrepreneurial or technical experience, insider knowledge of evaluator criteria (obtained through investor profiling or points of contact within accelerators), network embeddedness leading to legitimacy by association, material artefacts that made competence visible and transparency with customers, which sustained trust even when ventures under-delivered. Where these enablers were absent like unfamiliar geographies or before non-specialist evaluators, the ventures failed to gain legitimacy.

Boundary management was carried out using four mechanisms. *Aligning* involved reshaping narratives and category claims to evaluator frames: adopting or shedding the IoT label, framing through subcategories or adjacent technologies, and straddling categories. *Calibrating* involved selecting which evaluators to face at all: profiling investors, constructing investor funnels, choosing domain-specific events and relocating. *Complying* involved meeting evaluator-imposed requirements through certifications, milestones, reporting schedules and selectively incorporating feedback judged relevant. *Pivoting* involved BM shifts or product shifts such as temporary COVID-era products.

These mechanisms altered *evaluator expectations*. Ventures like BabyWearable, Nexum and HVAC used reframing and pre-emptive pitch work to prevent category misattribution, redefine milestones and shift criteria against which evaluators rendered propriety judgements. Other start-ups used profiling and funnels to change the evaluator audience to increase chances of or speed up gaining legitimacy. Framing IoT through subcategories, adjacent technologies or value claims redrew the symbolic boundaries of IoT, so that ventures' legitimation efforts reshaped the norms, values and definitional content of the category they sought membership of. Third, selection criteria through investor funnels and gatekeeper alliances gave ventures partial control over who evaluated them and on what terms, tempering the asymmetry that otherwise let resource providers dictate boundaries of competence and power. But, this control remained conditional, as HVACHealth and AIBlockchainIoT founders, who deferred to investor authority against market signals, or lost it entirely, discovered. Finally, identities were retold, physical and geographical boundaries redrawn, and

organisational boundaries temporarily extended into event spaces, accelerator premises and investor resources, contracting again once their purpose was served.

Winning pilot contracts or customer adoption meaning some pragmatic legitimacy was granted. Legitimacy was maintained where ventures managed ongoing evaluator relationships through transparency, customer references and support, Legitimacy was lost or thrown into crisis where mechanisms failed or shaded into legitimacy hacking such as funding efforts that never converted, founders displaced from leadership positions, and claims that unravelled under scrutiny. This chapter shows that boundary management is a continuous process.

6: Findings III: Boundary Bridging

This chapter explores boundary bridging as a boundary work mechanism employed by IoT startups in their efforts to achieve legitimacy. Legitimacy challenges faced by start-ups often stem from misaligned expectations, existing biases, and entrenched frameworks between the start-up and its stakeholders. These gaps can impede growth, delay scaling, or threaten the very survival of the startup. Boundary bridging is a vital process because it creates opportunities for startups to showcase their capabilities, establish credibility, and gain legitimacy. When applied cautiously, it can effectively address legitimacy issues. As discussed in Chapter 2, boundary bridging facilitates information transfer and coordination while maintaining boundaries and identities. This chapter illustrates how IoT startups attempt to overcome the knowledge gap between the startup and stakeholders through product development, business model innovation, incorporating stakeholder feedback, identity formation, and, at times, unethical practices. It also highlights the challenges faced during boundary bridging, such as biases, threats from incumbents, and stigma. The chapter begins by emphasizing the importance of boundary bridging in helping start-ups secure support and legitimacy from stakeholders. It then discusses efforts by startups to achieve product-market fit (PMF) and business model fit (BMF) to gain stakeholder trust. Next, it describes impression management tactics used by startups to bridge the gap between stakeholder expectations and reality. The chapter concludes by examining challenges arising from power dynamics within the start-up–stakeholder relationship and explores how boundary bridging interacts with technology work to influence technology adoption and boundary work practices, shaping overall outcomes.

6.1 Overcoming start-up challenges through boundary bridging.

The founder of IoTSecurity, an experienced technologist who was passionate about the technical aspect of the value proposition, found it challenging to translate this for prospective investors in commercial terms.

"[…] We have struggled in finding investors since […] they are more concerned about the market problems we're going to solve and not technical problems […] They do not even understand most of what I'm going to say and have been saying. So, there is a broken kind of phone - the knowledge gap in both ways […] they don't understand that you cannot fit everybody in the same box. Got it? ***That*** *is frustrating." (IoTSecurity Founder Interview, 2022)*

The two-way knowledge gap expressed here results in a lack of cognitive and pragmatic legitimacy. The start-up eventually found investors who had been technologists and were able to understand the founders' technical language., worked with the founder to adapt their value proposition to make it compelling and easily understandable for future investors. Bridging here took the form of finding an interlocutor who shared the founder's language and translating technical jargon into market-oriented narratives that enabled the start-up to gain legitimacy and funding.

Similar issues arise in market adoption when the customers are unable to see the benefits of the technology. Even if the start-up frames their offerings to fit the customer's needs, there is a need for continuous education and communication to ensure material outcomes, depleting valuable resources. In the case of FullBattery, the customer's existing processes did not accommodate for dialogue and evolution especially when it came to revenue.

"…they look for a viable business proposition […] problem is the customer is not willing to open up but is expecting that you will just present the number, and they will find the number favourable but that's hardly the case. So, in many cases it takes quite a lot of time […] because then the expectation of what you are able to get as a revenue and what they can get is not really aligned. And that is basically the single thing which breaks the business" - (FullBattery CEO Interview., 2023)

The start-up must spend a significant amount of time bridging the information and expectations gap, a potential drain on resources better used elsewhere. However, it also enables the continuance of the existing customer relationship that can be effective for longer term start-up operations.

During the sales cycle, start-ups undertake bridging by trying to align the product with customer expectations, sometimes without considering their limitations and customer's internal strategic agendas. This lack of negotiation opportunity also dictates the start-up's journey to become a service provider or vendor for their target customer. The expectation gap highlights a lack in market research in terms of quantification of value proposition, costing and, choosing the customer (Aulet., 2013). The legitimacy of the technology's value is challenged due to the expectation gap and power imbalance. Moreover, the adoption of the complete solution is dependent on several factors beyond the success of the pilot or proof-of concept (Rimbeck, Stumpf-Wollersheim and Richter, 2023). Meeting key performance indicators does not convince the customer of the value of scaling up the adoption. FullBattery met the agreed features, functions and outcomes of a proof-of-concept (PoC) but was not able to scale the resulting customer project. The customers were uncertain about the offering's necessity in the broader organisational strategy.

Even where a start-up achieves pragmatic legitimacy by demonstrating product utility to a client, the project is unlikely to move beyond 'PoC purgatory' till key internal stakeholders can comprehend the product and visualise a fit within existing organisational infrastructure. Deploying a PoC early is standard start-up practice, intended to secure customer feedback and legitimate the product through hands-on testing, and forms part of the build-measure-learn loop (Ries, 2011). Resource constrained start-ups end up spending more time in sales, business development, deployment and customer follow-up for feedback and scaling, stymying product development and growth. Unpaid PoCs such as in the case of IoTSecurity, further exacerbate the challenge. Without a scaled project credential, start-ups cannot gain customers' trust as a reliable and mature technology vendor. This also causes stakeholders to question the start-ups' capabilities as a legitimate company.

Successful boundary bridging is what enables the transition from PoC to scale-up, and scale-up projects in turn serve as proof of both product and venture legitimacy. Bridging toward this end requires consistent communication spanning business development, translation across contexts, sales and negotiation as well as the cultivation of customer relationships close enough for the start-up team to judge whether a given PoC is likely to scale. That judgement helps start-ups act

to conserve resources rather than pursue projects unlikely to convert. The underlying knowledge gap remains an obstacle to legitimacy throughout, since it signals a deeper misalignment in values, norms or beliefs between venture and stakeholder.

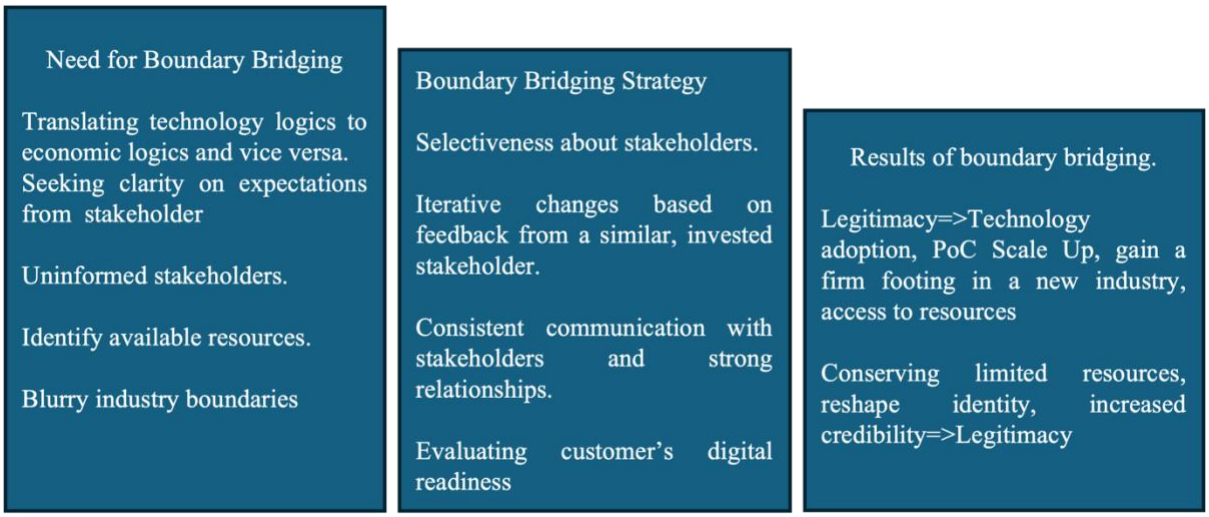


Figure 20 Needs, Strategies and Results of boundary bridging

Bridging efforts do not always convert to sales immediately but instead lay groundwork that only pays off once a customer's own readiness catches up. This is illustrated by TrackingParcels, where early discussions with customers did not convert to deals: *"[…] we had customers who were clearly hesitant to buy because they hadn't heard about anything like this before. But then, after a few years, once we already had competition and other companies were doing similar things, they start getting back to us, wanting to discuss further." (TrackingParcels CEO Interview., 2022).* The trust and credibility TrackingParcels had built through its earlier outbound efforts converted into inbound interest. The founder attributes this to avoiding a hard sell, preserve the relationship and conserve resources. This case illustrates how parsimony in bridging can itself be a route to legitimacy. A different rationale for bridging is evident in the case of SkyTaxiInfra working to set up a new industry where incumbents could potentially play a role. The newness of the urban air mobility industry and the still evolving industry boundaries posed a threat to existing organisations in the aviation industry -

> *"Because the industry is not mature, there is still a significant confusion of how the verticals are cut […] it's not quite entirely clear where the interfaces between the different verticals are and we discovered that*

while talking to potential customers, we were suggesting platform capabilities that they saw as their own domain and we had to make sure that we didn't kind of step on their feet too badly […] you may be surprised what your customer thinks he needs to do and what you can do for them (SkyTaxiInfra Founder Interview., 2023)."

SkyTaxiInfra discussed its platform's capabilities with prospective aviation customers led those customers to clarify their own roles within the emerging industry, which in turn reshaped SkyTaxiInfra's own understanding of where it fit. In addition, the team was aware of the disruptive potential of the platform and also respectful of the current status quo since most PoC opportunities sat within the existing aviation industry. This discovery process which included clarification of ambiguous boundaries and uncovering of latent customer needs became a route to shared value creation and, through it, legitimacy (section 4.2).

Misaligned expectations arise due to poor negotiation tactics or ambiguity and uncertainty around customer's requirements and available resources. Boundary bridging helps to uncover new needs but should be used with caution to avoid any potential conflicts. Additionally, bridging helps start-ups assess the customers' readiness and interest in scaling up, overcoming challenges in moving from PoC to scale up projects.

A spillover effect of scaling up is gaining legitimacy from prospective customers looking for vendors with wide deployment capabilities. Through boundary bridging, B2B IoT start-ups can gain legitimacy by aligning with customer requirements, integrate into an industry as a unique player, avoiding customer's perception of being disruptive and nurturing trust. Boundary bridging can also help start-ups to manage transitions related to products and BMs to ensure they don't lose their legitimacy as discussed in the next section.

6.2 Bridging the gap between customer expectations and IoT BMs to gain legitimacy.

Selection of a suitable BM is a prevalent challenge for IoT start-ups. Most investors and seasoned founders recommend IoT entrepreneurs to focus on a recurring revenue model. Most start-ups choose software subscription with free hardware

or a hardware subscription or hybrid model. Unfortunately, customers of start-ups building IoT based products have expectations very similar to those of other physical products such as a microwave or television when it comes to product performance and usability, and BM. In the case of B2C IoT products, customers are used to the high quality of product and smooth services that have become norm in the consumer durables space. IoT start-ups' tend to adopt an iterative product development cycle and so to avoid stigma from faulty and unfinished products they need to communicate constantly with their customers. Boundary bridging helps start-ups' stay on top of the customer relationship as seen in the case of Monitor. In its pursuit of scale and investor interest, the start-up adopted a recurring revenue-based model.

> *"The vast majority of customers had known about this for such a long time that more people expressed support than concern. It turns out that if you are honest and open in explaining why the transition needs to happen, customers are willing to understand and contribute. Especially when made aware of the alternatives — such as selling their data or displaying ads; and what they are being charged for. (Monitor CEO Blogpost, 2020)*

The start-up's new subscription-based model was adopted in lieu of usage of ads or selling customer data which are highly intrusive given the sensitive nature of the customer value proposition, that of letting property owners manage their short-term rental properties through sensors and devices that monitor properties occupied by end customers i.e. guests. The start-up faced resistance to adoption and possible loss of legitimacy from some customers due to its transition to a recurring revenue-based BM. The start-up managed the change through consistent messaging and communication of BM alternatives namely data broking or data driven attribution models. These alternatives are associated with troublesome outcomes including stigma creation for the start-up and its property owner customers. The start-up's strategies bridged the knowledge gap related to appropriate BMs for its customers, reducing the perceived risk of adverse selection and building beliefs that were congruent with what the start-up had on offer. In this way bridging helped reduce the knowledge and expectation gap and created legitimacy for the start-ups new BM. Through its continuous and persistent justification for the BM and recommending inconvenient alternatives, the start-up involved the customer in its BM transition as well as improved the BM

plausibility in front of both investors and customers. This BM as well as the start-ups change strategy enabled its rapid growth to a series B investment.

Another start-up, BabyCradle needed to bridge boundaries with their stakeholders in order to convince them of the viability of a B2C BM, after most conventional advice from prospective investors had been to use a B2B model catering to large employers or nurseries. The founders wanted to prove product traction and demonstrate product market fit which they felt would be possible by getting the end customers to adopt the product. They used this to demonstrate to B2B customers that the product was something that their employees or customers wanted and were already using. However, not all companies can manage both investor *and* customer interests as can be seen in the cases of MotherHealth and FullBattery where investors expected a recurring revenue model, but customers could not reconcile this with their contracting cycle.

Bridging is used to align customer expectations with product and BM realities. FullBattery spent a significant amount of time experimenting with different BMs and adding product features to achieve product-market and BM fit. This meant engaging with customers in different industries for different use-cases and gaining feedback. Customer preferences guided the selection of an annual recurring revenue model for the software meant to be paid out for a fixed duration annually and a one-time payment for the hardware, despite this being a significant deterrent to the start-up's growth according to the start-up founder.

Similarly, MotherHealth also changed its BM to a one-time fee to align with customer preferences. FullBattery lets the market drive the product and BM development to achieve the required propriety and validity outcomes. In contrast to Monitor's firm BM and product roadmap, FullBattery's bespoke product development and BM strategy allowed participation in an accelerator program where the accelerator managed the start-up and customer relationships. Bridging specifically with customers enabled the start-up to explore use cases in industries that had not been within its initial scope as well as spurring adoption by customers.

WiseBees had already achieved a product market fit and was adding features based on customer feedback. Their target customer segment was sideline beekeepers positioned between commercial hives and hobbyists. At the start, their BM was a one-time fee model for the hardware which was convenient for the customers. To align with investors' expectations and exploit future revenue streams through data, they switched to an installation fee and subscription model for hardware and software. They found a data exploitation opportunity by speaking to beekeepers who found regional data useful to find right locations for moving hives when required such as due to favourable weather. This data feature also made their offering more appealing to other customer segments such as commercial beekeepers and non-bee-keeping entities, discussed in the next chapter. Bridging customer expectations and their product enabled the start-up to add new revenue streams and gain legitimacy with new customer segments.

WiseBees reconfigured their product due to component availability issues discussed in 5.2, this led to change in features that were to be negotiated with customers. This was crucial since it would have impacted the reputation of the start-up if they had not been able to meet the customer demand especially since they had undertaken an aggressive sales approach in their initial days. In these cases, bridging the gap between customer expectations and their offering enabled start-ups to gain legitimacy from - investors helping the start-ups to survive and scale, *and* customers driving adoption from existing and new market segments, as well as maintain their legitimacy in the WiseBees case.

Bridging has questionable aspect to it. As seen in the case of Monitor where the consumers were given limited BM alternatives in order to justify the use of a subscription-based model. Other start-ups have adopted questionable strategies to bridge the gap between stakeholder expectations and their own stories explored further.

6.3 Boundary bridging by adapting start-up identities.

In many cases, bridging attempts are meant to align expectations and entrepreneurial stories for impression management. This takes the form of deception or impression management through the use of evasion, omission or legitimacy lies (Garud and Snihur et al.,2022; Turcan and Juho, 2014). For instance, in the case of BabyWearable, during a prominent televised pitch session,

the founder tried to concretize the abstract value proposition of 'getting parent's a total night's sleep' in the form of a non-functional prototype which fell apart on examination by an investor. Material artefacts are meant to help the audience understand the intended functionality and feel before a deep dive into the business and product such as the case of the palm pilot (Berglund and Glaser., 2022). The artefacts add to the comprehensibility of the offering and were a means to gain initial interest from investors. Despite claiming that the product was at a patent pending stage the founder declined sharing the basic idea behind the algorithm under the guise of fears of intellectual property theft, Furthermore, the founder evaded fundamental questions related to the technical aspects of the product by being transparent about her lack of application development experience. One of the investors considered these issues as legitimate and was convinced by the value proposition.

> *"Investor - 'I am not the tech one, I am a mother who understand the problem […] but I am not the tech expert, so I don't know at what level you are with the development of the tech. '*
>
> *Founder - 'We are ready to go'*
>
> *Investor - 'I am going to trust that you are.'" (BabyWearable pitch., 2021)*

The information asymmetry is especially stark given the lack of investor knowledge about technology-based products. The founder's statement about the state of readiness of the product and technology in order to raise capital was a false promise. The founder admitted during a podcast interview in 2023, that the prototype had been hastily put together for the televised pitch by a hardware design team of an accelerator program she had been accepted into -

> *'[…]my business partner said, "you're not ready, we're nowhere near ready, we've not even got a final proper working prototype." **** it I'm going […]. [The accelerator] were like "not a problem, we're going to get on the phone, get these made" […] amazing how quickly they managed to turn that around for me' (BabyWearable Founder's secondary interview on podcast., 2022)*

The accelerator contributed to the bridging attempts of the entrepreneur as the prototype design along with the founders' promise of being '*ready to go*' conveyed an impression of a production ready design. This helped align the expectation of the investors' with the entrepreneur's claims which obscured the reality. Bridging through prototyping and entrepreneurial stories, even if exaggerated, support

impression management. However, the initial deal, fell through as the investor's realisation of risk ultimately led them to state unfavourable investment terms. Soon after the pitch was filmed in 2021, the founder held less than 50% of ownership of the company and as of 2024, the founder no longer has significant control in the company (Companies House., 2021; Companies House 2024). Till date, there has been no product release.

SkyTaxiInfra found it hard to generate interest from stakeholders on its value proposition of providing infrastructure for future mobility requirements. In its initial stages the founder admits that their strategy was to be transparent with their investors about the 8-year development timeframe and financial requirement of nearly €100 million. The founder states that in the beginning, there would be investors who would show interest in funding such projects. With COVID-19 and Ukrainian war, investors become more risk averse, and the start-up had to shift its strategy by not just focusing on short term, demonstrable results such as working on integrating their software with heavy drones within an 18-month timeframe and embellishing their value proposition.

> *"If you say we're in the aviation infrastructure business, then people say, OK, go home. If you're saying, you know, we're providing autonomy as a service […] sounds good, right? So, it's complete ********, but it supports the sales process." (SkyTaxiInfra CEO Interview., 2023)*

The use of the word infrastructure added a negative connotation for investors since traditionally it had been developed and invested in by governments. To gain legitimacy from stakeholders, the start-up used a made-up phrase that did not accurately describe its identity. The start-up diverted from its initial strategy of being transparent with stakeholders. Unlike SkyTaxiInfra and BabyWearable, Nexum is a mature company with series D investment. They engaged in exaggerated claims in their branding campaigns related to the origins of the technology in a bid to differentiate themselves as a challenger connectivity technology competing with large telecom organisations and bridge the gap between their perceived identity as a connectivity technology company and customers.

Nexum's persona-based brand campaign was myth making, for instance the videos recount founding in a "garage here in town" while the venture was a university

spinout (Nexum brand campaign videos., 2021). Exaggerated claims are hedged with maternal pride "*my son made the world's best 5G IoT* […]" (Nexum brand campaign videos., 2021). The persona delegitimates cellular infrastructure (*"look at that mobile mast, it's very, very stupid"; "cellular IoT networks are full of unnecessary drama"*) and Silicon Valley *("if you want to buy your IoT solution from a guy eating vegan sashimi in a warm pool in Silicon Valley, that's up to you")* (Nexum brand campaign videos., 2021). The brand campaign was popular as trade-fair visitors queued to *"take a selfie with the cardboard mom."* and the agency responsible won several industry awards (Nexum executive interview., 2022). But these judgements were not rendered on the technology itself, as the interviewee mentioned *"people love the brand — so how this will actually yield into an actual business, that's something that we're still working on" (Nexum executive interview., 2022).*

In. these cases, bridging involved legitimacy lies, exaggerated claims and embellishments to help start-ups gain legitimacy from their stakeholders and overcome challenges related to funding and adoption. On the flip side, there are also evasive and illegitimate tactics employed by stakeholders and organisations who exploit the power imbalance that exists within the start-up stakeholder relationship as discussed in the following section.

6.4 Challenges faced during boundary bridging

While boundary bridging techniques are employed by start-ups to gain legitimacy and ultimately grow their businesses, they still face significant challenges while undertaking bridging work. As discussed in a previous section, customers are not always certain about their own expectations. They shop around different vendors to discuss various alternatives, never committing to any organisation. For the start-ups this means the waste of precious resources better used elsewhere. Many accelerator programmes contribute to this imbalance by introducing isomorphic vendors to the same customer in an effort to give the customer more alternatives as well as develop a strong reputation for their program.

> *"[…] a startup was developing a parking sensor for municipalities and another one was working on the exact same use case […] honestly we try to avoid that […] on the other hand, the smart city manager, who's working at the municipality of London, is probably going to hear from two companies who can implement smart parking in the city. So, it can also*

create some urgency in the market." (Corporate accelerator program manager interview., 2021)

The accelerators who function as bridge between start-ups and corporates view the problem of multiple potential vendors as a market saturation issue not taking into account the start-ups' limited resources. As long as the start-ups are getting straightforward responses from the customer regarding the adoption of the solution, a little competition might even catalyse start-up growth. Unfortunately, that is rarely the case as is highlighted by IoTSecurity's experience as they took boundary bridging efforts too far as discussed in section 5.5.

In an effort to find the right product market fit, the start-up kept adapting the cloud storage part of their solution in hopes of customer eventually making a purchase. Despite their bridging efforts, business development discussions took on more of a customer feedback session. Similarly, MarineMeasure found it difficult to elicit concrete feedback from customers which they could use to provide better offering or service. The founder found annoying that *"they're not saying directly what they think, and then you need to kind of read between the lines."* This can also prove tricky because there is no clarity on the customer's expectations, preventing the start-up from gaining legitimacy and their technology from getting adopted.

While lack of transparency and clarity on customers' end is a common challenge faced by B2B IoT start-ups, many start-ups also face issues while undertaking bridging work to build relationships with other resource providers such as investors and gatekeepers. YourPleasure is a start-up led by two female founders who don't have prior experience in developing technology-based products or any technology experience. As a result, they had to engage with multiple resource providers who could provide them with advice and resources.

"[…]in terms of having this accelerator experience, we've had a chance to talk with mentors from different fields. So, it might be hardware manufacturing, software building and many different areas. […] They were established professionals in their fields and if we entered a meeting to talk about hardware, sometimes we would hear comments like – 'Are you sure that this is a problem?' And they didn't answer our simple questions […] literally mansplaining you things about your body and pleasure, this

feels super weird to us. We are not even asking you about that. We are asking you about something different." (YourPleasure secondary interview., 2022)

The power imbalance between the resource providers and the inexperienced founders is reflected in the condescension and dismissiveness of the mentors, creating a barrier to the boundary bridging process. This also reflects the legitimacy struggle faced by start-ups led by female founders as well as start-ups developing technology for the female market or developing solutions for taboo problems. The start-up founders stated they were able to find specific individuals who made up for the other negative experiences by helping them gain valuable expertise and connections. Similarly, the founder of BabyWearable also talks about difficulties in gaining funding as a female entrepreneur,

"Female entrepreneurs, a lot of them, don't fall into the science category or IoT category and they might run a really successful business. But it's not anywhere near what I'm trying to do. So as helpful as it is, seeing how they've overcome it, there's still a lot of stigmata with female entrepreneurs. And sometimes you do feel, especially with investors, that they're treating you slightly differently." (BabyWearable Interview., 2022)

The founder's boundary bridging efforts were focused on developing a network of peers who might have been through similar experiences; this was accomplished by attending networking events targeted to female entrepreneurs. This did not yield intended outcomes since there were no other fellow female technology entrepreneurs. There is a lack of alignment between the experiences due to the difference in industry focus. The founder started trying to bridge this gap herself by mentoring female technologists or founders. She navigated the stigma associated with being a woman in technology by being selective in choice of investors or investor events she participated in as well as pre-empting the questions and expectations of the investors. By doing this she bridged the gap between the product and investor understanding, aligning with investor interests and gaining legitimacy. These founders persisted in their boundary bridging attempts by adopting certain strategies such as being selective about mentors and investors.

Besides, issues related to biases, YourPleasure also faced challenges as they tried to expand the scientific knowledge associated with their business idea at the early

stages as well as validate the idea. They spoke with key stakeholders and gatekeepers such as doctors, potential customers and other traditional business owners in the same domain. Some responses were positive, but an established gynaecologist labelled the founders as *'sick people setting out to do something inhumane.'* The start-ups values did not align with the entrenched values of the gatekeeper. This also reflects a failure in boundary bridging efforts as the stakeholder misunderstood the value proposition and it also indicates a cultural and ethical gap between the start-up founders and the gatekeeper. In addition, doctor's professional norms and standards of patient care were very far and removed from what the start-up was trying to do. The start-up's idea was delegitimated by an important gatekeeper at the outset. A similar experience was reported by the founder of BabyWearable where the founder had no previous education or experience in technology or entrepreneurship. The founder had no previous network and had to build the required social ties on their own. As a result, their boundary bridging efforts often did not yield the required outcomes.

> *"As soon as I said I got an idea for a new product and then a new hypothesis, you can assume that their eyes widened and they're like yeah we help hairdressers or plumbers set up their business, so not sure what to do with you!" (BabyWearable Founder Interview., 2022)*

This reflects the misalignment between the funding body and the start-up. The founder had to expend effort into bridging the boundaries by educating the funders were finally able to gain an understanding of the idea, make relevant connections, enabling the founder to start developing a prototype. The founder also had to convince them of the viability of the BM to get the support which was very different from the traditional industry category. The stakeholders relied on frameworks created for traditional industry category to evaluate a company for support or investment.

Bridging boundaries is critical because it helps founders overcome obstacles in their founding and scaling journey. The gap in knowledge, expectations and values between start-ups and their stakeholders – customers, investors or gatekeepers- can create significant challenges. Boundary bridging helps start-ups to cultivate trust, collaboration, alignment and thus, gain legitimacy, overcome biases and create lasting relationships. The technology work implemented by start-ups

results in the development of technologies that also serves as bridges between different entities and groups as discussed in the following section.

6.5 Bridging through technology work

Organisations face multiple pressures that influence technology adoption. Technology adoption is preceded by large amount of adaptation and change. Technology work influences change in the customer organisations as existing structures and processes need to be finetuned to accommodate for technological operations and resulting outcomes. Technology work includes the efforts put in by actors to shape technologies adopted by organisations such that they can become a seamless part of the organisational fabric. This includes form, practices and understanding of the technology (Lawrence and Phillips., 2019). It follows that vendors or start-ups make changes to their product or implement technologies that influence positive adoption outcomes and ensure continuing legitimacy. Technology work bridges the gap between customer expectations and the actual form of the product post implementation.

Marine Measure undertook implemented a solution that provisioned insights to customers who didn't possess the technical expertise to create such a system. The customer organisation benefited from the data collection and analysis as raw data were converted to easily understandable insights.

> *"So, we were in the marine industry […] we were collecting data from ships, refining the data, and then bringing the insights to our customers so that they can improve the operations of the ships. […]. We were collecting data about that. from some of our own sensors and then we thought okay, you should be having the vessel at a certain altitude […] and that gives you a few percent of savings."*– (MarineMeasure Founder Pitch., 2021)

The start-up's solution helps the operator bridges boundaries between the management teams and the crew creating a common ground for communication. The model output was translated *into "a display, our traffic lights, green, yellow, red, to help this crew who has this massively complex operation [...] just by following it and keeping it green" (MarineMeasure CEO, fireside chat., 2015).* There were fleet dashboards for management to monitor vessels and compare

their performances. The crew enacted the optimisations. The democratization of technological insights meant that the crew successfully exploited the technology without shifting their focus away from their daily responsibilities. The deployment of technology at customer site and associated testing and maintenance was technology work that bridged boundaries between teams and the physical ship and the ship's crew.

But better functional outcomes shown in the business case were not sufficient to gain legitimacy and this is also echoed by the venture's CEO – *"We needed to have a business case and trust [...] a big corporation has to trust us that we can really do what we set out to do" (MarineMeasure CEO, fireside chat at European start-up conference., 2015)*. The venture failed to meet the target set by the first customer, a leading cruise operator.

"I remember in 2009 when we started the initial trial [...] we set together a target for 2% of savings. And I will never forget the day we got the results; we got 0.6% [...] I walked out with a deal for six months [...] they had picked a vessel which they had been fine-tuning all the operations for years and years. They were not expecting a company to improve at all on that. Just the fact that we could improve within 0.6% meant that they saw a business case […] build the most important thing, which was the trust." (MarineMeasure CEO, fireside chat at European start-up conference., 2015)

Propriety judgements were rendered on the customers' baseline. Furthermore, MarineMeasure's CEO stated that *"they [the customer] are always testing us" (Marine Measure CEO, Fireside chat., 2015)* alluding to the constant evaluation they were subject to as part of the trust building. This also included the crew who challenged optimal recommendations from the venture that led to redesign of the outputs as near optimal options with trade-offs. As mentioned by the CTO of MarineMeasure – *"they felt that they were in control of the process […] it doesn't matter how good optimums you produce if they don't do them" (MarineMeasure Co-founder Interview., 2022)*. The venture gained legitimacy from the crew, leading to unexpected outcomes, leading to positive propriety evaluations from the management. This led to ultimate validity act of customer expressing the

beneficial outcomes of the partnership to an audience of potential investors and customers.

"By working very closely together [...] we create new competence, new knowledge, new ways of thinking [...] that is, I think, a good foundation for a true partnership[…][fuel optimisation] a very important element for us to work and optimise both from the environmental point of view, but of course also from the economic point of view[…]this is our number one focus and we have very systematic programmes in place [...] is really the key where [MarineMeasure] has been helping us" (MarineMeasure customer senior executive, Fireside chat at start-up conference., 2015)

With fuel optimisation, the start-up also helped the customer bridge the boundaries between on-ground ship operations and environmental goals. A spillover effect was the operator's compliance with environmental regulations. After the first positive propriety evaluation and deal in 2009, the venture had optimised 130 ships in the cruising industry and showed tenfold revenue growth within 4 years (Investor video., 2013). Customer trust extended to enhancing MarineMeasure's role as a technology provider to a third-party claims arbiter. This was shown by a customer's use of MarineMeasure's digital twin analysis in order to assess a propeller manufacturer's claims of improving efficiency by 11% (MarineMeasure CTO Interview., 2022). These instances all show legitimacy outcomes as a result of boundary bridging.

Bridging was accomplished through technology work through enablement of information dissemination in an easily understandable form. In Nexum's case, it was accomplished by increasing the usability of the technology. The technology was simplified to a point where the cost of training and education reduced.

> *"[…] anyone can install these things, as it is completely autonomous and you can do it anywhere in the world, you know, not needing to care about frequency planning or losing frequency, as it is having this new standard dedicated 1.9 GHz frequency. So, if you need a tech team, your return is already gone. So, we are seeing use cases where, for example, cleaning personnel have installed the system putting the sensors in the right places and not needing, special people" (Nexum CEO Podcast Interview., 2021)*

Nexum's team identified the additional cost of needing a technological team to install sensors within facilities as one of the inhibitors of new technology adoption. They removed the service component from the overall cost for the customer and made it a better investment that other alternatives that needed technological capabilities and would charge for the installation services. A global market analyst firm, granting the venture its new product innovation award against published criteria that include reliability and customer purchase, ownership and service experience. Millions of devices were connected to Nexum's technology *"due to its ease of deployment, versatility and economics of the company's next-generation offering"* and partnerships with 160 companies and 93 international patents (Global analyst firm award writeup., 2021). A leading national wireless research institute independently published results supporting the decentralized architecture's superior spectrum efficiency (Nexum CEO letter to stakeholders., 2021). In addition, the technology was integrated in the existing processes and infrastructure of the company, aligning the expectations of the customer and the values of the technology offering. By creating facilitating conditions within the product, the company was able to bridge the gap between non-technical customer employees and the new 5G system. Nexum's go-to-market strategy was based on the dictum "large corporates and customers do not have to worry about connecting the dots" (Nexum ecosystem manager podcast interview., 2021). But this required the venture to gain legitimacy from partners. This was accomplished by promising market access to partners. At one industry fair the venture had "a tiny booth with two partners who were not ready with a solution." Two years later it followed by "nine partners who collaborate [...] working with us on winning large-scale projects at industrial players. And this has been building the credibility over the last two years" (Nexum ecosystem manager podcast interview., 2021). A global industrial manufacturer engaged the venture directly for condition monitoring, coordinating its own technology partners around the venture's mesh network. The integrated ecosystems were driven by partners' pragmatic acceptance of Nexum's technology and its role as the ecosystem anchor. Furthermore, customer adoption of integrated projects shows that Nexum was accorded task and value legitimacy (Ren., 2019).

Besides the usability of the technology, other factors that impact the legitimacy of the start-up include the customer's satisfaction with the quality of the

technology. The founder of FullBattery discusses the importance of both hardware and insights to gain customer trust-

> *"With many clients, we start by running a PoC or pilot project […] they want to see how it works at scale. They need to be happy with the hardware quality as well.*
> *Looks, feels, check whether it has reliable data coming in and going out to trust it more. […] they would still have some doubts and then they would say 'we don't really like need this'" (FullBattery CEO Interview., 2022*)

After a start-up solution is being assessed for scale up within the customer facilities, experiences from implementation of PoC or pilot and its' performance evaluation is a boundary bridging practice that serves as an initial gauge of the solution's value for the customers. Once implemented, the customer still needs to validate the quality of the complete implementation. Even when PoC success criteria are met, the project is terminated since the customers' initial assessment of the PoC, and the scaled-up project don't align. Even if the technology meets the criteria to gain performance legitimacy it is unable to meet the conditions for task or value legitimacy which inhibits its eventual adoption by the customer (Ren., 2019). The start-up's boundary bridging efforts were only effective to gain performance legitimacy.

While B2B IoT start-ups had to bridge boundaries with their customer organisations, key stakeholders within the organisation and between the organisations and their business goals, B2C IoT start-ups needed to bridge the gap in the customer's knowledge about themselves or others. B2C solutions included products which would provide users with their own behaviour or data. For example, Your Pleasure's product was considered analogous to fitness tracker or sleep tracker by the founder, where user habits or preferences data would get recorded and guide the product's operations and usage. The technology is meant to connect user's personal preferences and usage patterns to their sexual preferences.

> *"[…] gets the data and analyses it and shows you more about your body but also with time it would learn also what are your preferences and then what you can explore even more, then you can simply relax, and the toy does its job based on what you liked and the way it has learned. That is, your way. And you can stimulate the most erogenous zone of the body, the brain. […]*

But obviously we have more things […] some experimental sessions that would also help you to understand more about yourself and your sexual desires and preferences. Based on what you like, and AI has learned, it suggests something to try out with your partner. It is like an educational toy." (YourPleasure Podcast Interview., 2021)

By recording user data and using it to provide an enhanced self-discovery, the technology is bridging the gap between a taboo subject and sexual health education. In addition, the product can also serve as a bridging tool between partners, helping them communicate needs that they may not verbally express. The product itself has the potential to challenge existing sexual and relationship norms. This could lead to the delegitimation of existing ways of sexual interactions. The start-up aims to achieve legitimacy by providing experimental sessions to its end customers, claiming to be educational as well as enhancing wellness and personal connection with others. This contrasts with existing studies which have highlighted potential concerns about use of sex toys, namely the replacement of human connection (Power *et al.*, 2024).

YourPleasure's technology serves a bridging purpose in its current form, providing education and wellness. However, the extent of integration of technology negatively influences the perception of the product as legitimate. Existing studies discuss that increased number of sensors or highly immersive technologies like augmented reality could increase the potential misuse, raising concerns related to individual, particularly, sexual consent and privacy (Power *et al.*, 2024).

Greater technological convergence leads to a shift in the role of the product from a bridging tool to one sharing a blurred boundary with users. Similar other start-ups focused on end consumers also bridge the knowledge gap but without highly intrusive technologies, for instance BabyWearable focused on providing baby's physiological data to parent to pinpoint the exact moment when the parent should try to put the baby to bed. This way the start-up technology is meant to bridge the gap in the parents' existing knowledge about the baby's sleep schedule.

IoT serves as boundary bridging tool, allowing for provisioning of information and democratization of knowledge to all users including those without the required technical knowledge such as Nexum and MarineMeasure. Moreover, technology

affordances designed by the start-up can also enable boundary bridging as seen in the case of Nexum. The success of PoC or pilots as bridging techniques establish performance legitimacy but does not translate to scale in the absence of value and task legitimacy.

Ethical concerns or potential for misuse as in the case of YourPleasure also lead to delegitimation as societal expectations and innovation values are not in alignment. Boundary bridging through technology work facilitate adoption, shaping relationships and long-term legitimacy. Technology work is accomplished by boundary bridging practices such as PoC execution, product and service adaptation to customer feedback, customisation and strategic selection of customers as discussed in the following section.

6.6 Boundary Bridging Practices

Practices are shared routines or activity that belong to certain social groups. Entrepreneurship experts and researchers have identified best practices that have enabled venture success and consequently adopted by most new ventures. Such practices include lean start-up approach with recommendations to validate ideas early and adapt to customer feedback (Ries., 2011), focusing on the end user, customer validation, iterative testing and sustainability (Aulet., 2013), developing a unique value proposition (Masters and Thiel., 2014). This section explores some of the boundary bridging practices that enable new ventures to span a knowledge gap and establish relationships.

Identifying a decision-making unit within a client organisation is a key practice in entrepreneurship (Aulet., 2013). MotherHealth adopted the practice of approaching hospitals that have lesser hierarchy, where there exists a concentration of power. They avoided hospitals where the power is distributed or where there are multiple decision-making levels.

> *"We have specifically approached the hospitals who runs by the Ob-Gyn's or gynaecologist where the decision making and influencing power are almost the same person, while in the corporate segment you have to go through the multiple levels or until now we have not touched them." (MotherHealth Founder Interview., 2022)*

This highlights MotherHealth's focus on resource efficiency as they target customers with simple decision-making structures. Through this strategy,

identifying the decision-making unit is straightforward (Aulet., 2013). In addition, once legitimised and contracted by these customers, the start-up can also begin the process of trying to navigate organisations with complex bureaucratic systems. However, this approach of targeting organisations with limited hierarchy i.e. single individual with decision making power and influence presents ethical concerns where there are low accountability and increased bias as a single vendor may get increased contract opportunities without an impartial evaluation process. The selection of customers based on ease of access to decision making unit is one boundary bridging practice. Another boundary bridging practice is the pursuit of customer feedback at different stages of the sales cycle.

Soliciting customer feedback is another popular recurrent boundary bridging practice, since the exchange of knowledge results in the evolution of an organisation. Start-ups use customer feedback at the initial stages for idea validation and to influence the product or customer service trajectory. In the case of BabyCradle, the founder began bridging boundaries with the key customer segment by initiating conversations with prospective customers, using the first version of the prototype at their customer's homes to gain feedback.

> *"Random parents messaged me, and I carried the crib and […] I went to their home I showed them, I said- 'please place your baby in this and talk to me'. in a very informal setting, met in coffee shops and I did talk to 50 parents before even designing the first CAD model for the US version." (BabyCradle Founder CEO., 2022)*

Directly engaging with the parents enabled the start-up to gain pragmatic legitimacy as the parents' feedback was incorporated to increase the utility of the product. Normalizing the child's placement on the crib also helped the start-up start the process of attaining cognitive legitimacy. MarineMeasure's founder vociferously criticises launching half-baked products, however, the founder of BabyCradle advises early-stage start-ups to launch 'half-baked products' based on the customers' propensity to manage the challenges with an early version of a product.

> *"Continuous improvement is needed but don't be afraid to launch half-baked products because early adopters have the capacity to digest that and we went to deliver the first crib, first 10 cribs and it was not pairing, 3 hours later and we are debugging and that person sat patiently with us,*

helping and being very empathetic towards us." (BabyCradle Founder Secondary Interview., 2024)

The launch of incomplete products allows the product to evolve based on real world feedback. However, this is highly dependent on the empathy and technological savvy of the early users. Early adopters are known to be experimental and developing a product and service based on their feedback may not make the product ready for the mainstream customers. The founder provides one example of a user who helped the team debug the installation issues at site for three hours. This strategy might help start-up to align their products much closer to the user's expectation of the product, but the early majority and subsequent categories of customers in the technology adoption lifecycle might not have the same levels of commiseration with the start-ups service and product issues (Rogers.,1995). In addition, constant iterative development may stretch financial resources, inhibiting the start-ups' ability to scale.

Boundary bridging is also a temporal activity since it can be continuous or dispersed based on an event or activity. Also, boundary bridging efforts at one point in time, may eventually lead to desired outcomes, at another time. For example, TrackingParcels was mentioned in an earlier section, having built deep customer relationships that led to fruition once the customer organisation had met the digital readiness and facilitating conditions requirement. This shows that boundary bridging efforts might not immediately lead to legitimacy from customers in terms of product acceptance or adoption, but it does create the conditions for it over a period of time. MotherHealth also discusses the dependence of impact of bridging on temporality since the feedback influences the product as well as the organisation using that device or software.

"Over a period, […] took their feedback and further supported them, we have given them updated software without any cost. So, making sure those relations are strong because they have helped us in our journey of using the product as recurring users." (MotherHealth CEO Interview., 2022)

Key outcome for continuous boundary bridging efforts is the formation of relationships that has helped in shaping the product. These customers were recurring users; they provided valuable feedback to the start-up based on which the product was adapted. This shows positive propriety judgements passed by the government customers. The start-up bridged boundaries between its own

commercial logic and the public sector logic by providing free updates to ensure smooth operations and continued use, aligning with the procurement and resource constraints. This illustrates the unspoken partnership the start-up enters with such lead users. Another commonly used practice for boundary bridging is the use of PoCs, and pilots as discussed through the example of FullBattery's scale up implementation in an earlier section on technology work. PoCs or pilots are tangible means of boundary bridging since it cultivates trust, builds or aligns expectations. – they are used to demonstrate viability of the solution. Once a PoC is accepted, the next step is a scale up project.

Making customisations to the solution or the BM based on the customer requirements also helps bridge the boundaries and attain legitimacy. Most of the early-stage B2B start-ups like FullBattery, TrackingParcels and MarineMeasure incorporated bespoke features into the offering to gain legitimacy and close deals with customers.

> *"We have a customer where we would provide the battery monitoring analytics for a golf cart and the customer would come later and say 'hey, can you also get us a GPS location of the cart, some on the field?' […] Add some details to it, so we just look at what we have and if they have all the hardware in place." (FullBattery CEO Interview., 2023).*

The incorporation of customer demands was beneficial for early-stage start-ups, to get client traction and implement PoCs. Early customer traction is a known signal for investors to evaluate the start-up's future potential. The start-up's effectual approach to boundary bridging also demonstrates its adaptability and flexibility to other customers. While these customisations might enable the start-up to get legitimacy in the short term, it still doesn't guarantee scaling up of the venture.

Ventures that succeeded in scaling up bridged the gap between internal organisational knowledge and external customer capabilities, post product adoption through the use of documentation and user manuals such as in the case of FullBattery, easy to install and use products such as in the case of Nexum and WiseBees and providing customer service such as in the case of BabyCradle. However, in some cases this reduced the efficiency of the solution. In the case of MarineMeasure, the start-up was installing 'half- baked products' on customer

premises and testing them onsite. The specific issue around hardware debugging required employees help bridge the gap between the start-up's product and technological capabilities and the demands in a production environment at the customer site. The expertise and efforts of the employees is crucial to ensure continued start-up legitimacy as perceived by the customer. During the initial stages, with early adopters, primarily cruise ships, the start-up employees, some of whom moved to a port city, were able to test and maintain the equipment once the ships came to port. As the product was refined and the start-up found a new customer segment in cargo ships, there were delays in testing and maintenance of equipment which could take place only a few weeks after any problems were discovered, undermining the efficiency of the solution.

> *"Some, of the things on the software side we could debug remotely. So, we could do all sorts of things that way. But if it was a hardware problem then we needed to send somebody on board. But this problem of course became even bigger when we went to cargo ships because it could take six weeks before we would see a cargo ship again. So, plenty of headache. Not recommended to anyone or what I can only say is- try to make products which would work before you install them on board, but that's not always an option for a startup" (MarineMeasure CTO Interview., 2022)*

MarineMeasure had to appoint someone to manage the issues arising due to the proof-of-concept hardware and bridge the gap between the hardware product and customer environment. The advice offered by the organisation's CTO on installing ready products in customer environments is contrary to commonly accepted lean start-up approach which focuses on getting an MVP to market and adapt it based on validation tests (Ries., 2011).

Boundary bridging practices do not guarantee immediate success but lay the foundation for legitimacy, trust and eventual scalability. These practices include continuous adaptation, collaboration with lead users, pre-emptive maintenance and debugging *and* iterative refinement using which start-ups bridge gaps in knowledge, trust, and expectations. These practices lead to pragmatic and cognitive legitimacy and also align the product with evolving customer needs, expectations and beliefs.

6.7 Discussion and Conclusion:

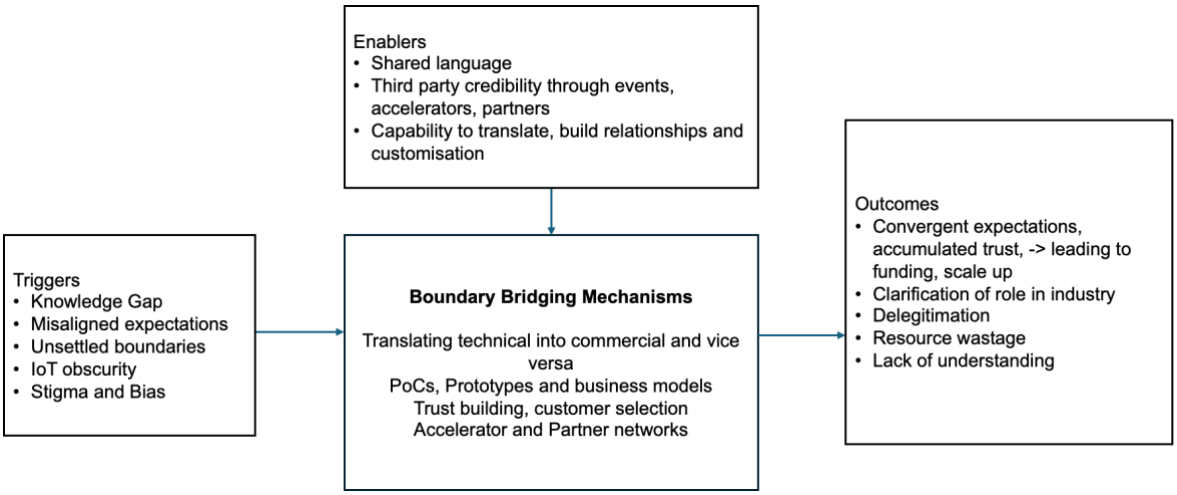


Figure 21 Triggers, Enablers, Mechanisms and Outcomes of Bridging

Boundary bridging, as used in this chapter, differs from boundary spanning and translation (Aldrich and Herker, 1977; Callon, 1986; Czarniawska and Joerges, 1996). Spanning is a role that actors positioned at organisational boundaries play to manage information transfer and relationships. By contrast, boundary bridging is a *process* of constructing conduits to overcome the demarcations that a start-up encounters while seeking legitimacy. Translation describes how concepts, logics and frames are adapted as they travel between social worlds, preserving their core logic while fitting local conditions. Boundary bridging is broader, as it includes discursive (reframing), artefactual (PoCs, prototypes, BMs), relational (identifying translators, building trust-based customer relationships) and structural (accelerators positioning start-ups with corporate customers) bridging. As developed here, boundary bridging is a process-level concept through which IoT start-ups close the gap between their institutional position and the legitimacy expectations of the evaluators by iterating, reframing, validating and constructing a shared language.

This chapter also highlights cases where boundary bridging succeeds and fails. Bridging fails when there is a persistent knowledge gap between start-up and evaluator, as in the case of IoTSecurity; when there is misrepresentation or legitimacy lies, as in the case of BabyWearable; when there is over adaptation through unpaid PoCs; and when feedback diverges and features accumulate, as in the cases of IoTSecurity and FullBattery. Conditions of success include persisting with relationships, as in the cases of MarineMeasure and SkyTaxiInfra; being able to restate commercial terms in technical terms and vice versa, or finding an evaluator who can do that, as in the cases of MarineMeasure and SkyTaxiInfra; and

co-operating without consensus, as in the case of MotherHealth and Monitor. Other success criteria include selection, funding, contract, and adoption, as in the cases of Nexum, MarineMeasure, IoTSecurity, and TrackingParcels. Given that boundary bridging involves varied activities at different boundaries and levels of analysis, it is important to note that some cases were coded outside boundary bridging during the analysis process.

Bridging is a venture-level response to the knowledge-expectation gap. Sustained bridging supports scaling by building the credibility, functional demonstration and system-level integration a start-up needs to move beyond PoC. Bridging also exposes founders to stigma and bias, as in the cases of YourPleasure and BabyWearable. These issues can be overcome through persistent bridging, which includes educating and networking. It helps ventures address issues around customer readiness, product-market fit and business-model validation, and, in cases such as SkyTaxiInfra and YourPleasure, can reshape industry norms and boundaries themselves.

When start-ups cannot align investor and customer interests simultaneously, most in this sample prioritised the customer relationship, bridging through supply-chain adaptation, new use cases and continuous feedback. These practices support product-market and business-model fit but carry the risk of half-baked launches and associated stigma, or a resource drain. B2C ventures depend more heavily on customers themselves to surface defects post-launch than B2B ventures, which can test on-site. Even where technology work succeeds in democratising information and improving usability, performance legitimacy alone does not guarantee the task and value legitimacy that adoption ultimately requires (Ren., 2019). Ventures also risk delegitimation where the technology used is itself intrusive. Several start-ups pursued illegitimate bridging through impression management, misrepresenting product readiness, embellishing their offer, or engaging in mythmaking.

Expectations converged where bridging succeeded. Where bridging failed, expectations remained unmet like IoTSecurity's founder and its early investors continued talking past one another, and MarineMeasure's cargo customers formed expectations of maintenance turnaround the venture could not meet. In some cases, bridging enabled shift of bargaining power toward the venture like Nexum moved from a two-partner stand at an industry fair to an ecosystem anchor around

which corporate partners coordinated their own offerings. But, bridging also left the underlying imbalance intact or exposed it further such as through unpaid PoCs and exploited feedback etc. Meanings were reshaped through bridging such as Monitor's recasting of subscription as evidence of transparency rather than value extraction or SkyTaxiInfra moving from infrastructure to 'autonomy as a service'. In some cases, meaning changes led to long term legitimacy and in some cases such as BabyWearable's false claims, it proved to be unstable on testing. Authority once developed was further strengthened as in the case of MarineMeasure's role as arbiter of a third-party claim, but when authority was being built, gatekeepers could easily delegitimate the venture as in the case of YourPleasure or dismissive accelerator mentors.

Bridging in triggered by knowledge or logic gap between the venture and the audience, the obscurity of IoT as well as stigma or bias. It is enabled by shared language and by event participation, partners and accelerators that can provide credibility, venture capability for translation, customisation and sustained relationship building. It is accomplished through mechanisms of discursive translation, PoCs-prototypes and BMs, trust building, customer selection and building long term customer relationships, accelerator networks and partners. Bridging can lead to trust leading to funding, contracts, scale-ups, clarification of industry roles. On the other hand, these bridging attempts can also lead to delegitimation, resource waste and lack of understanding. This chapter showed the ways in which bridging changes power, meaning, expectations and authority It also shows the different triggers, enablers, mechanisms and outcomes of boundary work. The next chapter focuses on the cases where boundaries get blurred.

7: Findings IV: Blurring Boundaries

This chapter examines the boundary work undertaken by start-ups to achieve and maintain legitimacy through the blurring of boundaries. Where boundary creation draws new distinctions and boundary bridging connects actors across boundaries that remain intact, boundary blurring erodes the distinctions themselves. Five forms of blurring recur in the cases - between technology categories as ventures claim membership in multiple categories or associate with incumbents; between organisations through mergers, partnerships, and the data flows that dissolve firm boundaries; between physical spaces and digital technology, as IoT reshapes the homes, bodies, and workplaces in which it is embedded; between old and new practices, as technology-enabled routines displace traditional ones; and between external institutions namely regulations and industry standards and the venture's internal products and processes. Blurring undergirds the creative, selective, and manipulative modes of legitimation, and it is the form of boundary work most prone to ethical issues. In some cases, blurring operates as an illegitimate means to legitimacy.

The chapter shows that blurring reconfigures existing power structures, generates values conflicts, and enables adoption. It contributes to entrepreneurship literature by showing how external enablers, category hype, regulatory change, and Industry 4.0 technologies are resources that ventures blur into their own boundaries, and by documenting departures from the assumption that early-stage ventures lock into a core focus (Davidsson, 2018; Chalmers, Mackenzie and Carter, 2021; Aulet, 2013). It contributes to the organisational work literature by examining the interplay between boundary work and technology work, and between boundary work and values work, through which legitimacy is gained with some audiences and risked with others. This chapter shows how blurring produces values conflict, identity incoherence, or stigma rather than legitimacy, and shows where blurring operates as an illegitimate means to legitimacy.

7.1 Blurring boundaries between categories:

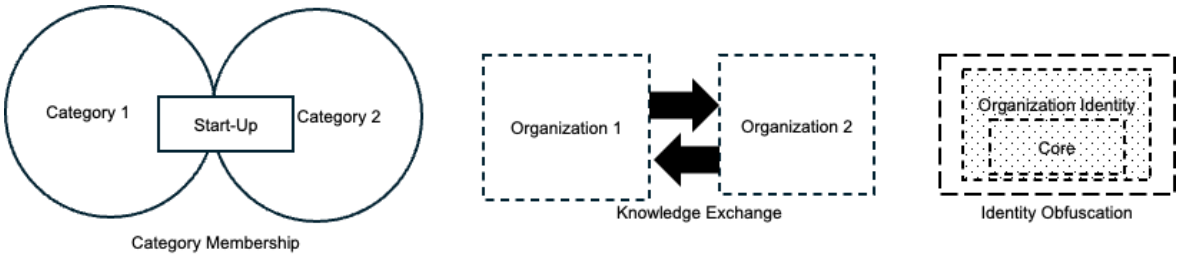


Figure 22 Blurry boundaries between categories

Organisations can achieve legitimacy through association by blurring the boundaries between different categories. In a bid to attain legitimacy, start-ups incorporate the use of industry or technological trends that may or may not be related to their value proposition. This creates ambiguity about the appropriate category or label that is assigned to the start-ups. These categories or labels are particularly important to craft easily communicable frames that reflect the start-up's core offerings and internal capabilities.

This section discusses the ways in which start-up boundaries are blurred and the exploitation of category ambiguity to gain legitimacy. The findings suggest that boundary blurring takes place due to multiple category membership, knowledge exchange, the obfuscation of venture identity, the adoption of multiple BMs – including some that may be exploitative, technology convergence, mergers or acquisitions. In some cases, the creation of ambiguity results in challenges to the organisation's established practices and BMs, negatively impacting its legitimacy. In another case, the start-ups' technology serves as an enabler for shaping of their customers' organisations through data sharing between multiple entities.

Nexum is an organisation creating software to turn devices into routers that encourages the formation of mesh type networks. This research on Nexum's proprietary technology commenced *"before Bluetooth or similar [technology] existed"* (Nexum Business Development Head interview., 2022). Nexum's leadership team relied on using frames linking to established radio-based technologies such as Bluetooth to generate legitimacy for Nexum's software.

"[…] we use low-cost chips, the same chips as Bluetooth are using, under our software. That enables in our offering, the lowest cost option." (Nexum CEO Podcast Interview., 2021)

Like the quote mentioned above, Nexum's leadership capitalised on the trust and acceptance of an incumbent radio technology by referencing commonalities or highlighting differences. This blurs boundaries between Nexum's technology and Bluetooth. However, Nexum's licence-based BM creates a unique challenge for the start-up as customers compared the two wireless technologies and concluded that Nexum's radio technology was unnecessarily costly–

"They come to us and wonder, why do we need to pay some licence fee to your technology? Because Bluetooth or Zigbee, they are free. […] If you do want to make Bluetooth or Zigbee devices, then there is a membership fee, which allows you to put Bluetooth or Zigbee logo to your stand. […] we say that, when you license from us, you not only get the connectivity, but we also have additional pieces that we have built in. So, what we call our connectivity suite." (Nexum Business Development Head Interview., 2022).

Bluetooth and Zigbee are well-established and widely accepted technologies. Customers preferred them due to their proven track records and extensive adoption (Rogers, 2003). Nexum's business development and sales teams exposed hidden costs and differentiation through the value-added connectivity suite, positioned the technology within a separate subcategory of radio-based technologies and highlighted the issues with Bluetooth in order to delegitimise it.

The emergence of 5G, shaped the boundaries of Nexum and its products (Davidsson, Recker and Von Briel, 2020). Its head of RF initiated and led a two-year drafting effort in the European telecommunications standards body's telephony-standards committee, serving as a vice chair and producing a new radio standard that "builds on current [Nexum] technology" (Nexum Head of RF account, Nexum Blog, 2020). The standards body announced the new standard in October 2020 which was followed by an independent academic evaluation confirmed its radio performance against the 5G requirement set and in October

2021 the International Telecommunication Union's radiocommunication assembly included the standard in its IMT-2020 recommendation (the specification that formally defines what counts as 5G). The standards body announced it as the world's first non-cellular 5G technology to receive that approval (European standards body press release., 2021). The "non-cellular 5G" label carries associations with consumer 5G's speed and ubiquity and Chapter 6, section 6.3 records the venture engaging in exaggerated claims in the same period.

Nexum's multiple category membership (Bluetooth and 5G standards) resulted in blurry organisational identity. Thus, Nexum gained legitimacy by de-legitimating incumbent technologies such as Bluetooth or Zigbee and even 5G.

> *"5G is bringing more speed, lower latencies and also accelerating the trend of private networks for the enterprises, or good so far, but it has failed in one place quite badly, which is the price […] So it's simply far too expensive to connect sensors and to have you know, a positive return for those use cases. Now, this new non-cellular 5G standard is our standardisation that addresses that problem." (CEO Podcast Interview, 2021)*

Nexum's CEO highlights that 5G is prohibitively expensive to use in certain cases such as connecting high number of sensors, and they position their solution as a more commercially viable alternative. Nexum exploited the coattail effect of associating with 5G. In addition, the company used creation strategy in association with a well-known telecommunications partner to achieve legitimacy by influencing existing communication standards. Thus, instead of being a member of any category of communication technologies, Nexum exploits its blurry boundaries and category ambiguity to gain legitimacy (Durand and Thornton., 2018). The venture consolidated the certified 5G membership into its market identity, launching its next product under the "Private 5G" (Nexum executive partner video interview., 2022). One of the container shipping industry's digital standards associations founded by the largest carriers and the venture's prospective customers published IoT connectivity standards with which the venture's stack is compliant (Nexum standards compliance announcement., 2022).

The venture created cognitive legitimacy through boundary blurring leading to a validity judgement by the ITU and further opportunities for legitimacy.

WiseBees is an organisation claiming expertise in smart devices and data driven beekeeping, this shapes its venture boundaries as IoT and adjacent to the IoT (data analytics).

> *"[WiseBees] is a beehive monitoring system that improves workflow and increases yield, to benefit the earth through data driven beekeeping. So, we are building a bunch of smart devices for this purpose. And also, there's a web app which shows all the data in a dashboard. And eventually, we're really focused on the data analytics side of things and also how we can utilise all this data for other stakeholders that may not even need our devices." (CEO Podcast Interview., 2021)*

The start-up's panoptic view of beekeeping operations influences the legitimacy of its beekeeping offering among customers. The venture creates a blurry identity by specifying the benefits of the innovative technology without opening the black box. By doing this, the organisation is undertaking boundary blurring in order to gain legitimacy from a wider group of stakeholders. From selling devices and data-driven beekeeping to potentially hawking beekeeping data to other stakeholders, is the change in BM. In addition, they are also blurring power relations as beekeepers go from owning the data from operations to potentially sharing data with others, outside their sphere of influence. Besides the potential ethical concerns that can arise from the third-party usage of this data, this also presents a diversion from one of their core activities namely building hardware for data-driven beekeeping for their end customer – the beekeepers. The founder goes on to mention that the data could be used in contexts outside of the chosen niche of beekeeping. This is contrary to existing studies which suggest that start-ups in the early stages need to 'lock into their core' (Aulet., 2013). Data-driven beekeeping is the 'core' of the start-up's business, enabled by the smart devices built by the start-up. The start-up is changing its core focus by exploring secondary market outside of beekeeping, with no use for the devices. However, this additional BM of exploiting collected data is a means to gain legitimacy from their target audience. Besides this, the use of hyperbole, and adjacent technology frames such

as "data driven" and sustainability rhetoric was continued in subsequent pitches to retain the cognitive and normative legitimacy. The start-up's multi category membership in the environmental and technology categories also contributes to a blurry identity. However, it also creates legitimacy challenges. The normative legitimacy accorded to environmental sustainability efforts influences the legitimacy of the technology enabling those sustainability efforts. In addition, the emphasis on tangible benefits and measurable outcomes of data-driven beekeeping enhances the offering and, by extension, the company's legitimacy. The start-up extends beyond its core focus and uses environmental frames to gain legitimacy. WiseBees's pursuit of alternative BMs which are potentially exploitative of its customers also influences its legitimacy, therefore boundary blurring influences the legitimacy of the company

WaterSensor was founded from the merger of two start-ups - one focused on developing ML and the other developing IoT. The merger was the outcome of collaboration between university and utility companies, and was undertaken to meet investor requirements for viability and business potential as mentioned in the following quote –

> *"then a university and two utilities had formulated a need for IT technology in the water industry and then my company was coming with the hydraulic experience, the data management side and then there was another small company that was coming from the IoT side […]device manufacturing and design and the whole grant, it's coming from an investor fund and of course their aim was to generate a business and because we were two relatively small companies, we said that we would make a joint business." (WaterSensor CEO Primary Interview, 2023)*

The convergence of technological disciplines – hydraulics management, data management, and IoT, was a precursor to the blurring of organisational boundaries. The existence and sharing of specialized complementary knowledge, enabled the formation of a new organisation. This development was triggered by legitimacy offered by investors. After the merger, the start-up focused on communicating the potential of machine learning and data analytics deployed in water management but obscured the role of IoT. Due to this boundary blurring,

the role of IoT got subsumed under the machine learning and data analytics umbrella. For example, while explaining the start-up's offering, the founder refers to data and machine learning in the following quote. During the pitch, the start-up founder delineated the organisation's boundaries around all aspects of water management-

> "*We work with water throughout the water cycle. More specifically, we work with data combined from water catchments […] we have machine learning experts, and we combine it all using data.*" (Water Sensor Pitch., 2020).

Moreover, the startup functioned as an external enabler by blurring the boundaries of the customer's organisation. Boundary blurring took place as data from multiple sources, beyond organisational boundaries was combined, under the purview of different controlling bodies.

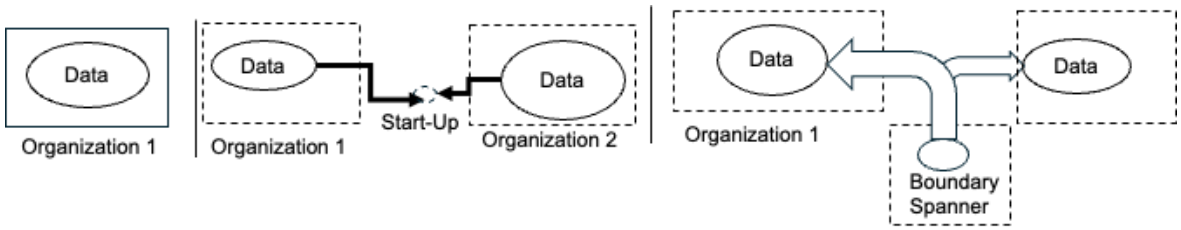


Figure 23 Data leading to blurry boundaries

WaterSensor's attempts at conveying expertise and acquiring legitimacy are evident through terms like 'machine learning experts' and 'data combined from water catchments'. The use of machine learning (ML) implies further automation through creation of ML models tailored to the water sensing use cases. In another interview in 2021, the CEO and head of IoT spoke about the importance of data sharing between different organisations in the water supply and treatment chain. The company undertook technology work through data and ML technology development and implementation. Thus, technology work resulted in blurring venture boundaries through partnership structures and innovation. In this case, there exists an overlap between technology and boundary work. The IoT head acknowledged that the venture focused on software as the core business because of the insights provided to the municipal bodies. He also highlighted that native IoT knowledge and expertise enabled the ML performance. The blurry boundaries around the key technologies used by the start-up (ML, IoT) are an outcome of deep technical know-how and adaptive communication. The start-up founders in their

pitch and interview demonstrate an understanding of data usage and quality. This adds to their legitimacy in data analytics. The CEO and IoT head discussed the impact of their technology practices on climate change and the broader water industry. This abstraction of the company's vision, along with their demonstrated hardware expertise helps them garner legitimacy. Trust accorded by various organisations in sharing data with them also demonstrates their status as a legitimate organisation. Their boundary-blurring work is further enabled by the legitimacy they have gained as an expert organisation in software and hardware in the field of water management, and their broader cause. This adaptation is dependent on the consistent demonstration of competence in the field of AI, data analytics and hardware

BabyCradle referred to their product as AI-powered smart crib to gain cognitive legitimacy despite the indispensable role of IoT for their product. During conception and growth stages, the company was part of two IoT start-up accelerators (2016-2018, 2018-2020) that helped build the physical product, establish IoT supply chain and incorporate AI. In this way, they blur between two technology categories. They adapted their identity to cohere to the buzzwords of the time. The use of occultation is evident here with the focus on terms such as 'AI or data-driven' to describe the product, that hides IoT at play. Further, their legitimacy hinges on successfully blurring boundaries between traditional childcare practices and technology that is acceptable to parents. They also challenge the legitimacy of existing traditional practices by providing something better than existing tools and techniques. Their core message of giving parents peace of mind by offering insights into their baby's physiology and sleep through AI helps them gain pragmatic legitimacy.

AgeObserve's value proposition is that its' AI-powered monitoring system lets elderly individuals stay at home with reduced risk. In the cases of BabyCradle, AgeMonitor and AgeObserve, the use of AI can be attributed to the fact that their solutions use machine learning algorithms for better automation and alerting as well as the fact that AI is a buzzword. In a pitch in 2020, AgeObserve used terms like IoT, AI and ML to describe their technology stack and in a response to the investor's query on the development of Apple's 5G smartphones, said that 5G was on their radar.

> *"We are an IoT sensor, AI, ML technology stack. We will be continuously relying upon any advancements that are going on in carrier technology and 5G is of course, you know, going to be the next best thing for us […] a lot of what we do today requires us to bring data into the cloud and run our AI algorithms […] we are banking on developments in the edge computing industry where we feel like we can take some of that AI processing and put it at a lower level […] gets done in a more efficient way." (AgeObserve Founders' Investor pitch., 2020)*

It is evident from the above quote that the AgeObserve's adaptation to emerging technologies, includes product and firm boundary adaptation. This adaptation highlights its responsiveness to the external environment. Since the quoted technologies (IoT, AI, ML, 5G) require a vast amount of cross-domain knowledge and interdisciplinary collaboration, AgeObserve's adaptation also blurs boundaries across technological divides enabled by knowledge exchange and collaboration.

CleanCooking used smart metering in their early pitches. The use of smart meters as a descriptor for technology or meters, commonly known in the context of energy, makes it easier for audiences to understand how the solution would work without needing to be aware of IoT. Occultation was a strategy here as well. However, they would use IoT in front of audiences such as IoT accelerators as it aligned with their understanding. Similarly, BabyWearable used a subset of IoT to describe the product –

> *"[BabyWearable] is a wearable device that I have created for infants that will give parents and caregivers the upper hand when it comes to bedtime."* (BabyWearable Investment Pitch., 2022).

Like BabyCradle, BabyWearable too tries to blur boundaries between traditional childcare and technology by addressing the most common pain point of parents and achieving legitimacy. Similarly, they try to blur the physical (infant) and the digital (mobile application) using an IoT device. This is discussed further in following sections.

Blurring boundaries around categories (organisational, technological, sector-specific, temporal, practice specific) enables start-ups to gain legitimacy due to the creation of ambiguity. Some start-ups like AgeObserve, Nexum, MarineMeasure and WaterSensor focused on constructing narrow frames on the offering, to underscore expertise and establish pragmatic and cognitive legitimacy. However, WiseBees shifted its core focus, which is contrary to assumptions in existing literature (Aulet., 2013). Start-ups employ boundary blurring to achieve cognitive legitimacy through the blurring of category boundaries between IoT and other technology categories, through the coattail effects of association with technologies such as AI, ML, and 5G among others. In addition, many of them employed occultation to obstruct IoT from the view of the audience, increasing the explainability of the offering and increasing its legitimacy. Next, founders exploit technology hype to move beyond *just* an IoT start-up category, displaying the blurriness in category boundaries. Following dominant trends of applying universal values in business, there was a use of values terminology such as safety, privacy, sustainability etc. (after 2018), going beyond the traditional expectations of profits as the sole social responsibility, to achieve and sustain legitimacy. The use and outcomes of blurring different categories of values within the venture offerings are discussed in subsequent sections.

Ventures attempt to assert some control and governance over their boundaries through the appointment of boards, selection of mentors, recruitment of teams, gaining certificates and adhering to regulatory requirements which are discussed in the next section.

7.2 Boundary blurring to navigate industry norms and regulatory environment.

Adhering to industry standards and regulations is an important process in achieving legitimacy (Ruef and Scott, 1998; Tost, 2011., p.693). Standards reduce complexity for the ventures adopting them and increase complexity in the wider ecosystem (by creating new recombination possibilities) (Kim.,2025, p. 343). This section shows how start-ups boundary blurring efforts includes adapting its operations to comply with rules and requirements and shaping the regulatory environment. Start-ups conform to industry standards and regulatory requirements to gain legitimacy. The need to conform is viewed as an opportunity

to develop new markets or enhance artefacts by the entrepreneurs. Some other start-ups grabbed opportunities by using their position and influence during standard setting and policy creation processes to gain a favourable position in their industry, to ultimately achieve or enhance legitimacy. Both these categories of creating or adhering to standards and regulations are a form of boundary-blurring work that blurs the boundaries between the internal products, practices, routines and external regulatory and industry requirements.

Nexum, MarineMeasure and CleanCooking brought about change in the external environment that enabled their businesses to establish credibility and capture market share. This form of boundary work had sector-wide effects, shaping the conditions of competition for all organisations in their respective industries (Kim., 2025). This is absent from existing literature that assumes new ventures primarily conform to established regulations rather than reshape them (Kuratko et al., 2017; Karlsson and Middleton, 2015; Zimmerman and Zeitz, 2002). Nexum, introduced in the previous section for blurring the categorical boundary between its wireless technology and 5G, extended this into the regulatory domain by contributing to the creation of a new industry standard that defined the quality threshold for technologies eligible for industrial IoT deployment.

In MarineMeasure's case, environmental regulations such as sulphur emission regulations imposed on the shipping industry in specific areas known as SECA (Sulphur emission-controlled areas) impacted product adoption because more shipping companies wanted to manage energy efficiency, since sulphur emissions were linked to the speed of the ships and fuel utilisation. The start-up's product captured digital data of these parameters near specific emission-controlled areas. MarineMeasure's product captured performance data near SECA boundaries, enabling operators to speed up outside controlled areas and slow down within them. While this helped customers maintain regulatory compliance within SECA, it simultaneously drove up CO_2 emissions outside those zones, *"the net CO_2 emissions were actually increasing because of this change in the regulations" (MarineMeasure Co-founder Interview., 2022)*. The venture's technology thus enabled its customers to blur the boundary between regulatory compliance and circumvention and blurred the venture's own identity boundary, leading to greenwashing. Pragmatic legitimacy from customers was gained because the

product made costly compliance manageable, while normative legitimacy was placed at risk by it. This ambiguity was compounded when MarineMeasure led the formulation of the ISO 19030 standard for alternative ship hull and propeller performance measurement, influencing the inclusion of a method highly specific to its own technology (also discussed in sections 4.2 and 6.5). This symbolic violence was a means to create and translate boundaries to closure (Lamont and Molnar, 2002). The conflict of interest in the standard-setting process itself blurs the boundary between legitimate participation and self-interested influence, yet it enhanced MarineMeasure's legitimacy by positioning its solution as exceeding the standard it had helped write. Standard formulation in this case, exemplifies boundary-blurring work while simultaneously creating new boundaries. The venture had been invited to work on the standard by a leading shipping operator due to its legitimacy gained from building customer trust and continuously evolving (discussed in 6.5). By claiming compliance with the standard, the venture "could then use the same [standard] frame so people would know what we were talking about", harvesting the cognitive legitimacy of commensuration, and by claiming to exceed it with ISO19030 plus framing it became differentiated. During the last five months of the standard drafting (Industry trade magazine., 2016), the venture was acquired by a company citing its "world class analytics capabilities" – *(Shipping trade magazine., 2016)*. This is a positive propriety judgement by a leading operator in the shipping industry. Bridging with the standards body created the conditions for subsequent blurring, as compliance framing got blurred into differentiation claims. Boundary blurring became an illegitimate means to legitimacy.

CleanCooking blurred a boundary between commercial advocacy and public policy formation by joining a Nigerian government committee tasked with drafting the country's first clean cooking policy. The venture used this position to shape the "future of cooking in Nigeria," influencing the regulatory trajectory in ways that aligned with its own market strategy. This blurs the line between legitimate policy participation and the pursuit of competitive advantage through regulatory co-optation. Separately, CleanCooking encountered a more constraining form of regulatory boundary change, the introduction of E-SIM network profile registration requirements in the adjacent telecommunications sector increased licensing complexity, transforming what had been a straightforward technical procurement process into a regulated one. This suppressed the venture's operational agility due

to the blurring of boundaries between being a nimble, operations led entity to a heavily regulated one. Taken together, these three cases illustrate that entrepreneurial boundary work can alter the external environment in ways that serve as legitimating and enclosing mechanisms establishing new rules that competitors must subsequently navigate (Kimjeon and Davidsson, 2022). These findings are in contrast with existing legitimation and entrepreneurship literature that assume new ventures mostly apply conformance to existing regulations or industry standards (Kuratko et al.,2017; Karlsson and Middleton, 2015; Zimmerman and Zeitz., 2002). A second group of ventures blurred the boundary between internal product design and external regulatory requirements by conforming to regulatory requirements.

BabyCradle had to take into account the regulatory differences related to baby sleep and changed their product design. The start-up incorporated regulatory requirements which mandated restrictions to the degree of inclination of the bed or the use of a side-by-side rocking mechanism. They filed a design patent and connected with designers and manufacturers in China to develop the prototype that adhered to regulations in the USA. Thus, BabyCradle's operations span multiple countries, each with its own regulatory environment. They adopted a global-local dynamic that blurs the line between different operational environments, as the company integrates global expertise to meet local regulatory demands. BabyCradle's decision to adopt design flexibility, compliant data privacy and sharing practices, demonstrate its adaptability to markets and ability to navigate regulatory boundaries as it expanded across geographies. The company blurs the line between external regulatory requirements and core business operations by incorporating regulatory requirements into product design and operational processes. While Nexum influenced industry standard, EU telecommunications regulations blocked implementation of the sub-gigahertz technology which was the foundation for Nexum, within Europe due to duty cycle restrictions. The company responded by deploying in geographies where the same frequency was permitted, blurring the boundary between regulatory constraint and market opportunity through geographic selectivity. Regulation shaped product development and the go-to-market strategy. For Monitor and IoTSecurity, GDPR influenced data practices. Monitor used regulatory requirements to establish principled data collection procedures, sorting only data with a legitimate purpose.

This transparency served as a legitimacy signal to privacy-conscious customers and investors. Monitor extended this logic to the short-term rental market, embedding regulatory compliance features directly into its product and educating customers on applicable regulations. However, Monitor's guidance included information on tax loopholes that customers might exploit, blurring the line between client empowerment and facilitation of potentially unethical conduct, leading to implications for the start-up's normative legitimacy. Finally, WiseBees and TrafficIoT engaged in anticipatory regulatory boundary work by blurring the temporal boundary between current operations and future regulatory environments. WiseBees monitored pending pesticide regulations for their indirect effects on the beekeeping industry while TrafficIoT tracked the EU digital passport initiative and EV charging infrastructure mandates for implications for its product roadmap. By attending to regulatory developments in adjacent industries before they became operative, both ventures reduced transition risk, they were positioned as leaders in complying with these requirements. Across these cases, boundary blurring in the regulatory domain took three forms. First, ventures shaped the rules of their industries. Second, they adapted their products to meet rules across jurisdictions, and third, they converted rules into competitive differentiation. In each case, the venture blurred the boundary between the external regulatory environment and its internal identity, product, or processes. Regulations and industry standards functioned as external enablers that structured the venture's boundary work. The result was enhancement of legitimacy.

Besides incorporating new or existing regulatory changes or requirements into their product development, processes and practices, start-ups addressed potential indirect effects of regulations in their respective industries pre-emptively. This anticipatory boundary work allowed start-ups to stay ahead of regulatory changes and mitigate operational or market risk. For example, WiseBees is concerned with the indirect effects of pesticide regulation on beekeeping, while TrafficIoT is considering the impact of the EU digital passport on their products. This blurs the boundary between their immediate industry focus (e.g., beekeeping, IoT) and adjacent industries (pesticides, digital infrastructure) that might influence their operations. In addition, regulations that impact the electric vehicle industry related to technology changes such as retrofitting of payment terminals in the EV charging infrastructure also requires changes to TrafficIoT's product.

Most start-ups look at regulatory requirements as a use-case for their BMs. As a result, they blur the boundaries between external regulations and internal technology by incorporating the former into the latter. This is boundary work that exploits regulatory frameworks to create value and drive market adoption. By observing regulations through the lens of opportunity instead of simply 'complying', they attempt to gain legitimacy from a wider group of stakeholders. Start-ups in the sample engaged in different types of boundary work in order to achieve regulatory legitimacy. They blurred boundaries between their external environment and internal products, processes and routines by incorporating the regulatory requirements and industry standards or by influencing the external environment in favour of their solutions. Regulations and standards served as external enablers that shaped the venture, product and processes. Thus, they adhered to existing regulations to expand or adapt existing organisation boundaries. They assumed power by manipulating the lack of existing industry standards or regulations to influence the trajectory of regulatory decisions in their respective industries. They enabled their customers to blur regulatory boundaries. They undertook anticipatory boundary work to address potential regulatory changes blurring temporal boundaries. Thus, start-ups navigated industry standards and regulatory frameworks through boundary-blurring work, to shape their strategies and enhance their legitimacy. While start-up boundaries are shaped due to these external enablers, by exercising their expertise in IoT, they also shape boundaries of other entities and influence power and legitimacy.

7.3 IoT as an instrument to blur boundaries

In the previous section, start-ups complied with and conceptualized industry standards and regulatory frameworks to gain legitimacy by blurring boundaries. Industry 4.0 technologies including IoT are known to impact how entrepreneurs shape, scale, develop and design their organisations (Chalmers, Mackenzie and Carter., 2020). In line with this strand of literature, the interviewed start-ups exploited IoT in order to shape their venture boundaries by designing functional benefits such as seamless experience, convenience and ease in collaboration into their offerings and communication. However, while the start-ups focus on the benefits provided to their customers, the implementation of IoT and its usage is

an exercise in instrumentarian power since it possesses the potential to blur individual, organisational, physical and digital boundaries.

In the case of consumer IoT start-ups, every aspect of life is now a site for surveillance, from gestation to senescence. BabyCradle undertook boundary work using IoT (in the form of sensors) that blurs boundaries between physical spaces (the cradle or crib) and AI-based mobile app. BabyWearable, AgeObserve, BabyCradle, MotherHealth, YourWearable and AgeMonitor, used IoT to blur boundaries between physical spaces and technology as well as the boundaries between individual privacy and personal safety or convenience. As mentioned in the quote below, while making parenthood convenient, the technology enabled crib replaces the mother's touch when it comes to sleeping -

> *"She used to sleep in my arms […] I used to get exhausted […] when we bought the cradle, initially she wasn't used to it, but 5 out of 7 nights she sleeps tight […] she has associated the cradle with sleep, that's the best part. When she is very fussy, I put her in the cradle, and I know that she'll sleep well." (BabyCradle customer testimonial., 2018).*

As mentioned by BabyCradle's customer, the product becomes the fix for the 'problem' of a fussy baby. Collected data is analysed to condition the baby. This datafication is enabled by IoT. The start-up uses IoT to blur the boundaries of the physical (the mother) and the digital (the IoT based cradle). MotherHealth goes a step beyond and enables datafication of the foetus. While foetal and maternal surveillance have been crucial in providing care during pregnancy, technology work using IoT is employed to enhance the quality of surveillance and by extension the quality of care. IoT is used by entrepreneurs to increase blurring across physical and digital boundaries, not just in hospitals but at home as well. By increasing the presence of surveillance beyond just the traditional point of care such as a healthcare provider into an individual home, IoT is used to blur boundaries between home and hospital, between privacy and promise of safety. This sort of "caring dataveillance" while being a way to gain control for those doing the watching, can also restrict freedom as it influences the 'norms' under which care is being provided (Lupton., 2018).

Another form of surveillance enabled by IoT is in the equipment and labour tracking space. TrackingParcels provided their solution to an electrical equipment

manufacturer in order to help them track the location of their tools within the facility. They did this through technology work, by the installation of receivers at specific locations within the facility and the addition of tags to each equipment. Each employee was provided with a device loaded with an application that would provide a panoptic view of all tools within the facility. IoT implementation blurred the physical and digital boundaries between the tools and the app meant to locate the tools through the help of sensors in any location -

> *"TrackingParcels has reduced unnecessary wandering caused by the search for tools in the hall, the reduction of unnecessary walking and searching has saved us several weekly working hours (TrackingParcels Customer Testimonial., 2023)"*

While the tracking solution is meant to track tools within the facility and result in an increase in productivity, it can also have a potentially detrimental effect as by tracking these tools, the customer's organisation has no room for any additional labour force engaged in the search for tools and increase in work intensity for the others. Even though employee' 'wandering' is not monitored, it ends up having the same result. Similarly, by implementing their technology, the start-up WaterSensor functions as an external enabler by blurring the boundaries of the customer's organisation. Boundary blurring takes place by combining data sourced from IoT devices, under the purview of different controlling bodies across the water cycle. In 2021, the CEO and head of IoT spoke about the importance of data sharing between different organisations in the water supply and treatment chain. The company becomes a boundary-spanner when it comes to data collaboration and sharing. As a service provider, the company undertook technology work through data and ML technology development and implementation. Thus, technology work resulted in blurring venture boundaries as it required the change in partnership structures and innovation. In this case, there exists an overlap between technology and boundary work, were technology work results in blurry internal and external organisational boundaries.

Thus, start-ups using IoT to deliver services, and products have a massive impact because of datafication, resulting in the creation of new power structures through the possibility of surveillance and change in partnerships.

7.4 The emergence and resolution of values conflicts through boundary blurring.

In most cases, technical values are communicated through start-up pitches, demos and interviews, reflecting the focus on demonstrating feasibility and generating trust in the venture's capabilities. As BMs are finetuned and the venture progresses, boundaries evolve and there is a shift towards emphasising broader social, economic, and environmental outcomes and benefits. This shift suggests a deeper consideration of the impact and implications of the venture beyond its technical aspects, aligning with broader societal values and expectations.

As discussed in the previous section, consumer IoT start-ups in the study also attempt to influence norms in their respective categories. For instance, BabyCradle and BabyWearable attempted brand building by providing parenting and pregnancy advice unrelated to their core offering of newborn's sleep. This included diet and product recommendations, childcare related information and entertainment content. Furthermore, they began framing information about newborn sleep as imperative guidance, subtly implying that adhering to it was essential for being a good parent, blurring boundaries between the start-up's primary role as a service or product provider to that of a parenting authority. These actions exploit the vulnerabilities of their customers. This results in a values conflict, specifically between providing information relevant for decision making which is the promised offering to customers and manipulating knowledge to further their influence. As seen in 7.3, Monitor potentially facilitated tax avoidance through its blog, creating a values conflict.

In addition, Monitor's narratives emphasised technical values, highlighting the functionality of their hardware solution and algorithms while addressing concerns about privacy by avoiding the use of cameras or needing to store data. This framing allowed them to differentiate themselves in a market where property owners sought security solutions that did not compromise guest privacy, as exemplified by the issues faced by Airbnb with the installation of cameras. They addressed a values conflict that was emerging with the growth of Airbnb. Property owners wanted to secure property safely which was being done using cameras and

other sensors. However, guests were concerned about their privacy with the installation of these devices in the properties.

> *"I happened to meet one of the early employees […] at Airbnb back in 2008 […] already then they had issues with people putting up cameras in Airbnb." (Monitor Podcast Interview., 2018)*

They created their identity by focusing on claims related to privacy and using non-intrusive sensors (other than cameras). Their offering thus blurred the boundaries between privacy and security. As Monitor's organisational boundaries evolved, they adapted their narrative to incorporate additional values, particularly economic and environmental considerations. By showcasing the success of their Kickstarter campaigns and emphasising recurring revenue growth, low customer acquisition costs and high LTV (lifetime value) per unit, Monitor aligned their offering with economic values, appealing to investors interests. Moreover, they expanded their value proposition to include environmental values, positioning their solution as conducive to "sustainable tourism" and guest safety, thus appealing to the environmental concerns of guests and property owners. They started off using frames that incorporated technical and economic values and eventually included environmental values. This blurring of different types of values and evolution of values framing reflects the entrepreneur's attempts to mould the identity of the venture. Thus, organisational identity was formed as a response to the conflict between property owners and guests. By addressing both sets of values through their offering, Monitor successfully navigated changing organisational boundaries and solidified their identity as a solution provider that balances economic and environmental considerations.

In the case of WaterSensor, the intersection of values work, and boundary work is evident in their evolution from emphasising technical and environmental values to prioritising outcomes and client demands as their organisational boundaries changed. In their exploratory phase, WaterSensor's narrative included testing of technological capabilities rendered by the use of advanced technologies like IoT and ML (machine learning) in combination with their environmental focus namely reducing the impact of incorrect battery usage on climate change. Their belief was that their clients were more like partners working towards shared goals. However, conflict in values emerged as newer clients demanded faster payback to their investments. While the company continued to value environmental

sustainability, these demands of newer clients necessitated a shift in focus towards outcomes and efficacy. This shift represents a blurring of organisational boundaries, where the company had to balance its original values with the changing demands of its clients. Managing this organisational boundary blurring and conflict in values required the organisation to adapt their narratives and priorities to the changing needs of the clients. This shows that blurring was needed to align values and organisational goals.

As discussed in an earlier section, when BabyCradle were expanding their operations across geographical boundaries, they had to manage the differences between the regulatory norms related to infant product requirements between US and India. However, the driving force behind these differences were the differences in cultural norms and value orientations related to safe sleeping environments for babies. In the US, inclined sleepers are considered unsafe while in India inclined sleeping positions including using pillows are prevalent. Acknowledging these differences, the BabyCradle team adapted their product to align with local markets. This adaptation highlights the company's ability to blur boundaries by incorporating the regulatory requirements and cultural needs into the offering. In addition, their initial framing consisted of technical values (explaining the product's working) and social values of helping parents and ensuring child safety. This helped establish initial legitimacy since many of the early adopters were familiar with the technology. These customers also provided inputs and raised concerns related to safety and privacy which were incorporated into the BabyCradle system. This demonstrated a responsiveness to customer needs and values. Thus, organisational boundaries were continually adjusted as the customer's closely held values guided the adaptation of the product. As newer customers who were not familiar with heavily technology laden descriptions started adopting the product, the use of technical frames was reduced, and social values were emphasised upon i.e. how the start-up benefits the parents and information related to children sleep, health and safety. As the venture started incorporating - "the best technology is invisible" in the product and supporting application, their descriptions followed suit. BabyCradle managed values conflicts through boundary blurring.

Like Monitor, TrafficIoT discursively blurred the boundaries between the critical values of safety versus innovation that defined the company's identity, to achieve legitimacy. The company had emphasised safety values by preventing accidents using smart traffic management solutions. The venture visualises building autonomous traffic infrastructure; however, the founder pragmatically acknowledges the time before the vision can be brought to fruition. This pitch blurs the boundaries around the company's futuristic claims, present capabilities and technology development. The venture's lofty claims of inventing the future imply that it is a leader in the domain of autonomous traffic management infrastructure. Yet there is an eventual demand for resources for the core value proposition of road traffic safety.

> *"How do we get from where we are now to a fully autonomous traffic environment? So, we believe that there will be quite a long transition time with a key word of connectedness […] but who is doing the infrastructure? We are. We are inventing the future with you […] People really want to see advanced technology, reaching public space to serve a greater good and we are here today to plead for your support for our smart railway crossing, which essentially is a smart traffic sign with a lot of sensors and we gather a lot of data to provide device to have a great a lot of great features. For example, and most importantly, we prevent accidents on railway crossings." (TrafficIoT 2018 pitch transcript., 2023)*

In 2018, the start-up's identity was managing autonomous traffic and preventing traffic accidents. The start-up's values aligned with societal values and expectations regarding the importance of road safety, efficiency, and technological advancement, impacting the start-up's normative and cognitive propriety and validity. By highlighting affordances, the start-up blurs the boundaries between the infrastructure needed for enabling autonomous vehicles and the infrastructure needed to prevent accidents. Their vision for the future is pragmatically associated with the current state of the industry and used to illustrate viability of their solution for other critical use-cases. This demonstrates their attempts at enhancing legitimacy and nurturing trust with stakeholders not just in the transport industry but also for the nascent autonomous vehicle industry. Safety remained a core value for TrafficIoT as it became a publicly traded company in 2021. Innovation acquired a more prominent status and was positioned

as the means to advancing the development of autonomous vehicle technology. This shift illustrates a blurring of organisational priorities, where the company had to balance its foundational values with the demands of stakeholders and the market.

> *"[TrafficIoT] goal is to build a world where no one is seriously injured or, worse, killed, in traffic […] Given the prospects for the increased deployment of automated and autonomous vehicles, the company believes that the time is right to integrate smart solutions into the current and future traffic environment." -(TrafficIoT Annual Report 2021-22, 2023)*

Boundary blurring between safety and innovation and the start-ups' expansion caused values conflicts. With a smaller team, the mission to "save lives" was reinforced on a frequent basis. As the team size increased, there emerged a values conflict due to missing professionalisation of internal organisational communication. The organisation experienced issues in communications between leadership and employees. There were challenges in ensuring internal coherence. This reflects an issue with the start-up's leadership as well. The newer employees focused on innovation while there was a lack of communication about "safety" values that had formed the core company's vision from conception. In this context, boundary blurring was detrimental to the organisation. Values needed to be rephrased and communicated across the organisation to ensure the resumption of trust and cohesion across the organisation and reinforcement of organisation's boundaries. The lack of clear communication about the importance of safety values contributed to this internal conflict, suggesting that while boundary blurring between organisational values facilitates growth and adaptability, it also requires careful management to ensure that core values are not lost in the process.

AIBlockchainIoT espoused technical values as the company's offering combined IoT, AI and blockchain, to create a "digital asset as a service" platform, overcoming the known problems with each technology. AIBlockchainIoT's core innovation lies in its ability to blur the boundaries between multiple advanced technologies—blockchain, IoT, and machine learning—creating a platform where

these technologies interact to address each other's limitations. Boundary work here entailed the establishment of connections between the technologies and the development of synergies to ensure the efficacy of the platform and enhance its perceived value.

> *"So, blockchain is out in the cloud, but it doesn't really touch you in the physical world […] that's where we are going to talk about how IoT comes into play, and links up with Blockchain. […]If you are running machine learning algorithms on poorly collected data, you know, data that is tampered with then there's no point. So, these are two problems that we attack. The last thing is how do you go from data acquisition to analysis, and then sharing and performing transactions on that? So that requires a platform. So, what we're going to present here today is the platform that does these things." (AIBlockchainIoT founder pitch, 2023)*

AIBlockchainIoT's approach to technical values changed over time. Initially the company used industrial IoT to collect data for creating digital assets and then moved on to blockchain to manage the created digital assets and to artificial intelligence for providing analysis on the digital assets. While AIBlockchainIoT's offering has different technologies that work together to create one complete solution, the venture itself changed boundaries as it tried to capture the upcoming technology trends.

> *"First I started seeing something then I started to tweak, tweak, tweak, tweak, tweak so many times. I'm not proud of it but I also think that we were too early. Whatever I was saying years ago now people are saying the same thing. […] industrial IoT, then I started saying digital asset as a service. And I started, you know, tweaking the words […] cognitive computing." (*AIBlockchainIoT Interview, 2023)

The founder discusses the iterative process of product development, refining and redefining the company's technical values. This demonstrates a form of boundary blurring where the organisation's focus shifts in response to the evolving technological landscape. The blurring of organisational identity across constant adaptations resulted in a difficulty in gaining legitimacy from their stakeholders,

since the company was always early for the target market. These constant changes also resulted in the creation of value conflict between the organisation and its stakeholders. The shifting focus resulted in a failure in maintaining coherence in values and messaging, lack of clarity in organisational identity and loss of organisational credibility. As a result of this, a CEO of a 'blockchain company' was brought in to oversee AIBlockchainIoT while the founder had to take a cut in equity and was asked to assume the role of CTO. Eventually the 'blockchain company' acquired AIBlockchainIoT (AIBlockchainIoT Director of partnerships, Director of partnerships blog post ,2023).

In contrast to the previous examples of start-ups' espousal of primarily technical values, CleanCooking's solution initially centred on addressing health and environmental concerns associated with the use of solid cooking fuels, highlighting an inherent values conflict between social and economic considerations. Despite the known health and environmental risks, the lack of affordable alternatives posed a significant barrier to adoption. To reconcile this conflict, CleanCooking introduced an alternative payment model to distribute financial power to their customers, effectively engaging in boundary work to overcome the customer's economic challenges and encourage adoption. They enabled this through the integration of IoT technology into their payment model to enhance their solution. This blurring technical and economic values was meant to address economic barriers and expand the solution's impact by incorporating social values of supporting other businesses and service providers. Concurrently, the start-up started focusing on environmental considerations such as emphasising the importance of reducing pollutants from solid fuels and safeguarding the ozone layer in order to gain legitimacy from other stakeholders. This combination of social, economic, and environmental values enabled by technology allows CleanCooking to expand as it could strategise to launch in multiple countries with similar challenges, garner international support from France and Germany, obtain funding and assume power

Like CleanCooking, AgeObserve's overarching focus since 2019, has been on social values specifically– "helping the elderly to age in place". This social value impacted its normative legitimacy among its audience. Providing care and safety is interspersed with the technical value of ensuring privacy and using non-intrusive

technology i.e. avoiding video-based data collection. This choice of technology guides the development of the venture's identity and its boundary. In addition, this social value of helping the elderly and ensuring privacy also guided the data collection mechanism i.e. motion sensing technology as opposed to a wearable or voice enabled solution. Next, customers' economic considerations drove them to seek legitimacy from insurance providers, impacting their BM and enhancing the focus on technical value of interoperability. The BM of the organisation evolved to include physicians and insurance providers as part of a broader business ecosystem. Consequently, the organisational boundaries have been influenced by a combination of economic, social, and technical values upheld by the organisation. This alignment of values not only shapes the organisation's identity but also impacts its legitimacy. It also determines the scope of its operations and partnerships, illustrating the interplay between values work and boundary work.

The start-ups mentioned here employed boundary blurring across different stages of growth. By incorporating different values into the development of an offering based on changing demands, trends, growth, they blurred their organisational boundaries. This included blurring of product and technology, identity and physical organisational boundaries. Identity blurring when employed strategically was a means for legitimacy, however it also resulted in the creation of values' conflicts and resulted in a loss of legitimacy as shown in the cases of BabyCradle, Monitor, TrafficIoT and AIBlockchainIoT. This raises questions related to start-up leadership, communication and growth.

Conversely, values conflict was addressed by the blurring of boundaries across different types of values. Values conflicts originated between the venture and its stakeholders namely customers and employees, cultural differences between different geographies, values conflicts emerging at the customer's end and conflicts between different value types. Resolution was achieved by the blurring of external elements into internal artefacts i.e. by the incorporation of broader trends, feedback, concerns into the product or technology. For example, technical values in combination with social or economic or environmental outcomes were used to generate trust in the IoT based ventures. This created a compelling value proposition considered legitimate by key stakeholders. Besides customers or investors, partners are also key stakeholders. Partnerships have the greatest

influence on organisational boundaries as it enables start-ups to extend their capabilities and access external resources.

7.5 Legitimacy through boundary blurring and partnership

Partnerships are instrumental in shaping the boundaries of companies, enabling them to expand their capabilities. The legitimacy of partnerships also becomes important since legitimate partnerships enhance the firm's reputation and by extension its survivability (Tina Dacin, Oliver and Roy, 2007). The formation of partnerships is a form of boundary work and results in blurry boundaries between firms that form the alliance. These collaborations with external entities such as businesses, research institutions, and government agencies allow organisations to tap into new expertise, technologies, and markets that lie beyond their traditional boundaries. Choosing allies, nurturing alliances, and engaging in collaborative relationships represent essential aspects of boundary work for businesses. This section explores how boundary work enables companies to navigate organisational and external boundaries. This process includes identity changes, competence refinement, change in power relationships, legitimacy building and resource optimisation.

Partnership Configuration	Functionality	Type of Legitimacy	Level of boundary blurring	Power relationship
Go-To-Market	Market Access Market Expansion Learning	Associational legitimacy Alliance legitimacy Inter-partner legitimacy is needed.	BM blurring between start-up and partners.	Asymmetric – in favour of the partner due to its intermediary role.
Customer Partnership	Market Entry and Access. Knowledge Access.	Regulatory Legitimacy Pragmatic	Product/Technology blurring due to the adaptation based on local requirements – different versions of the same product at the same time.	Symmetric
Value Chain	Outsourcing-Focus on Core	Partner is legitimised by start-up.	Organisational boundary blurring – due to the flow	Asymmetric – in favour of the start-up.

	Gain external expertise. Complementary technology Improving Efficiency	Efficacy of partnership dependent on efficacy of partner.	of information and access to partner resources.	
Ecosystem	Complementary Services Market Expansion Data Access Enhancing Competency	Ecosystem Legitimacy Inter-partner legitimacy	Organisational boundary blurring BM blurring Blurring across offerings incl. technologies	Asymmetric – in favour of focal partner or established organisations.

Table 14 Partnerships and boundary blurring

FullBattery started using battery distributors and battery maintenance companies as a go-to-market channel. This was the result of many failed efforts undertaken to identify and acquire target customers. Later, they started including telematics solution providers as a go-to-market channel as they expanded their focus to automotive batteries. They partnered with manufacturers who could help them manufacture hardware designed by FullBattery for lead acid battery types and hardware designed by different companies for other types of batteries. FullBattery went on to provide software integration for this hardware. They have also partnered with organisations providing network connectivity solutions for their sensor to be able to transmit data to the cloud. Similarly, RoboticMeasurement and BabyWearable utilised hardware devices and components sourced from a vendor. RoboticMeasurement's team procured and assembled hardware to create a computer vision enabled camera loaded with internally developed algorithms for data analysis.

> *"We use subcontractors to manufacture certain parts for us. But yeah, we have used consultants and marketing specialists to help us to […] help us to acquire money from certain projects." (RoboticMeasurement CEO Interview., 2022)*

Thus, the company engaged in resource optimisation and efficiency, blurring its organisation boundary to include partners providing complementary technological expertise and knowledge resources. This approach enabled RoboticMeasurement to focus on its core capabilities and technical expertise of equipment and

algorithm development and data interpretation. Through outsourcing, companies temporarily blurred their organisational boundaries to be able to access partner resources.

HVACHealth similarly accessed resources of their manufacturing partners and partnered with other organisations to create an ecosystem where services were easily accessed by their customers. HVACHealth collaborates with partners and blurs the organisational boundaries, resulting in the creation of an ecosystem, allowing users to access additional services and features beyond its core offerings such as maintenance or other services. The integration of a back-end API enables partners to access the HVACHealth customers' data, empowering them to develop and offer complementary services or add-ons to users. They offer features like filter replacement ordering and service scheduling through its app, this strengthens HVACHealth's relationship with users and enhances their overall experience. Additionally, by enabling partners to access its data via the API, the company nurtures innovation and collaboration within its ecosystem, ultimately driving growth and differentiation in the market. Blurring of organisational boundaries takes place as the ecosystem is reified. All this impacts its legitimacy with users and partners. Another organisation that allows partners to access their technology is Nexum. Nexum's decision to transition from a full stack IoT solutions provider to a technology company and refine its core competencies reflects a blurring of the start-up's identity. Their licensing BM required the development of an ecosystem of partners. By narrowing its focus to technology development and licensing, Nexum established clear boundaries around its core competencies as well as redefined its role in the IoT ecosystem. By doing so, the company also engaged in boundary crossing since this enabled it to transcend existing boundaries of perception. The ecosystem-based approach enables Nexum to establish partnerships with complementary organisations. Client requests for turnkey solutions were directed to partners who would use Nexum's technology to deliver the service. This reflects Nexum's and their partner's organisational boundary blurring as the partner becomes an extension of Nexum's offering to their customers. This boundary work encompasses identity change, competence refinement, development of new power relationships and the enhancement of legitimacy and reputation. Besides ecosystem, Nexum also forms partnerships with customers. Through these partnerships, it can identify regulatory requirements

that might require shaping of its technology but does not seek out this information proactively unless there is a strong business opportunity. Solution adaptation to meet the specific regulatory requirements enabled them to strengthen their legitimacy as trusted partners as well as acquire regulatory legitimacy.

Like Nexum, TrafficIoT's technology focus positions it within a technology ecosystem specifically autonomous vehicle. By collaborating with industry partners, such as connected and autonomous vehicle manufacturers, TrafficIoT blurs its organisation, BM and technology boundaries. This collaboration enables the exchange of standardised safety messages between vehicles, contributing to increased traffic safety. However, this also influences TrafficIoT's power relationships, specifically within an ecosystem where larger players dominate. Furthermore, partnerships with cities, municipalities, and research institutes extend the company's reach and capabilities. Collaborating with cities and municipalities allows for the integration of new data sources into urban planning and management, enhancing overall traffic safety and efficiency. Meanwhile, working with research institutes provides academic grounding and expertise, ensuring that the technology aligns with current research and best practices. Through these partnerships, TrafficIoT not only enhances the functionality of its products but also amplifies its legitimacy among various stakeholders. Additionally, partnerships with research institutes facilitate ongoing innovation and improvement, ensuring that the technology remains at the forefront of safety and transportation advancements. Overall, through partnership formation, the company engages in boundary-blurring work that increases efficiency, enables leveraging of external expertise and resources while advancing its technological capabilities and impact. By collaborating with industry and academic partners, the company strengthens its legitimacy in smart transportation solutions. Besides similarity in the types of partnerships, TrafficIoT, Nexum, HVACHealth, WaterSensor all are organisations where boundary-blurring work involved identity changes, product or technology shaping, competence refinement, development or change in power relationships. This impacted the type of legitimacy that these start-ups needed to gain for the successful functioning of the partnerships.

Initially WiseBees intended to develop purely hardware products and to produce all components internally. Eventually, the company founders realised the

constraints of a hardware-based BM and shifted focus to finding the right partners to help with its growth and enable scalability.

> *"In the initial days, we saw ourselves as a hardware company, we thought we're going to produce all of that ourselves. And we still do, but we have gotten to realise that how important it is to be able to scale and to find the right partners, and we don't see ourselves as a purely hardware company anymore […] we see ourselves as a hardware enabled data company. So, we realised the aspects of data […] generate further kind of development of our BM a […] there's quite an evolution going on." (WiseBees CEO Interview., 2022)*

Due to the partnerships, the company's boundaries blurred, and identity changed from hardware manufacturing to broader data capabilities enabling them to become a 'hardware enabled data company providing beekeeping solutions'. The blurring of organisational boundaries enabled the formation of new boundaries that included partners, i.e. the organisations that enabled the company to access complementary expertise, resources, and technologies to enhance its overall product offerings.

Insights from IoT data are more dependable and accurate when big data from multiple sources are integrated. WaterSensor's focus is providing information related to water management to its customers, as such it has established partnerships with other data providers such as satellite services or weather forecasting services to enhance the capabilities of their hydraulics analytics system that can provide accurate insights related to water and wastewater ways. By blurring organisational boundaries, it gains power since its role of being a data provider expands to becoming an oracle for its customers. Additionally, it also collaborates actively with universities, providing its software to students who are developing new analytical tools and processes. Through this partnership, WaterSensor gains access to cutting-edge research and innovative solutions, which can then be integrated into its consultancy services, impacting its overall BM. This engagement with academia not only expands WaterSensor's knowledge base but also nurtures a collaborative environment for advancing water management practices. It has also developed specific data models using less expensive open-source technologies that are created, maintained and updated by an ecosystem of users or developers. The use of open-source technologies is favourable for the

business as well as reliability of the data models. WaterSensor depends on partnerships for gaining insights from massive and complex data sets and developing new tools for its customers. Thus, these partnerships contribute to its legitimacy by enhancing WaterSensor's capabilities and promoting innovation. Thus, formation of partnerships results in the extension of organisational boundaries and result in more robust dataset and offerings. While WaterSensor primarily used partnerships to enhance its competence, most of the start-ups including RoboticMeasurement, TrafficIoT, WiseBees focus on improving efficiency through the outsourcing specific business tasks.

While most of the start-ups mentioned earlier focused on partnering with organisations in the same or similar domains and research institutions, CleanCooking established a strategic partnership with a business support organisation located in France enabling it to expand across geographies. This decision was influenced by France's favourable patent laws and its significance as a hub for francophone countries, which aligns with CleanCooking's target regions in Africa. Through this partnership, CleanCooking gained the opportunity to conduct research and development (R&D) activities in France while implementing its Francophone Africa Strategy. Additionally, the partnership enabled CleanCooking to facilitate access for African start-ups seeking to enter the French market or access resources available in France. This collaboration not only enhances CleanCooking's operational capabilities but also strengthens its legitimacy by leveraging resources and networks in a key geographical location. In addition, it also positions CleanCooking as a start-up enabler. CleanCooking's efforts to form the partnership and collaborating successfully involves navigating geographical, organisational and strategic boundaries by making decisions that optimises the company's growth and position.

Like CleanCooking, AIBlockchainIoT too undertook geographical expansion. Like some of the other start-ups mentioned earlier, AIBlockchainIoT recognised the challenges and costs associated with in-house hardware development including hiring issues. They decided to outsource their hardware development to another firm in India and underwent an identity transition from a full stack solution provider to IoT platform. By redefining its identity, AIBlockchainIoT aligned its boundaries with its core competencies of platform development and associated

services. The partnership is a strategic one since the vendor also gets introduced to AIBlockchainIoT's clients for all their hardware needs, directly. Besides, internal boundary work, the company also established external partnerships such as consulting partners that could complement AIBlockchainIoT's offerings in a different geography. Their partner focuses on the market penetration, while AIBlockchainIoT helps them understand the technology and "how to make it work."

This is similar to AgeMonitor and TrafficIoT's approach to partnerships during geographical extension. AgeMonitor initially approached care homes and potential customers directly. However, their plan is to focus on acquiring partners in the long term that could help them reach a larger customer base by helping them capitalise on existing customer relationships. This would reduce their cost of acquisition and de-risk market entry (like AIBlockchainIoT). AgeMonitor partnered with channel partners or resellers who have a subscriber base of over 100,000 subscribers to scale the company's reach and increase market penetration. Like WaterSensor, they are collaborating with a research centre demonstrating a willingness to adapt since this partnership provides access to valuable insights, expertise, and feedback that can inform its product development and strategy. By partnering with a reputable research institution, the company signals to stakeholders, including customers, investors, and industry peers, that it is an innovative and adaptive organisation. While both AgeObserve and AgeMonitor operate in the eldercare industry, AgeObserve's approach to BM and partnership was massively different. Embracing an ecosystem-based approach, they established partnerships with physicians, insurance firms and device manufacturers. By integrating insurance companies into their platform, they provided required data for long term health policy development and offered reimbursement for AgeObserve product which includes sensor kit and software. Physicians started using AgeObserve technology to obtain data to transform their practices. AgeObserve's CEO emphasised the concept of a "synergistic alliance" with these partners during their BM pitch. This boundary-blurring strategy in the form of healthcare ecosystem partnerships enhances its legitimacy in the eyes of investors and customers.

Boundary work undertaken along with external entities like other businesses, research institutions, and government agencies facilitate the development and implementation of technology, exploration of markets beyond traditional organisational boundaries. WaterSensor exemplifies this approach, focusing on providing valuable information to its customers through partnerships with data providers like satellite services and weather forecasting agencies. By actively collaborating with universities, WaterSensor gains access to cutting-edge research and innovative solutions, enhancing its consultancy services and nurturing a collaborative environment for advancing water management practices. Similarly, RoboticMeasurement leverages partnerships to augment its technological capabilities, sourcing hardware components externally while focusing its efforts on algorithm development and data interpretation. HVACHealth extends its ecosystem through partnerships, offering users access to additional services beyond its core offerings, thus enhancing user experience and encouraging innovation within its ecosystem. Strategies employed by various start-ups, including RoboticMeasurement, TrafficIoT, WiseBees, and others, illustrate the significance of boundary-blurring work in optimising efficiency and promoting growth. These companies undertake boundary-blurring work by utilising outsourcing and strategic partnerships to focus on core competencies while accessing external expertise and resources. By collaborating with industry and academic partners, they strengthen their legitimacy and reputation within their respective ecosystems. Additionally, boundary crossing, and boundary extension enable organisations like Nexum, AIBlockchainIoT, and CleanCooking to expand across geographical boundaries and blur organisational boundaries, tapping into new markets and enhancing operational capabilities. These examples underscore how boundary-blurring work through partnerships contributes to organisational legitimacy, innovation, and growth. While the formation and management of partnerships remain the most legitimate boundary blurring mechanisms, start-ups also use practices for boundary blurring that may be considered illegitimate, discussed next.

7.6 Blurring Boundaries – An illegitimate means to legitimacy

In an earlier section, it was discussed that some start-ups such as BabyCradle, Monitor, AIBlockchainIoT and TrafficIoT attempted to gain or enhance their

legitimacy through the blurring of organisational, product or technology boundaries. However, their attempts at legitimation led to the creation of values conflicts that resulted in their delegitimation. These start-ups also gain legitimacy through questionable means as their technologies cause a blurring of user identities and spaces as well as obscuring the actual impact of their technology on the lives of their customers.

While privacy is associated with a thing or an object and can be characterised with a "thing value", in the modern context it holds "material value" (Mumford, 1981). IoT devices or sensors blur boundaries between spaces (Floridi., 2014). Companies like Monitor, AgeMonitor, and AgeObserve pre-empt any concerns about incursions on user privacy by creating an illusion of preserving privacy through frames emphasising 'non-invasiveness' in their discourse. This enables them to avoid any potential challenges to the legitimacy of their solution. In doing so, they blur the boundaries between the venture's core identity and projected identity. (collecting and providing user information while working in the background versus ensuring safety). For instance, in the case of AgeMonitor, the founder repeatedly describes its sensors as 'privacy-preserving', while at the same time explaining its functionality of collecting and transmitting user information.

> *"As a caregiver, I just want to know that they're okay. So that's where the root of the of the core philosophy of the product is, how to still be non-invasive and non-intrusive, give them the ability to live in their own homes, […] interested parties to get access to critical information that is needed to an either make sure that they're living safely, … make sure that they're living healthily, they're thriving, and then they're happy, right?." (AgeMonitor Founder Interview, 2023)*

The end users in whose space these technologies are installed remain, for the most part, the unwitting performers of boundary work as they go about their daily lives. Every action or inaction serves as an interaction which blurs boundaries between the user's space with those of peripheral actors such as caretakers or property owners. The start-ups' pitches also suggest a blurring of boundaries between the end users space and the peripheral users (specialists/owners) as can be gleaned from the quote below –

"People want to stay and experience the world like locals do. Unfortunately, they don't always behave like locals. Parties, noise and crowding causes conflicts in communities, damage to properties and fines or lost permits for hosts. [Monitor] detect and solves 94% of these issues while respecting privacy of guests." (Monitor Pitch Deck., 2022).

In both cases, start-ups justify the need for blurring of boundaries between spaces through safety or societal logics specifically by abstracting from the data collection and transfer context, and gain legitimacy from their stakeholders.

7.7 Conclusion

Scenario	Antecedent	Outcome	Challenge
Boundary Blurring between technology categories. a) Point of reference. b) Subsuming under category.	Comparable technological configuration. Repeated communication highlighting the comparability	Creation of ambiguity – Functional identity of Nexum conflated with that of incumbent.	Any divergence from the incumbent's established structures or routines.
	Comparable technological configuration. Communicating using incumbent or popular technology frames. Highlighting the cost effectiveness compared with the incumbent	Acceptance of new technology due to association with incumbent. Organisation known as an expert in adjacent technology category without reference to IoT	Performance issues. Problems with incumbent(5G) – delegitimating by association. Sideling IoT updates, further development for maintained functioning and legitimacy.
Boundary Blurring due to inclusion of new BM.	Generation of new resources from initial BM.	Creation of New identity and BM – additional revenue source. Change in power relations and sphere of influence	Exploitative BM. Greater regulatory scrutiny.
Blurring between different values	Changing market trends, client demands and start-up growth.	Creation of new identity, changing identity	Loss of legitimacy Leadership and communication issues.

		Creation of value conflict	
Boundary Blurring between organisations with complementary technological focus.	Funding considerations Convergence of complementary technological disciplines	Creation of a new entity	Gaining legitimacy as a coherent entity.
Boundary Blurring between organisations as a result of data sharing	Data Sharing Technology Work undertaken by vendors or experts.	Formation or change in power relations. Emergence of boundary spanner organisations for data collaboration and sharing.	Security challenges Data Viability and pre-processing.

Table 15 Scenarios of boundary blurring

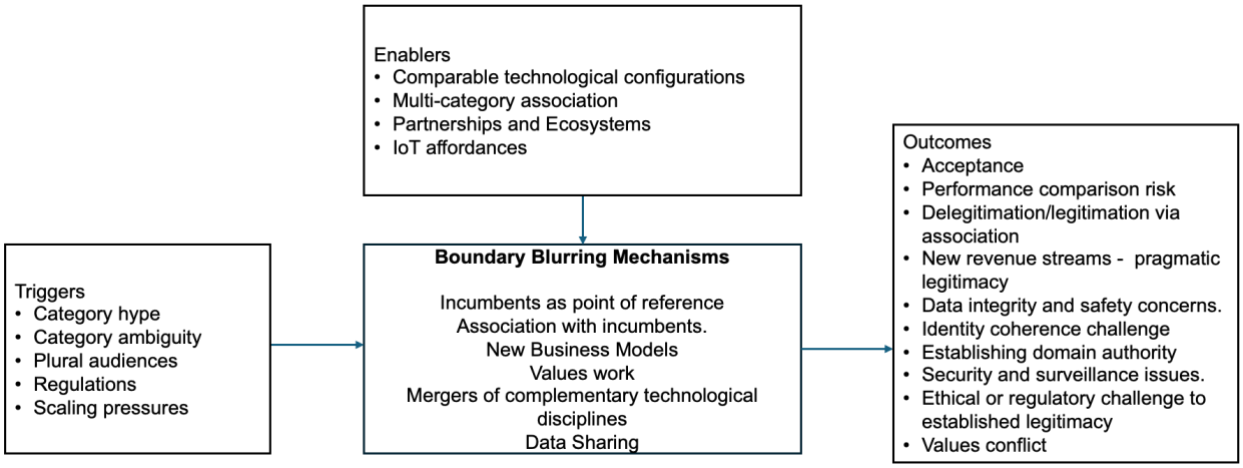


Figure 24 Boundary Blurring Triggers, Enablers, Mechanisms and Outcomes

This chapter shows how start-ups blur boundaries between technology categories, regulatory environments, values, organisations, and physical and digital spaces, in pursuit of legitimacy. Boundary blurring was triggered by category hype and ambiguity, the plural values of audiences, regulatory constraint or opportunity, and pressures to scale. It was enabled by comparable technological configurations, multi-category association, partnerships and ecosystems, and the data affordances of IoT itself. These converged in the five scenarios summarised in Table 15. Blurring was an exercise in power –Data aggregation elevated ventures

from suppliers to obligatory points of passage for their customers, while shifting data ownership away from users; the surveillance affordances of IoT exercised instrumentarian power over end users who became unwitting performers of boundary work; and within partnerships, power remained largely asymmetric. Category blurring produced cognitive legitimacy through association with recognisable incumbents, but exposed ventures to delegitimation by association and to pragmatic challenges when audiences compared costs and performance, as when Nexum's licence fees were questioned against "free" Bluetooth. BM blurring yielded pragmatic legitimacy from new revenue and stakeholders while risking normative legitimacy, as WiseBees' prospective sale of beekeepers' data shifted it towards an exploitative model. Values blurring secured normative and pragmatic legitimacy where values aligned with audiences but produced delegitimation when they did not. TrafficIoT's safety mission eroded among new employees, and AIBlockchainIoT's shifting identity cost it cognitive legitimacy and its founder the CEO role. Merger-based blurring won validity from investors but left the new entity's coherence to be established. Data-sharing blurring conferred expert status while carrying normative risks around security and surveillance. In the extreme, blurring operated as an illegitimate means to legitimacy. MarineMeasure gained pragmatic legitimacy from customers by enabling greenwashing, and privacy-preservation framings won propriety judgements from buyers while concealing normative violations against end users. The discussion chapter now draws blurring together with creation, management, and bridging to theorise how boundary work shapes the legitimacy of IoT ventures.

8: Discussion

This chapter examines how IoT-based new ventures build and maintain legitimacy with key stakeholders, including customers, investors and venture development organisations (Gieryn, 1983; Lamont and Molnár, 2002; Santos and Eisenhardt, 2005; Zietsma and Lawrence, 2010; Langley et al., 2019). Using the boundary work approach, this chapter aims to deepen understanding of the dynamic, multilevel and complex process by which IoT-based start-ups pursue and sustain legitimacy.

IoT start-ups undertake legitimisation practices and mechanisms in an interplay with evaluators, namely investors, customers and accelerators. So far, this thesis has found that boundary work is central to the unavoidable, socially constructed and contested legitimacy-building process undertaken by IoT-based start-ups as they navigate resource acquisition and survival. Previous chapters examined boundary work, including the creation of new boundaries, the management of existing boundaries, the bridging of boundaries with evaluators and the blurring of boundaries to gain legitimacy. This chapter ties this together by showing the mutually constitutive nature of legitimacy and boundary work, the interplay between the types of boundary work across institutional, firm and artefact levels, and, lastly, by identifying the different boundaries created by and encountered by IoT start-ups in the pursuit of legitimisation.

8.1 Boundary work for legitimation – significance of creating, managing, bridging and blurring boundaries in entrepreneurship.

Form	Triggers	Enablers	Mechanisms	Outcomes
Boundary creation (Ch. 4)	Desire to create social impact Resistance to innovation in the current state Pursuit of autonomy	Founders' technical, industry, entrepreneurial and educational experience, alongside that of their teams	Competence, failure and continuity narratives Reframing of problems Iterative improvement of platforms and prototypes	Opportunity recognition Venture identity underpinned by entrepreneurial identity Distinctiveness from

				alternative solutions Technological credibility Propriety judgements from customers, investors and incumbents enabling further boundary work and generating validity cues Created boundaries remain provisional: negative evaluations of new practices, consortium obligations, board power asymmetries, imitation invited by standards
Boundary management (Ch. 5)	Evaluation and selection processes (investor pitches, accelerator applications, demo days) Ambiguity of IoT as a category Recurring evaluator feedback (persistent questions, category misattributions, BM recommendations)	Founder entrepreneurial or technical experience Insider knowledge of evaluator criteria (investor profiling, accelerator contacts) Network embeddedness and legitimacy by association Material artefacts	Aligning (narratives and category claims to evaluator frames) Calibrating (selecting evaluators: profiling, funnels, events, relocating) Complying (certifications, milestones, reporting, selective feedback)	Altered evaluator expectations and criteria Redrawn symbolic boundaries of the IoT category Partial control over who evaluates and on what terms Pilot contracts and customer adoption (pragmatic legitimacy)

	External jolts (COVID-19, supply-chain and geopolitical aftershocks)	making competence visible Transparency with customers	Pivoting (BM and product shifts)	Legitimacy maintained through transparency, references and support Legitimacy lost or in crisis where mechanisms failed or shaded into legitimacy hacking
Boundary bridging (Ch. 6)	Knowledge or logic gap between venture and audience Obscurity of IoT Stigma or bias	Shared language Event participation Partners and accelerators providing credibility Venture capability for translation, customisation and sustained relationship building	Discursive translation PoCs, prototypes and BMs Trust building Customer selection and long-term customer relationships Accelerator networks and partners	Trust leading to funding, contracts, scale-up and clarification of industry roles Convergence of expectations Shifts in bargaining power towards the venture Reshaped meanings and strengthened authority Or: delegitimation, resource waste and persistent lack of understanding
Boundary blurring (Ch. 7)	Category hype and ambiguity Plural values of audiences Regulatory constraint or opportunity Pressures to scale	Comparable technological configurations Multi-category association Partnerships and ecosystems	Category blurring BM blurring Values blurring Merger-based blurring Data-sharing blurring	Cognitive legitimacy through association with incumbents, with exposure to delegitimation by association

		Data affordances of IoT	(the five scenarios of Table 15)	and pragmatic challenge Pragmatic legitimacy from new revenue and stakeholders, with normative risk Normative and pragmatic legitimacy where values align; delegitimation where they do not Validity from investors in merger-based blurring, with coherence still to establish Expert status from data sharing, with security and surveillance risks Power effects: obligatory points of passage, instrumentari an power over end users, asymmetric partnerships In the extreme, an illegitimate means to legitimacy (greenwashing ; concealed normative violations)

Table 16 Boundary Work Triggers, Enablers, Mechanisms and Outcomes

Agents, namely founders, managers, customers and investors, undertook boundary work throughout the venture's evolution. Venture boundaries were constructed and reconstructed during identity formation, stakeholder evaluation and the entrepreneurs' responses to the external environment and stakeholder feedback (Lounsbury and Glynn, 2001; Navis and Glynn, 2010, 2011). These boundary work efforts were guided by the need for venture legitimacy and the adoption of its offerings (Lounsbury and Glynn, 2001; Navis and Glynn, 2010; Berglund and Glaser, 2022). Boundary creation began at the pre-start-up stage, as the first seeds of a legitimate new venture identity took root. This took the form of entrepreneurs' efforts to ingrain evaluators' inputs and laid the groundwork for the start-up boundary. In the early stages, a new venture's identity is indistinct from the entrepreneur's identity (Lounsbury and Glynn, 2001). In seeking legitimacy for their ideas and ventures, founders attempted to build their networks by exploiting existing ties and gaining access to resource providers at the boundary management stage. Start-ups also undertook boundary bridging and blurring as they established partnerships and communicated with various stakeholders, such as customers, partners, investors and venture development organisations.

This research finds that new ventures are consistently under construction, as their boundaries are always changing. Further, ventures' legitimisation efforts include the *construction, pivoting and adaptation* of identities, products, BMs and their constituent elements. The start-ups implemented legitimisation efforts at institutional, firm and artefact levels, through the processes of boundary creation, management, bridging and blurring.

8.1.1 Industry boundary creation and blurring - How IoT start-ups create and re-shape norms.

IoT start-ups undertook boundary creation at the industry level. *Nexum, MarineMeasure, SkyTaxiInfra and CleanCooking* influenced the formation of industry boundaries by creating technical standards, lobbying, participating in policy discussions, and reporting. Others, namely *BabyCradle, BabyWearable, AgeObserve, AgeMonitor, and Monitor*, engaged in boundary creation by

constructing new distinctions and categories around institutionalised practices such as parenting, elder care, and guest management.

Start-ups created technical standards that mimicked the technical features of their own technology. This is a known strategy to gain legitimacy (Deephouse and Suchman, 2012). Creation of new standards led to isomorphism and erection of barriers to innovation and entry, leading to challenges of unfair competition. (Boiral, 2012; Karlsson and Middleton, 2015; Blind and Mangelsdorf, 2016). Boundary creation led to blurring boundaries of legitimate participation (For instance - *MarineMeasure* strategically influenced ISO standards creation, ensuring their technology became the industry benchmark) since it excludes less resourced entrants with potentially disruptive innovation.

Controlling the dominant design narrative gave the start-ups an advantage over alternative service providers (Teece, 1986). In contrast to existing research which suggests that limited number of start-ups engage in manipulation strategy through changing existing institutions and creating new institutions due to the high costs involved (Karlsson and Middleton, 2015), start-ups studied in this research successfully created and are creating new institutional norms to gain pragmatic legitimacy (*Nexum, SkyTaxiInfra, MarineMeasure, CleanCooking*). First, these organisations formed alliances with powerful organisations. Second, they developed an ecosystem of users and partners. Third, they co-opted partner legitimacy to gain initial approval from evaluators and finally, acted as first movers to bolster their own authority as technical experts in their domains. By developing an ecosystem and partnering with incumbents, these companies contributed to the expansion of IoT sector boundaries and gained status of gatekeepers.

Other start-ups challenged traditional caregiving norms and practices through the creation of boundaries around established routines like parenting, eldercare and guest management. The use of IoT reframed traditional practices on 'appropriate' care and guest management. These start-ups also created ecosystems and partnerships (*AgeMonitor, AgeObserve*), blurring the line between traditional and technology-based care, to integrate their solution into a broader industry practice. Successfully setting new norms or standards gave the start-ups

informational power from data collected by IoT systems and market power at the expense of traditional providers or late entrants. While the practices adopted by these entities impact industry creation or transformation, it also raises questions on privacy, autonomy, exploitation, inclusivity, access and fair competition.

The start-ups formed partnerships by blurring boundaries with large industry players, including research institutions and government bodies. Blurring at different levels entailed the formalization of agreements (firm level), integration of start-up technology with other organisations (artefact level), integration of data from multiple sources (artefact level) and alignment with regulatory frameworks (institutional level), enhancing pragmatic legitimacy and reputation within the industry. They actively developed or contributed to a partner and user ecosystem, where they positioned themselves as keystone actors (*Nexum*) or complementors (*TrafficIoT, AgeObserve, AgeMonitor, SkyTaxiInfra, CleanCooking*). Both actor types are highly influential in the legitimation of the ecosystem (Thomas and Ritala, 2022)The integration of data and technology with partners, the development of ecosystems and the outcomes of the integration enhanced the start-up's legitimisation efforts.

Boundary creation and blurring both led to creation of new categories that enabled these companies to gain cognitive legitimacy through categorical fit as well as a distinctiveness over others. They challenged the legitimacy of the status quo by problematizing existing solutions and practices (Suddaby, Bitektine and Haack, 2017). It is well known that challenging the status quo is a costly proposition for start-ups. This disruption of institutionalised norms was made easier by the well-established problems inherent in prevailing solutions. The start-ups' created new boundaries in the form of categories and innovation and entry barriers. But they also reinforced existing boundaries and power hierarchies by co-opting existing networks with incumbents and serving as enablers to existing ecosystems. The start-ups established new power hierarchies by designing platform ecosystems with their technology at the centre *and* by providing a significantly better alternative to the prevalent solutions. A key takeaway here is that most start-ups need to be well-connected to incumbents to be able to influence industry standards. So, before forming partnerships, legitimacy was acquired from targeted partners or customers in the industry. The legitimacy gained from key partners

became an enabler for the boundary work requiring institutional changes. This boundary work further led to the creation of the start-ups' status as a legitimate authority, as a creator of a new industry standard or practice (Figure 23).

Legitimacy required to establish partnerships with leading actors in an industry is accomplished through boundary bridging efforts. These efforts show how start-ups became adept translators of institutional logics (Thornton, Ocasio and Lounsbury, 2013) , demonstrating adaptability by conforming to customer or partner expectations, regulations and standards, and using boundary objects (such as proposals or agreements). This process of start-ups' aligning with dominant actors' expectations is a form of firm level boundary work that enables them to exert influence on industry boundaries.

8.1.2 Firm level boundary work and the making of legitimacy.

In uncertain and ambiguous environments, start-ups do not just create new categories, they also engage in firm level boundary work to shape legitimacy perceptions of their evaluators as well as manipulate their external environment. They employ the mechanisms and practices summarised in Figure 26.Narratives, reframing and iterative improvement in creating boundaries; aligning, calibrating, complying and pivoting in managing them; discursive, artefactual, relational and structural bridging; and category, BM, values, merger related and data sharing. Early stage venture formation including the pre-startup boundary work are part of boundary formation. This is where symbolic boundaries are drawn from founder experience and interaction with early evaluators.

Start-ups employed four modes of boundary bridging: discursive bridging, through a shared language and the translation of commercial terms into technical terms and vice versa; artefactual bridging, through PoCs, prototypes and BMs subjected to real-world testing; relational bridging, through trust building, customer selection and long-term customer relationships; and structural bridging, through accelerator networks and partners (Figure 21). These modes play a critical role in achieving alignment with resource providers and evaluators and in building credibility.

In many instances, the new ventures collaborated with traditional organisations including research institutions and universities through co-development projects. These alliances allowed the start-up to co-opt their partner's or resource providers' legitimacy, but it also created a risk of assimilation within the partner's dominant logics and dilution of the start-ups' accountability (Pfeffer and Salancik, 1978; Kislov, Wilson and Boaden, 2017; Hornberger, Mack and Baiyere, 2022). To establish legitimacy and credibility of the product, collaboration data and outcomes, the start-ups bridged the boundaries between the realities of the product or joint project and the expectations of the key decision makers (Cash *et al.*, 2003). Once the project was successful i.e. its outcomes met the expectations of the evaluating audience like a prospective customer or partner, start-ups facilitated the technology work undertaken by the customer or partner to maintain its legitimacy. However, the research reveals a few tensions due to boundary bridging processes (Håland, 2012; Langley *et al.*, 2019). While these collaborations enhanced legitimacy, they also introduced risk of partner dominance and identity blurring such as in the cases of CleanCooking, HVACHealth, WaterSensor (Apesoa-Varano, 2013)

Firm level boundary bridging when successful, nurtured legitimacy at the ecosystem and industry level as discussed in the section on industry level boundary work. Boundary work at firm level relied on technological artefacts like software packages or hardware which became material sites for inter-organisational collaboration (Langley et al., 2019; Lindberg et al., 2017). Boundary bridging practices increased the alignment of the key components of artefacts, projects and processes with expectations of customers or partners, influencing acceptance and signalling credibility with resource providers. Despite their effectiveness, bridging practices also masked legitimacy gaps and resource asymmetries.

Many of the mechanisms and practices of bridging are resource intensive requiring new ventures to adapt to their customer's needs. Excessive adaptation stymies the start-ups' growth as some customers is exploitative (requiring unpaid PoCs). In an attempt to bridge legitimacy gaps, start-ups also use legitimacy lies to mislead stakeholders for expedience, compromising long term reputation (Gehman and Wry., 2022). Frequent challenges encountered during boundary bridging were lack of transparency, biases specifically related to gender (Swail

and Marlow., 2018) and stigma related to taboo business ideas. These challenges were countered by the venture's consistent efforts involving frame manipulation based on investor expectations and strategic networking.

Firm level boundary bridging took the shape of collaborative boundary work enabling start-ups to gain legitimacy by association (Langley et al., 2019). Bridging efforts take place before any enduring and formal agreement between organisations is in place. Boundary blurring at the firm level takes place through formal partnerships such as mergers or strategic alliances. However, boundary blurring had number of consequences for start-up identities.

At the industry level boundary blurring included negotiating and overcoming institutional constraints, creating new spaces in regulated environments and enhancing legitimacy as discussed in the previous section. At the firm level, boundary blurring also took place through mergers and formal partnerships that led the start-ups to gain pragmatic and cognitive legitimacy. This resulted in the formation of new, hybrid identities (Zolberg and Woon., 1999; Corley and Gioia., 2004; Clark and Gioia et al., 2010). Other forms of blurring at the organisational level included the use of frames enabling multicategory membership, alignment with market or technological trends, association with reputed technology standards, access to partner resources, adoption of multiple BMs including role hybridization, product adaptation -where start-ups leveraged category ambiguity, flexibility, and fashion, increasing the risk of identity confusion (Ashforth, Rogers and Corley, 2011; Durand and Thornton, 2018; Alexiou, Wiggins and Fourkan, 2024) Figure 22. These attempts also expanded the start-ups' stakeholder base to gain cognitive legitimacy (Haack., 2012).

Boundary blurring outcomes and the accompanying technology work enabled start-ups' customers to engage in a farcical display of alignment with regulatory norms (*MarineMeasure*) and test new technology in sensitive settings while making claims of modernisation and cost effectiveness to gain legitimacy (*MotherHealth, AgeObserve, AgeMonitor, TrafficIoT*) (Ashforth and Gibbs, 1990). Boundary work and values work together facilitated the development and resolution of values conflicts and identity creation and change (Gehman et al., 2013; Nicolescu et al., 2018; Gabriel; 2020). IoT start-ups blurred boundaries by continually negotiating

their identity and embracing adaptability, crucial to their legitimation process. This leads to enhanced legitimacy due to strategic associations, stakeholder acceptance and better market position. The downside of this is that the venture's identity is perceived as deceptive or incoherent, if the changes are frequent or inconsistent with the espoused values of the start-up, making legitimacy a futile pursuit (*Garud, Snihur, Thomas and Phillips., 2025*). This brings to light, the relationship between legitimacy outcomes and boundary work. In this case, boundary blurring activities lead to enhanced legitimacy which needs to be maintained through further boundary work efforts. If these efforts are insufficient or non-existent, it can lead to a loss of legitimacy or even stigmatise the new venture, creating an urgent need for engaging with evaluators to restore lost status (**Figure 27**). This also reinforces the assumption of this thesis that boundaries can never be stabilized. So, boundary stabilisation is essentially the translation from symbolic to objective boundaries. However, environmental change, judgements by key stakeholders and internal interdependencies can impact this stability and so post-formation boundary management covers the ongoing adaptation and maintenance of boundaries, post stabilization.

Boundary blurring and creation work at institutional level required the implementation of unique BMs and go-to market strategy leading to enhanced technology and organisational legitimacy (Figure 22) (*Zimmerman and Zeitz, 2002*). For instance, case studies- including *Nexum, CleanCooking, MarineMeasure, BabyCradle, AgeObserve, AgeMonitor, Monitor* – demonstrate that creating new institutional norms and categories, signals a start-up's legitimate authority in its' domain to evaluators. Start-ups' legitimacy is propagated by the user and partner ecosystem's adoption of the technology underlying the standard (Gawer and Phillips, 2013). This was only made possible by the acquisition and retention of customers and partners facilitated by artefact level and firm level boundary blurring and bridging work. Here also, the creation of boundaries leads to legitimate authority status and this legitimacy is only enhanced through ecosystem boundary work efforts (Figure 27).

Boundary creation at firm level including, defining the organisations' purpose, identity and scope preceded the identity change enabled through boundary bridging and blurring. Opportunity identification commenced symbolic boundary

formation through the exercise of cognitive skills and resources accumulated from prior experience (Shane and Venkataraman, 2000; Sarasvathy; 2001; Garud and Giulani, 2013). Symbolic boundary construction influenced legitimacy at early venture and pre-venture stage. For instance, founders of *BabyCradle* and *BabyWearable* used their experience as a parent and researcher/engineer to create boundaries between what was available in the market for parents and what was needed.

Start-ups constructed symbolic boundaries through the interactions with key evaluators namely investors, venture development organisations and customers (Pfeffer and Salancik, 1978; Lamont and Molnar, 2002; Dimov et al., 2007; Zietsma and Lawrence, 2010; Gordon, 2014; Lamont et al., 2015; Langley et al., 2019). These negotiations informed the opportunity development from idea to new venture stage and laid the groundwork for objective boundary formation (Dimov, 2002; Lamont et al., 2015). In some cases, interactions were conducted through practices like market research, prototype development and demonstration of successful project outcomes (specifically in case of spinouts) and in some others it included engaging with evaluators at events through meetings or competitions (Figure 25)

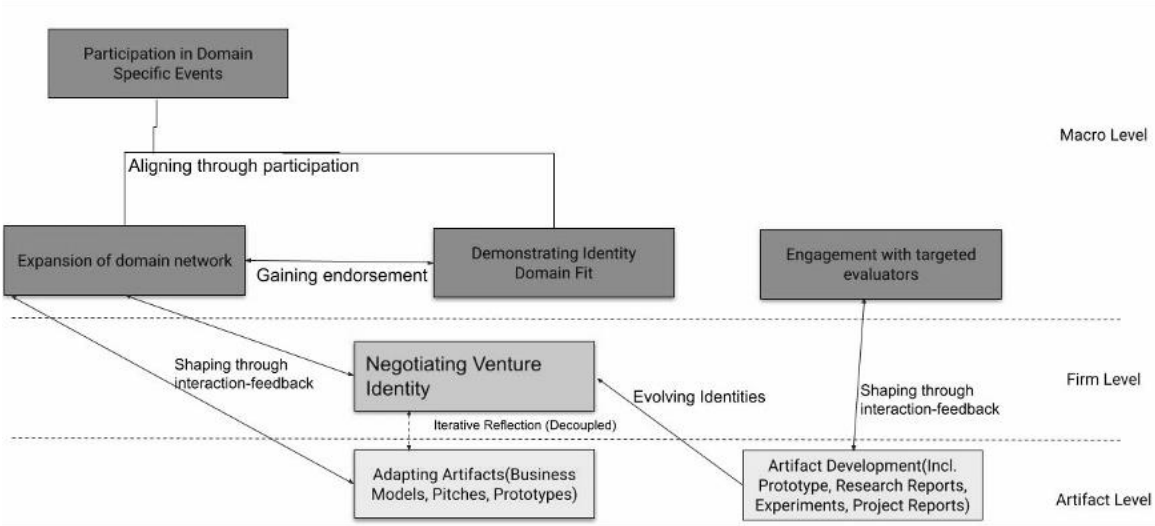


Figure 25 Pre-Start-Up boundary work mechanisms and practices

Both symbolic and objective boundary formation involved development of distinctiveness claims which contributed to the legitimation of the entity (Navis and Glynn, 2011; Snihur, 2016; McKnight and Zietsma, 2018)|(Table 16)Practices of market research, market validation, patenting, feasibility studies helped establish the legitimacy of the start-up idea and BM which served to circumscribe

the start-up's objective boundaries (Figure 22). Similarly, practices like board formation, crowdfunding, physical products and prototypes further created a separation between the start-up and its environment or category (Santos and Eisenhardt, 2005) (Figure 22) .These practices helped create defensible boundaries, establish the start-up claims of legitimate authority in a specific domain and demarcate relevant market segments (Santos and Eisenhardt, 2009; Bafera and Kleinert, 2023).

Start-up efforts in engaging with evaluators and resource providers at the pre-selection stage included eliciting and implementing feedback, reducing information asymmetry that contributed to their selection and led to the creation of boundaries segregating the in-group and out-groups (Shane and Cable., 2002; Franke at al., 2008). Across all resource providers, tacit criteria for start-up selection included adaptability along with the measurable value creation and capture ability (Mason and Harrisson, 2010). This adaptability was demonstrated by the start-ups through their boundary work efforts within the entrepreneurial ecosystem such as their participation in pitching competitions and active engagement with key evaluators.

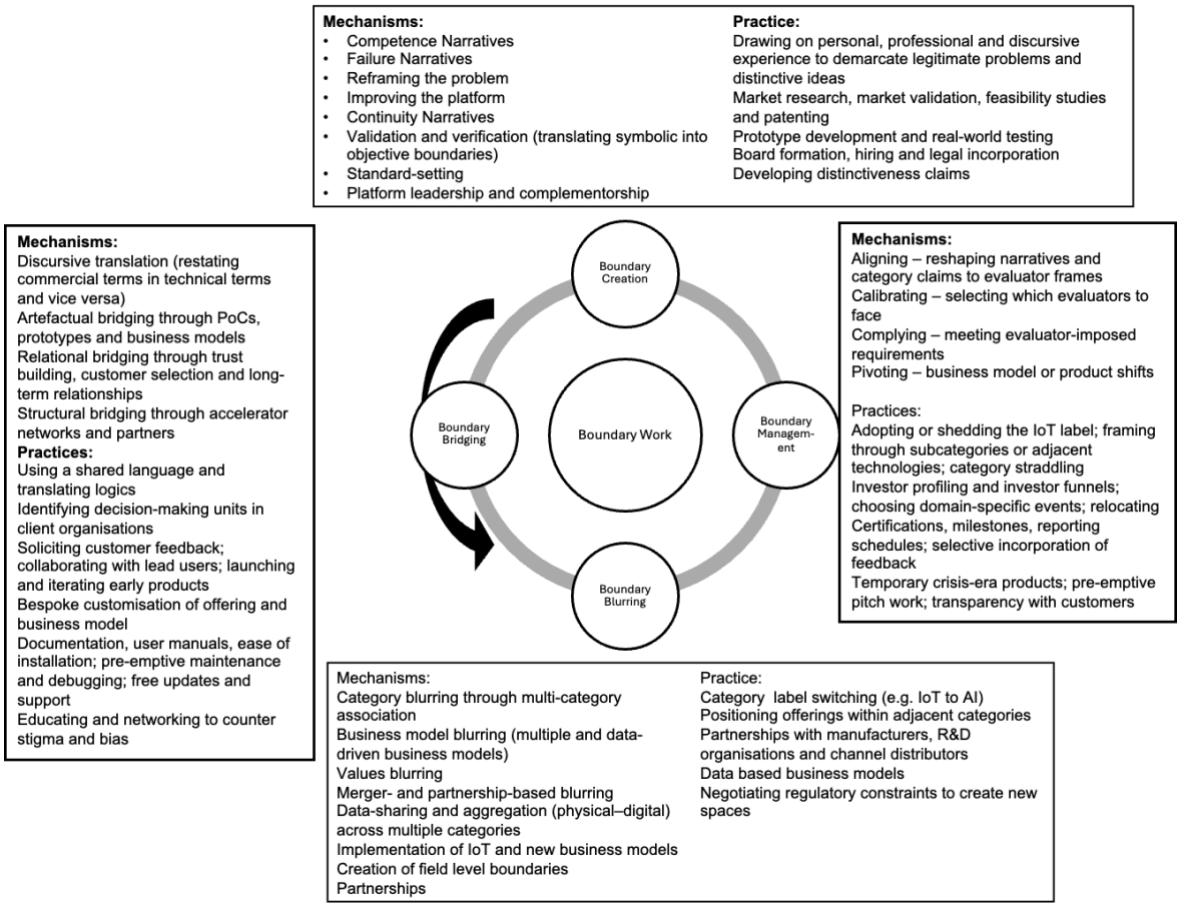


Figure 26 Mechanisms and Practices of boundary work

Prior to selection in an accelerator or investor cohort, the start-ups managed the external boundaries set by the resource providers by clarifying and aligning with the expectations (Shane and Cable, 2002). Through participation in domain specific events, they expanded their network and demonstrated identity coherence with said domain (Santos and Eisenhardt, 2005). Relevant interactions served as a site for identity negotiation of the start-ups' and enabled them to discover or affirm the necessary components of identity that would lead to their legitimacy when evaluated by key resource providers or customers. So, some of the start-ups undertook temporal identity work to gain acceptance to events (such as investment opportunities, industry pitching events) where propriety and validity judgements took place (Bitektine and Haack, 2017). Firm level boundary work affected changes to the artefacts that are crucial to its identity such as pitches, prototypes and BMs. Some of the start-ups created a 'circle of relevance' by evaluating events and stakeholders based on a selection criterion which included alignment in values and focus (Katila, Rosenberger and Eisenhardt, 2008). These practices were attempts to control the selection process making legitimacy creation easier (Figure 21). During the selection process, firm level activities

contributed to legitimacy from the resource provider and customers including submitting to ongoing monitoring, compliance checks, due diligence and provisioning documents for validation. Whilst engaging with customers, start-ups also had to manage power dynamics, establish competence and adapt identities to align with customer's internal hierarchies and incumbent ecosystems to drive adoption and scale (Santos and Eisenhardt, 2005).

Start-ups tried to maintain or enhance their legitimacy by managing external and organisational boundaries. For instance, these ventures managed macroeconomic constraints imposed by COVID-19, supply chain shortages and political issues. They pivoted their core artefacts -identity, BM, development process, products and pitches in order to gain legitimacy (Table 16). Besides responses to external jolts, firm level boundary management also involved manipulating identities and exploitative power relationships. The research reveals concerning power dynamics where start-ups wasted resources to gain legitimacy from customers or large investors (Alvarez and Barney, 2001; Dushnitsky and Shaver, 2009; Colombo and Shafi, 2016; Pahnke, Katila and Eisenhardt, 2015). These large organisations engaged with start-ups only for knowledge gathering purposes, not to purchase or collaborate or invest and proved to be difficult collaborators. Further, events and programmes in which start-ups took part to gain legitimacy, exerted a temporal pressure on start-ups where they had to demonstrate their capabilities in a compressed time. Start-ups manipulated temporal boundaries to avoid scrutiny while commercializing new technologies (Knopf, Frahm and M. Pfotenhauer, 2023). This is shown by an exaggeration of readiness, scalability or capabilities in the start-ups' rhetoric which if unproven can undermine long-term credibility (Giazitzoglu, Whittle and Mueller, 2024). The flexibility that makes adaptation easier also conflicts with maintaining a coherent identity. Thus, organisations must manage this ongoing negotiation between their perception as a legitimate domain authority and internal coherence. To manage evaluator expectations especially when engaging with resource providers like investors or accelerator programmes,, start-ups needed to show that they adhered to quality assurance, technical assurance and intellectual property demands. They did this by provisioning technical and product documents. Post selection, start-ups were expected to pivot and adapt their products and identities based on the feedback

provided by the resource provider. This took the form of artefact manipulation such as pitches, prototypes and BMs discussed next.

IoT start-ups navigate the uncertain and fluid environments by engaging in intricate boundary work at firm level enabling legitimacy creation and enhancement. The research shows that start-ups mitigate the liabilities of newness by aligning with evaluators, collaborating with institutional actors and mobilizing identity claims. But while boundary work is an important part of the legitimisation process, its resulting outcomes can also be problematic for the start-ups and their evaluators. Start-up legitimacy is in a constant state of development based on the negotiation of firm identity, artefacts and evaluator expectations. Overall, firm level boundary work is iterative, responsive to the external environment and enacted through changes to the artefacts that comprise the start-ups identity.

8.1.3 Artefact level boundary work: Negotiating legitimacy through adaptation

Start-ups in this study employed boundary work at artefact level at various stages of growth. In the early stages, artefacts like business plans, BM documents, prototypes, research reports, project documents were shaped by interactions with external evaluators and experts. These artefacts contributed to the formation of start-up identity. Further, as the venture progressed, the changes wrought in the artefacts reflected in venture identity and vice versa. However, there is a decoupling between the venture identity and artefacts where the venture identity did not reflect in artefact adaptation (Figure 21). This highlights a performative tension in start-up legitimation. This research has earlier shown the role of firm level boundary work that resulted in adaptation of artefacts as well as artefacts such as project, prototype, experimentation, research and validation outcomes that shaped firm identity. This section focuses on how IoT artefacts are instruments of legitimation. These artefacts influence boundary work and boundary work is done on artefacts to align with evaluator expectations and venture identity to gain legitimacy.

When working for organisations, start-ups undertook product customisation or conducted PoCs and pilots to meet the goals of aligning with customer's

expectations and values. This helped them gain value and performance legitimacy (Ren, 2019). Both sets of B2B and B2C launched products in early stages of development, in line with the validated learning approach, risking potential harm and damage to reputation due to faulty technology (Ries, 2014). In some cases, start-ups ceded control of products to meet customer demands and aligned products completely with customer expectations. This enabled and constrained start-up as they acquired few customers with similar needs but were unable to expand to other target segments.

Artefacts like PoC and pilots, during execution helped the evaluators establish relevant parameters for future judgements of projects. However, successful PoC or pilot outcomes did not always translate to bigger deals. Start-ups adopted practices which decreased the ambiguity and uncertainty related to customer's acceptance. B2B start-ups continually assess customer digital readiness, expectations from the product and BM and potential for increasing scale of implementation. This consideration helps new ventures prioritise relationships yielding greater benefits. Boundary bridging is a useful tool in identifying key stakeholders, managing relationships with different stakeholders including customers and partners.

Start-up attempts at bridging boundaries (at both firm and artefact level) with customers or partners enabled cultivation of strong relationships to sustain legitimacy. For instance, they implemented project management practices that led to changing of artefacts including maintenance or modification of the installed equipment or devices at customer sites to allow for ease of use and better performance. Further, the start-ups improved the usability of their technology by packaging their offerings into a form that required minimal training or education for installation and usage. These different forms of technology work reflected in artefacts facilitate legitimation by serving as evidence of competence and alignment with evaluators.

This study found that boundary bridging with stakeholders enabled the start-ups to navigate tensions related to entrepreneurial artefacts namely BMs, pitches and products. While traditional boundary work literature looks to artefacts as shared representations not needing a consensus between diverse stakeholders, consensus

is important in ensuring the legitimation of the artefact (Garud, Gehman and Karunakaran, 2014). For instance, subscription-based BMs were preferred by investors, it was in opposition to customers who preferred paying a one-time payment fees and found it challenging to reconcile the subscription model. Start-ups used boundary bridging to manage this tension in the emergent BMs. To increase customer and partner acceptance, start-ups used boundary bridging tactics such as communication of unsuitable BM alternatives to create a perception of transparency, changing BMs to align with customer preferences and ensuring a product-market fit.

Start-ups embedded diverse stakeholder values, trends and feedback into BMs, products and technologies. These artefacts were also used to resolve values conflicts and negotiate legitimacy. For instance, the conflicts between safety values of *Monitor's* customers and societal value of privacy, led to an artefact designed to collect data without infringing on end user privacy. *CleanCooking* similarly needs to reconcile its focus on technical and environmental values with the economic values of its target customer segment and incorporate a pay per use feature in their platform.

Artefacts are adjusted to conform with regulatory standards and industry requirements. The artefacts thus are not just the outcomes of boundary work conducted by start-ups but also sites where firm and institutional boundary negotiations take place. For instance, *BabyCradle* exhibited pre-emptive regulatory boundary work by redesigning their product to conform to regulatory demands. Artefact choices also influence firm level boundary work and industry structures. As discussed previously, *Nexum* orchestrated the formation of an ecosystem that served as a channel for its new technology, providing a rich source of feedback and enabling adoption. Similarly, the dependence of *SkyTaxiInfra* on incumbents and existing power structures guided the firm's product development and BM. In addition, regulator standards also impact the start-up processes surrounding artefact development. For instance, *Monitor* and *IoTSecurity* used GDPR compliant data practices and developed a set of internal protocols to shape product design. Thus, artefacts as well as the antecedent practices are adapted to the prevailing values, trends, and feedback from external environments.

Technological artefacts are known to informate and automate their environment (Zuboff., 1988). IoT start-ups blur the boundaries between physical and digital world by implementing and developing products and technologies dependent on sensor-based data collection and their analysis (Ashton, 2009; Naik *et al.*, 2020; Seidel and Berente, 2020). This also blurs how space and identity is perceived by users as well as exposing them to surveillance (Floridi, 2013; Zuboff, 2019; Seidel and Berente, 2020). IoT's physical digital blurring embeds ethical risks into designs. Data itself becomes a site for boundary exploitation as it is used for empowering and exploiting users and enabling collaboration between entities (Table 15). Further, firm level boundary decisions such as *Monitor's* deferral of transparency disclosure (on data collection and usage by devices) to partners or customers reflected a deferral of accountability.

Start-ups also responded to environmental jolts or pressures through product and BM adaptation. For instance, *BabyCradle, Monitor, WiseBees, BabyWearable* had to adapt to the constraints due to COVID-19, supply chain shortages and geopolitical issues. This required start-ups to forego core identity elements and launch untested solutions, prioritising speed over stability. Product and BM adaptation in response to the environmental triggers enhances legitimacy and shows that legitimacy is contextual and temporal. Responsive adaptation and pivoting enabled start-ups to maintain legitimacy even if the changes were temporary, incongruent with core identity and untested. Other start-ups also used issue-specific framing to gain legitimacy in response to the external environment. When start-ups try to overreach by combining roles- it creates values conflicts and risks erosion of legitimacy. Role conflation can confuse evaluators and create credibility gaps.

So far, the discussion on IoT artefacts adaptation to gain legitimacy has focused on the changes wrought to enable alignment with the external environment. However, internally, IoT start-ups manage multiple boundaries around different types of technology that are part of their IoT offerings. The necessity to align disparate functions (such as app updates with hardware development) forces the venture to continually redefine and integrate its internal boundaries. Start-ups examined in this study did this through the development of firmware, hardware and app components simultaneously and managing the interdependencies

between these parts of IoT systems. This also signals an IoT start-up's technological credibility.

This thesis found that artefacts, whether product, BM or technology were central to shaping venture identity, serving as evidence of competence and credibility, and gaining legitimacy. Start-ups gained legitimacy for their offerings through adaptation of artefacts to external environments including the selection criteria and feedback of evaluators. Artefacts resolved tensions between competing values and expectations. But owing to the panoptic nature of IoT and the necessity of deliberate development processes to uphold accountability makes it a precarious vehicle for legitimacy.

8.2 Legitimacy Outcomes of Boundary Work

This study shows that IoT start-up legitimisation is continually and socially constructed by the start-up's interactions with the external environment and key actors. Legitimisation requires continuous boundary work involving artefacts, venture identity, evaluators and institutions. This thesis found four key types of boundary work undertaken by the start-ups, namely boundary creation, management, bridging and blurring. Boundary work and legitimacy outcomes shape each other. Boundary work creates legitimacy, and legitimacy defines boundaries (Figure 27).

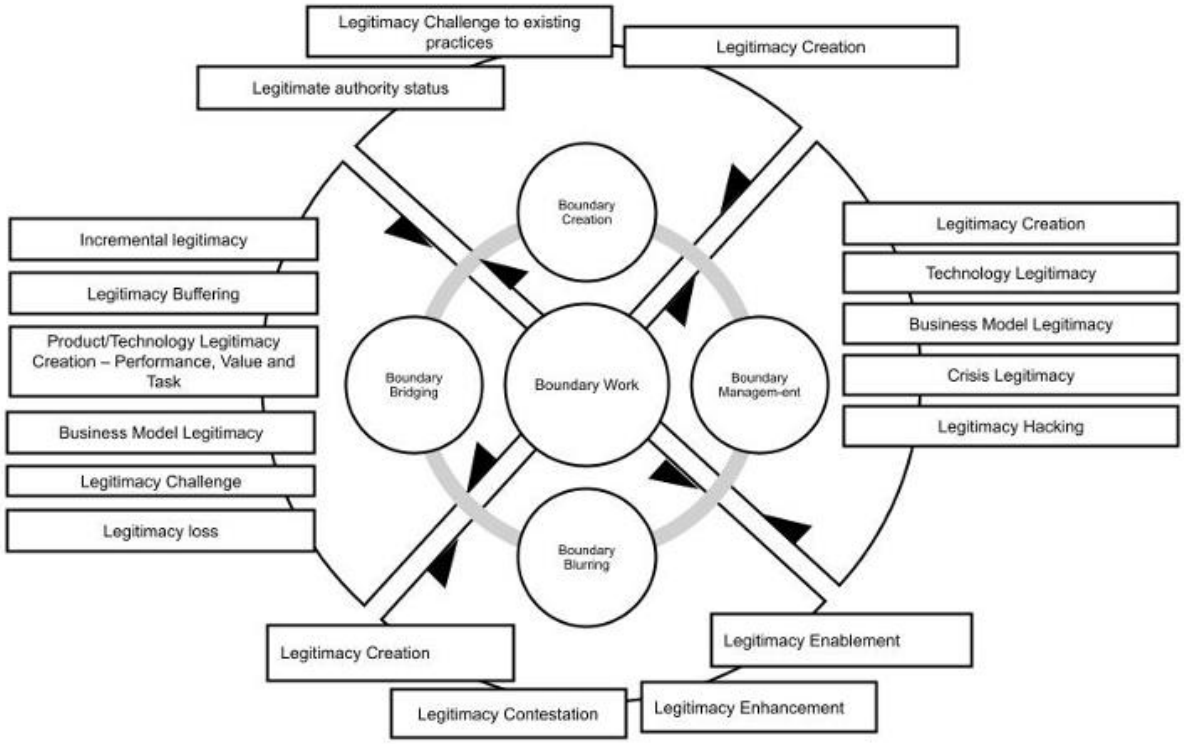


Figure 27 Boundary work - legitimacy outcomes

8.2.1 Boundary Creation - Drawing the lines of legitimacy

Boundary creation entailed the creation of new institutional forms and practices as well as creation of optimally distinct identities. IoT start-ups operate at the intersection of the technology itself, the organisation, the BM and related products and services. As such IoT ventures need to legitimise all these components.

Creation of new institutional boundaries with start-up technology as a blueprint led to creation of legitimacy for the start-ups offerings (Table 16). It led to a recognition of the new venture as a legitimate authority in its domain. Further start-ups challenged the legitimacy of existing institutionalised practices to create new categories that entailed new practices. Thus, legitimacy or its' loss engendered new boundary creation.

Start-ups engaged in symbolic and objective boundary formation to create optimally distinct identities that led to their legitimacy. These included products or technological, organisational and idea boundaries (Table 17). Start-ups

commenced the process of legitimacy creation through the creation of boundaries resulting in distinct identities. The founders expertise, experience and interactions with experts, gatekeepers and resource providers led to novel value propositions and domain specific frames, creating identity and product boundaries (Table 17). Start-ups gained legitimate authority when transitioning from symbolic to objective boundaries through patenting, recruitment of board members and employees, creating market segments and creating a recognised organisational entity.

8.2.2 Boundary Management - Adapting boundaries to gain legitimacy

Boundary management enabled IoT ventures to signal legitimacy across technology, BMs and organisational identity. Start-ups attended events to get their offerings, value propositions and categorical fit validated by resource providers which contributed to the legitimisation process. They targeted specific events and resource providers through a selection criterion to strengthen their claims to legitimacy. These start-ups adjusted narratives and pitches to align with evaluator expectations at events creating and reinforcing BM legitimacy.

To portray an impression of technological credibility and their own competence, ventures had to manage the internal boundaries of the different IoT components in a system. In some cases, start-ups also undertook legitimacy 'hacking' by manipulating the institutional pathways to engage with investors or other resource providers. Furthermore, start-ups demonstrated efforts to manage existing and new norms during external jolts to gain and maintain legitimacy during a crisis demonstrating resilience and adaptive capacity.

8.2.3 Boundary Bridging - Connecting the dots to build and risk legitimacy

Boundary bridging enabled start-ups to connect with diverse actors to incrementally build legitimacy over time. This started with demonstration of product or technology to demonstrate performance capabilities, task fit and alignment with evaluator values. While participating in several well reputed events or engaging with well-known actors, start-ups benefited from legitimacy

buffering due to the credibility associated with the events and actors. Start-ups were considered as going through structured evaluation processes due to their participative efforts. Demonstrating product performance results in tightly curated conditions was a means for impression management.

To attain BM legitimacy, start-ups reframed their narratives and translated venture logics to evaluator specific logics. Stakeholder logics were integrated into start-up offerings such as economic logic for investors and social impact logic for users. However, this caused legitimacy challenges as ventures expended additional resources in bridging differing values or engaged in legitimacy lies in exaggerating their technological readiness and capabilities. When these ventures were unable to live up to their claims or maintain consistent positioning across boundaries, they faced legitimacy loss.

8.2.4 Boundary Blurring: Creating, enabling, enhancing and contesting legitimacy

Start-ups pursued legitimacy through a hybrid identity approach and association with more accepted and popular categories (even before developing these capabilities). Ventures made future claims regarding the diagnostic, prescriptive or predictive features of their technologies, dependent on the quality and accuracy of real time data, training data and algorithms being used. Further, the start-up's value proposition included long term values such as sustainability gains or preventative health outcomes while under short term pressure from key stakeholders. This thesis shows other normative conflicts between start-up's key evaluators, start-up and evaluators, start-up's teams and start-up's core and projected identities. Attempts to reconcile differing values or gain short term legitimacy led to legitimacy contestation where start-up had to manage expectations and reality.

Mechanisms such as multi-category membership, use of specific jargons, multiple BMs including those driven by data signal innovation and relevance, particularly for evaluators keen on outcomes from data collection and analysis enabled by the start-up technology. Furthermore, the start-ups enable legitimacy creation for their customers and partners through technology and data affordances.

BMs related to data brokering and management create new forms of value creation and alter existing power relationships. Start-ups also form partnerships with manufacturers, R&D organisations and channel distributors to integrate hardware, data and analytics, blurring lines between internal and external capabilities. This leads to the legitimisation of ecosystems and new organisation structures. Start-ups enhanced their legitimacy by re-designing their products and adapting identities in alignment with regulatory, cultural, sectoral and technological norms.

Start-ups building IoT facilitated boundary blurring between physical and digital realms but also created boundaries between the beneficiaries of the data driven insights and those subjected to monitoring. This created new power structures as many individuals and groups are subject to monitoring without knowledge or consent or without the ability to understand the potentially exploitative applications of data being given away. This raises ethical, accountability and legitimacy concerns regarding both IoT and the venture developing the technology.

8.2.5 Temporal and Spatial Dynamics of Legitimacy

This thesis identified the temporal dynamics of legitimacy outcomes as start-ups attempt to legitimise their ventures and offerings through undertaking boundary work. The dimensions of speed and durability were identified based on the identified legitimacy outcomes (Figure 28).

While the onus falls on the start-ups to pursue the path of least resistance to survival and gain the required resources, they rely on the inputs of their evaluators to reach acceptance and gain status as an appropriate technology provider. In line with the lean start-up philosophy, these ventures incorporated the feedback from various actors as well as the external environment to incrementally change their identities. These adjustments were evaluated by the resource providers and made over a period, starting from conception. Further, boundary work mechanisms and practices such as idea and BM validation, product market fit, event and program participation, prototype development and demonstration all led to incremental legitimacy.

In contrast, start-ups enhanced their legitimacy through the incorporation of cultural and sectoral norms and different regulatory requirements across geographies (such as *BabyCradle* with changing consumer expectations and regulatory requirements across geographies or *Monitor* with changing data privacy regulations) and the use of specific category associations such as AI even in absence of capability. This included activities like developing formal partnerships, redesigning products and refining identities.

Start-ups used legitimacy hacking to manipulate traditional pathways to legitimacy such as pitching to investors, developing working prototypes or expanding service portfolio, speeding up the process of legitimisation. However, this meant that start-ups could make claims about aligning with evaluators expectations such as stage of the offering and the venture, and risk losing legitimacy when subjected to further analysis. Further, this legitimacy was only present for the duration of the program or association with the evaluator such as the case of *BabyWearable* and *HVACHealth*.

These ventures also pivoted and changed in response to external crises like COVID-19 to gain legitimacy. This resulted in a surge in trust for the venture illustrating their capabilities in managing macroeconomic challenges but because of its reactive nature, this legitimacy only lasts during the period of the crisis unless it is reinforced.

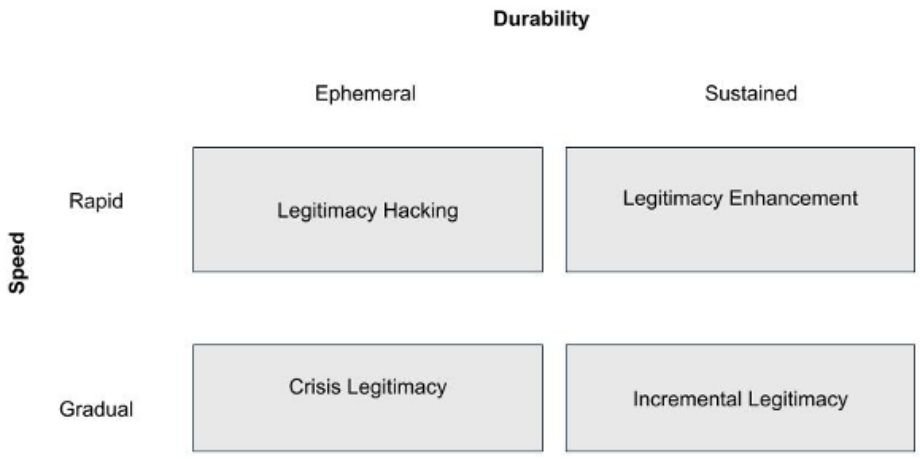


Figure 28 Legitimacy outcomes and temporal dynamics of boundary work undertaken by IoT start-ups

Spatial dynamics included structural, power and ecosystem role dimensions of legitimate authority and enablement. Start-ups gain authority because of their role as industry standard creators, first movers in technological innovation and anchors in their ecosystem. Secondly, they adopted specific mechanisms to develop the governance structure to position the venture as a legitimate authority in their domain. Further, start-ups as a technology integrator and innovation partner, enabled their customers and partners to gain legitimacy through improvement in their performance and efficiency.

Boundary type	**Boundary of.**	**Boundary work link**	**Illustrative cases**	**Principal legitimacy stake**
Cognitive–categorical	Meanings and classifications: what counts as IoT, category membership, venture identity claims, idea boundaries	Creation (distinct identities, new categories); blurring (multi-category association)	FullBattery, BabyCradle, AgeObserve (IoT-to-AI label transitions); all ventures' identity and framing work	Cognitive legitimacy: comprehensibility, categorical fit, distinctiveness
Organisational	Venture and environment: membership, governance, alliances, in-groups and out-groups, venture–partner interfaces	Creation (boards, legal structures); management (evaluator selection, network calibration); bridging (partnerships)	Nexum (ecosystem orchestration); SkyTaxiInfra (incumbent dependence); selection episodes with accelerators and investors	Pragmatic legitimacy: resource access, partnership formation

Technical–material	Product and system interfaces: hardware–firmware–software stack, data flows, physical–digital divide, product boundaries	Management (internal stack integration); bridging (demonstrations, PoCs); blurring (physical–digital)	Monitor (privacy-preserving sensing design); BabyCradle (regulatory redesign); all ventures' stack integration work	Cognitive and pragmatic legitimacy: technological credibility, demonstrable performance
Normative–regulatory	Standards, regulation, values, and norms of appropriate practice in a domain	Creation (standard-setting); management (compliance); blurring (values conflicts, stigma navigation)	Nexum, MarineMeasure (standards influence); Monitor, IoTSecurity (GDPR practices); CleanCooking, WiseBees (values framing); YourPleasure (stigma)	Normative and regulative legitimacy; legitimate authority as standard-setter
Temporal	Stage expectations, evaluation windows, readiness thresholds, crisis periods	Management (readiness claims, temporal manipulation, crisis pivots)	COVID-19 pivots (BabyCradle, WiseBees);; AIBlockchainIoT	Durability and timing of legitimacy: incremental, hacked and crisis legitimacy

Table 17 Types of Boundaries

8.2.6 Failure outcomes

During boundary creation stage, past failure narratives were used to for symbolic boundary formation and the construction of competence and reflexivity narratives. Here, failure enabled boundary work that led to legitimacy. Most IoT start-ups had rendered the propriety judgement that IoT had "failed to deliver on most of its promises" suggesting that it had become a contested sector. These start-ups also indulged in using frames of non IoT category membership. This shows that sector level legitimacy concerns impact firm level frames.

At venture level, the hardware scale bottleneck, exception-dependent value in industrial deployments, sensor lifecycles and founders' inability to open the IoT

black box converted into refused funding and stalled adoption. These were instances where boundary management efforts failed due to IoT specific challenges. In some cases, failure meant that business development discussions became feedback sessions for the start-up and shopping alternatives for the customer. These discussions were meant to be a mechanism for start-ups to firm up customer requirements and deliver a paid engagement through PoC or scale-up, but power dynamics led to unpaid PoCs and wasted resources for the start-up.

Venture's lies and exaggerations also led to failure as their products or prototypes could not sustain scrutiny. Blurring creates values conflicts, that can lead to delegitimation. Hybridization (in positioning) can lead to loss of coherence, credibility and founder authority such as the case of AIBlockchainIoT. Where organisation scaling includes repositioning, lack of communication can lead to loss of coherence within the organisation, including challenges to founder authority such as in the case of TrafficIoT. As ventures try to move from service provider to domain authority role particularly in domains related to sensitive data and safety, the role blurring leads to exploitation of audience vulnerability, that can undermine the venture's legitimacy as in the case of BabyCradle, BabyWearable and Monitor.

8.3 Conclusion

This chapter shows the importance of IoT start-ups' boundary work efforts at industry, firm and artefact levels in gaining legitimacy and the recursive relationship between boundary work and legitimacy. It has established that new venture legitimacy was an outcome of boundary creation, management, bridging and blurring efforts undertaken by agents of the venture. This chapter points out the key mechanisms and practices that comprise the boundary work.

Boundary work included creation of and changes to new venture artefacts including pitches, BMs and products, venture identity and relationships and venture authority in an industry. These efforts commence at the pre-start-up stage as symbolic boundaries were constructed by entrepreneurs and early teams which were then formalised and concretised into tangible, objective boundaries. Those ventures that were adept at managing power dynamics within their partnerships and ecosystems were able to create industry standards and norms. This highlights an important capability that leads to start-up's legitimacy and gain

dominant design status for their technology. This also shows the importance of ecosystems for the success of an IoT start-ups' legitimisation efforts. Start-up legitimacy acquisition was also impacted by the start-up actors' pre-emptive efforts in securing alignment with key evaluators.

IoT start-up founders actively managed external and organisational boundaries by identifying relevant evaluators and organisations for resource acquisition, adapting identities to align with relevant stakeholders and environmental constraints, demonstrating competence in their capability displays, complying with the industry and regulatory standards and aligning with customer and ecosystem hierarchies (Santos and Eisenhardt.,2005). However, this also led to formation of potentially exploitative power relationships that led to wastage of start-up resources (Pahnke, Kahlin and Eisenhardt., 2015). The start-ups pivoted their identities to align with new constraints posed by external events but the legitimacy from these pivots was short-lived as the solutions were untested and the identities disconnected from the core purpose of the venture (Tost., 2011). While adaptation was meant to improve the alignment between the start-ups and the expectations of their evaluators and the external environment, it also undermined the coherence of the start-ups' identity creating confusion within the start-up itself.

Even with the challenges of constant adaptation to adhere to multiple institutional logics of different evaluators, some start-ups managed to gain legitimacy through the practices of boundary bridging and blurring such as through development of strategic partnerships. They used the power from these relationships as well as the influence over an existing ecosystem of users and partners to set and propagate new standards and create new norms. In certain cases, start-ups faced challenges due to the existing power hierarchies such as biases and even stigma. The start-ups overcame these challenges through consistent communications and strategic networking. In some cases, the ventures themselves increased chances of facing stigma by using deceptive tactics. Start-ups manipulated evaluator perceptions by aligning with their expectations using early prototypes or specific jargons in their pitches which did not appropriately reflect the type or stage or readiness of the venture. As a result, these ventures gained legitimacy temporarily. However, their success after gaining funding or a promise of funding

or partnership was dependent on additional proof or documentation. Some for instance, like BabyWearable and HVACHealth did not meet the required expectations based on their claims and ultimately failed.

Start-ups also adapted their BMs to adhere to multiple institutional logics by incorporating these logics as part of the overall value proposition or using multiple BMs or by prioritising specific evaluators over the others. The use of alternative BMs also gave the IoT start-ups power over their customers data and led to changing of existing power relationships. This led to start-ups' blurring boundaries of other actors. For instance, IoT start-ups' panoptic capabilities, use of data and its justification of data exploitation forms a part of the BM and led to the development of instrumentarian power wielded by the start-ups over end users, customers and employees (Zuboff., 2019).

The multi-level boundary work led to legitimacy outcomes across levels. The processes of creation, management, blurring or bridging of boundaries were driven by legitimation strategies undertaken by the start-ups. At the same time, these forms of new venture boundary work gave rise to different legitimacy outcomes. Based on four identified legitimacy outcomes, a typology of temporal dynamics of legitimacy and boundary work were identified. Legitimacy hacking was an outcome of boundary management efforts such as aligning with expectations of investors through relationships with insiders within the evaluators' organisation and developing shadow prototypes that substantiate false claims about stage of the venture. These manipulations sped up the legitimisation process compared to traditional pathways, but the retention of the legitimacy was temporary, based on the start-ups genuinely meeting the established criteria versus claim making.

Enhanced legitimacy was based on blurring categories, sectoral and regulatory requirements and trends. For instance, positioning venture solutions within the environmental sustainability categories beyond the core offerings enhanced the legitimacy of WiseBees and CleanCooking due to the added normative context. Further, the incorporation of new industry or regulatory norms to gain legitimacy in new contexts enables the ventures to sustain their legitimacy over a longer period of time.

Crisis legitimation through boundary management is also a gradual process as it requires significant changes to process, identity and product such as the case of BabyCradle and WiseBees unlike legitimacy hacking which is farcical at best. Further, the gained legitimacy from crisis work is retained for the crisis's duration as the start-ups' revert to a previous state.

Incremental legitimation through boundary bridging is a gradual process as it involves significant changes over a period of time. This chapter also shows the relationship between boundary work and legitimacy. Boundary work efforts lead to legitimacy outcomes. Start-ups sustained or enhanced their legitimacy through continued boundary work. Loss of legitimacy or stigma was also counteracted through boundary work.

This chapter follows the theorization that boundary work is done at, for or through boundaries and defines the boundaries used by IoT start-ups during the legitimation processes (Langley et al., 2019). During the legitimation process, start-ups took up roles in their ecosystem or industry as central or peripheral actors. As central actors, they created standards setting new legitimacy criteria for their industry. As peripheral actors, they supported the requirements of larger partners. Their acceptance was dependent on their perceived legitimacy and strength of partnerships. Besides industry or ecosystem positions, start-ups' governance structures and their impact on customer or partner performance and legitimacy are some of the spatial dynamics that emerge from this study.

This chapter highlights the various boundary work practices and mechanisms employed by IoT based start-ups to achieve legitimacy and shows interplay between boundary work and legitimacy outcomes. It establishes the multi-level nature of boundary work undertaken by IoT based ventures to gain legitimacy. Further, the start-ups' continuous adaptation and pivoting of pitches, products, technology and BMs contribute to both construction and erosion of legitimacy.

9: Conclusion

This thesis presents findings of a theory-building study on the legitimation of Internet of Things based ventures and their BMs. The study makes use of the theoretical lens of boundary work to analyse how Internet-of-Things based new ventures, and their BMs get legitimated. First, this research identifies how boundary creation by IoT based start-ups leads to identity formation, positive propriety judgements and legitimacy (Bitektine and Haack, 2015; Bitektine and Haack, 2015; Wry, Lounsbury and Glynn, 2011; Suchman, 1995) Second, this research identifies the various legitimacy challenges IoT start-ups face and the boundary practices and mechanisms used to manage these challenges (Deephouse *et al.*, 2017). In addition, this research examines the roles of investors, accelerators and customers in this process. Third, this research shows how IoT start-ups try to close the knowledge gap with key resource providers and customers as well as the emergent challenges of the process. Last, this research shows how IoT start-ups try to adapt to the changes in the external environment including technological and industry trends and regulatory changes. Further, it shows how IoT start-ups align with key partners, undertake multiple roles to engage with customers and partners and use questionable means to gain legitimacy.

This research contributes to the undertheorised area of boundary work as a form of socio-symbolic organisational work and its relationship to legitimacy (Santos and Eisenhardt, 2005, 2009; Lawrence and Phillips, 2019b). It shows the key mechanisms and practices of boundary work undertaken by start-ups to gain legitimacy. The study reveals the effects of boundary work in the form of legitimacy outcomes including those that stem from issues related to power and values. By contextualizing this for IoT based new ventures, this thesis builds a portfolio of strategies used by existing or new IoT ventures to gain legitimacy and that policy makers can use to support these start-ups. This thesis contributes to the literature on socio-symbolic organisational work by showing the overlap between technology work and boundary work, and values work and boundary work (Lawrence and Phillips, 2019). Lastly, this thesis contributes to literature on dark side of entrepreneurship by showing how start-ups use embellishments to gain legitimacy and the biases they face(Gehman and Wry, 2022).

The research combines the theoretical strands of BMs and new venture development to show how new ventures achieve legitimacy through creation and manipulation strategies. It contributes to existing literature on new venture identity by showing how new ventures are pivoted and adapted in response to external feedback. The thesis strengthens BM research by showing how IoT start-up BMs evolve in response to legitimacy needs. Finally, it contributes to the design perspective in entrepreneurship by showing how new ventures design their context to gain legitimate status and introduces the role of power in shaping artefacts.

Drawing on rich qualitative data, key empirical contributions include the start-ups use of co-optation of power from larger partners, creation of institutional boundaries and practices, pivoting and adaptation to external environment and evaluators, selecting the external environment, and multi category membership. This thesis shows how start-ups create and exploit information asymmetry and create and manage power asymmetry in their quest for legitimacy.

9.1 Empirical Contributions:

The study analyses primary, secondary and grey literature data from 20 IoT based ventures, 7 IoT resource providers- namely investors and accelerators and 3 IoT start-up experts, to further existing knowledge of how IoT based start-ups undertake venture and BM legitimisation. Further, this study benefits from data collected from geographically diverse regions. This research also benefits from the perspective of start-up failure, as during the course of the research, two ventures ceased operations during the course of the study and one venture saw the change of leadership from founder to board appointed executive and the closure of its IoT department.

Four types of boundary work were identified based on the collected data - Boundary creation, management, blurring and bridging. The study found that start-ups' pursuit of legitimacy commences with the creation of boundaries including symbolic boundaries such as identification of opportunities and creation of legitimate distinct identities, and objective boundaries such as formation of boards and proprietary know-how. This is shown through the different case studies where founder experience, start-up interaction with expert individuals, entities

and resource providers resulted in the gradual formation of boundaries that encapsulated distinct identities. Further, the key boundaries around the start-ups BMs, material offerings and market segments were also found to be constructed and shaped in line with interactions with key evaluators to ensure legitimacy acquisition. This helped define product categories, distinguish features, incorporate the diverse needs of different geographical groups and rule out customer segments. Start-ups carved out their identity as a legitimate authority in a domain, underscoring their technological expertise by patenting technologies as well as constituting a board and team with the relevant domain expertise.

A key empirical contribution of this study lies in showing how IoT start-ups-contrary to prevailing theories portraying them as institutionally powerless-actively co-opt the legitimacy of established actors to re-shape industry norms and create new institutional boundaries. Start-ups also re-defined the boundaries around traditional cultural and professional practices through the incorporation of IoT, customer relationship building, and consistent adaptation based on feedback. This study found that IoT technologies-based start-ups face a set of legitimacy challenges and liabilities which are distinct from those faced by start-ups for whom hardware usage or implementation was unnecessary. Start-ups overcome these challenges through strategic pursuit of resources and constant change.

Start-ups navigated competing demands between different types of evaluators, the difference in expectations between the evaluators and the start-up's leadership and external environmental shocks through selection, prioritisation, pivoting and adaptation of identities, products and BMs. Social networks, information asymmetry and start-ups acquired status allowed the venture to manipulate existing power dynamics The use of social networks along with evaluation of resource providers to selectively engage with few and exploring alternate resource access pathways were mechanisms aimed at maximising their chances of legitimacy acquisition. In some cases, ventures *temporarily* adapted their identities in anticipation of and in response to external jolts, advice of insiders from evaluator organisations and evaluator feedback. This form of decoupling was spurred along with the support of venture development organisations in the form of publicity or product development or funding. IoT start-ups dealing with business customers invested in mapped organisational

hierarchies and demonstrated competence to support scaled adoption and legitimacy. Within the study, the ventures provided signals of legitimate authority through the technological boundary management of the IoT stack and exhibiting strong capability for integration across multiple levels. The decoupling may help start-ups gain initial legitimacy, but without demonstrating expected performance, leads to negative outcomes ranging from market disinterest to start-up failure.

Start-ups' efforts to gain initial legitimacy from customers and investors included the use of customer specific narratives, translation of technical to market logics, use of specific tools, adaptation of BMs and products based on evaluator's needs. Artefacts like PoCs and MVP's were used to obtain feedback and eventually legitimacy from customers leading to scale up projects. In a bid to gain legitimacy and align with expectations, start-ups ended up launching half-baked products, resulting in stigma or failed expectations. In most cases, start-ups undertake additional technological implementation, project management practices and training in order to increase the likelihood of adoption and decrease technical opacity. This thesis highlights the stark power asymmetry present in the start-up-customer relationships as customers are shown to exploit the start-up for information gathering purposes. Even if the PoC or MVP are perceived to be successful based on evaluator criteria, scale-up outcomes are contingent on the start-ups abilities to interpret customer signals, navigate internal hierarchies and nurture existing relationships, not just on the success of the PoC. This thesis also shows the dark side of legitimacy seeking efforts as myth making and verisimilitude replace genuine alignment with evaluators. Founders engage in exaggeration and misinformation to gain short term legitimacy. Founders also face microaggressions, stigma and biases that they navigate through consistently networking and embarking on educational efforts to convince evaluators including gatekeepers, mentors and investors.

This thesis shows that start-ups engage in blurring boundaries around, categories, identities, products, values and technologies to meet their evaluator's expectations and gain legitimacy. Start-ups also undertake projects and BMs that require formation of collaborative partnerships and ecosystems for success. Many start-ups associated their offerings with trending technologies even when such

capabilities are underdeveloped at launch. This multi-category membership at once enhances as well as complicates legitimisation efforts. Practices such as the association with popular normative categories, adoption of data driven BMs, strategic technological choices, product adaptation to conform with changing regulatory or cultural norms, assuming additional roles (beyond that of a technology provider) and forming new alliances were also implemented to acquire legitimacy from evaluators. The formation of relevant partnerships enhanced legitimacy, signalling to evaluators enhanced competence, enablement innovation and shift in organisational position within existing power dynamics.

Start-ups reconciled conflicting values into their offerings to gain legitimacy. BM changes pivoted the start-ups core focus which is in contrast to existing advice on entrepreneurship. The values work also led to change in power dynamics within the start-up's external environment. Ethical dilemmas were introduced through this change process and threatened the start-ups legitimacy. While the mechanisms and practices discussed here were implemented as part of legitimisation and adoption efforts by the start-up, some led to undermining of organisational legitimacy. For instance, identity blurring led to visible failure in maintaining coherence in values and messaging, lack of clarity in organisational identity, loss of organisational credibility and failure of leadership. At the artefact level, start-ups developed new technology that enabled the datafication of entities, creating new power structures through surveillance and partnerships. This increases the potential for exploitation of the key users raising questions about the venture's capabilities as a legitimate technology-based organisation. At the institutional level, start-ups created new norms that led to their legitimacy as standard setting authority in the industry while also dictating the legitimacy of technology developed by others.

9.2 Theoretical Contribution: An examination of the interrelatedness of boundary work and legitimacy in the context of IoT ventures.

This thesis concurs with scholars that boundaries precede entity and that symbolic boundaries are a prerequisite to objective ones (Abbott., 1995; Lamont Pendergrass and Pachucki, 2015). In contrast to neoinstitutional theorists, this thesis assumes that boundaries are in a state of flux (Abbott., 1995). This thesis contributes to studies on institutional work, particularly studies that explore how

new ventures challenge actors within a field (Lawrence and Suddaby., 2006; Zietsma and Lawrence., 2010). In Chapter 4, the start-up's founders engaged in theorizations of change (Suddaby, Bitektine and Haack., 2017).

This thesis contributes to entrepreneurship studies. The findings align with opportunity identification based on experience and knowledge (Shane, 2003), advisory board constitution to improve start-up profile in the eyes of the evaluators (Møller., 2020; Bjørnåli and Gulbrandsen, 2010; Kor and Misangyi, 2008). affiliate-based hiring to assure cohesiveness (Drori and Honig, 2013; Leung, Foo and Chaturvedi, 2013). In order to gain legitimacy, start-ups also had to manage power dynamics, establish competence and adapt identities to align with customer's internal hierarchies and incumbent ecosystems (Santos and Eisenhardt, 2005). The start-ups launched products in early stages of development and these ventures incorporated the feedback from various actors to incrementally change their identities (Ries, 2014). There was an outlier that preferred installing ready products in customer environments which is contrary to lean start-up (Ries, 2014). In addition, start-ups were flexible with boundaries, adapting and pivoting in response to feedback or pressures which is contrary to studies recommending start-ups lock in their core (Aulet., 2013).

This thesis contributes to BM studies. The findings are in line with existing studies that show emergence of BM through interaction between the firm and the external environment (Zott and Amit, 2007, Ahokangas et al. 2014; Iivari et al., 2016; Ahokangas and Myllykoski.,2014).

The theoretical contributions from this thesis are - boundary work leads to legitimacy and in some cases legitimacy challenges, while legitimation further propagates boundary work(Figure 27); Typology of boundary work (Table 18 Boundary Work Typology and Connection to Legitimacy), Key mechanisms, practices and challenges of boundary work (Figure 25 & Figure 26, Table 17); Pre-start-up boundary work (Figure 25); Key legitimacy outcomes of boundary work undertaken by IoT start-ups (Figure 27); The temporal and spatial dynamics of the legitimacy outcomes were discussed (Figure 28); Typology of boundaries (Table 17).

The claims this thesis makes based on the findings and analysis are the following - First, legitimacy functions as a condition for boundary work and not solely as its outcome; the relationship is mutually constitutive. Second, new ventures are not institutionally powerless, and this study specifies the conditions under which they successfully create institutional boundaries. Third, boundary blurring is a deliberate institutional strategy rather than something that is emergent based on existing studies. Fourth, legitimacy hacking constitutes a distinct mechanism in which ventures manipulate the evaluation pathway rather than the claim. Fifth, legitimacy outcomes vary in speed and durability and not only in degree and type.

Taken together, these claims support that legitimacy for IoT ventures is not acquired by conforming to existing boundaries but created by working on them; and because every mechanism that produces it also risks its erosion, legitimation can never truly be complete.

9.2.1 Relationship between boundary work and legitimacy

Existing work demonstrates that boundary work bears on legitimacy (Zietsma and Lawrence, 2010; Langley et al., 2019), but proceeds largely through single-case, single-sector accounts (Garud, Gehman and Karunakaran, 2014; Palmer, Owens and Doubleday, 2019; Faulconbridge, Sarwar and Spring, 2023). This study uses a multiple case study approach across sectors as discussed in section 3.3.

Prior research has primarily examined boundary work in terms of creation and maintenance (Katz and Gartner, 2016); work-life balance (Greenman, 2012); ecosystem formation (Neumeyer, Santos and Morris., 2018);the role of power, identity, competence and efficiency in driving boundary work (Santos and Eisenhardt., 2005; Santos and Eisenhardt., 2009); occupational boundary work (Langley et al., 2019). However, the role of boundary work in legitimisation remains underexplored. This study demonstrates IoT ventures use four types of boundary work namely, creation, management, bridging and blurring in their pursuit of legitimacy(Table 18)

For instance, start-ups blur the boundaries between digital and physical domain or between sectors or with regulatory domains to frame themselves as legitimate and innovative actors. However, achieving legitimacy through boundary work triggers legitimacy challenges. For instance, as start-ups gain acceptance by associating with popular categories like 5G or AI, they risk scrutiny and potential loss of legitimacy when evaluators identify misalignment between claims and capabilities. Similarly in growth stages, taking on additional roles such as advisory or authority which lie beyond start-up's technical expertise led to value conflict, damaging credibility. Gaining legitimacy creates conditions for further boundary creation such as reshaping ecosystems, creating standards or categories such as in the case of Nexum. When venture legitimacy is challenged, like YourPleasure developing IoT solutions in a taboo industry, they undertake boundary bridging work by engaging and gaining acceptance from gatekeepers and mentors and associated resource access. So, while boundary work facilitates legitimation, the gained legitimacy or contested legitimacy invites further boundary work as venture scaling efforts or facing and managing new evaluator demands.

Boundary work is positioned in existing scholarship as a means by which legitimacy is achieved (Zietsma and Lawrence, 2010; Langley et al., 2019). This study finds that acquired legitimacy is itself the precondition for boundary work that the venture could not previously attempt. Legitimacy licenses further boundary work, and because further boundary work reopens the boundaries that legitimacy had provisionally fixed, there is no equilibrium state in which a venture is legitimate and no longer working on its boundaries.

9.2.2 Boundary work contribution in context of IoT-based ventures

This research advances the understanding of boundary creation as a key strategy through which IoT start-ups legitimate their identities, offerings and market categories. Prior research has examined boundary work primarily in terms of configuration, differentiation, collaboration and competition (Gieryn., 1983; Zietsma and Lawrence., 2010; Langley et al., 2019). This thesis extends that by demonstrating how IoT start-ups engage in a multilayered process of boundary creation as discussed earlier in this chapter. At the individual level, founders draw on their expertise, knowledge and experience to identify and frame the initial

opportunity. At the firm level, opportunity or frame is translated into a formal structure through the formation of objective boundaries. This translation helps create a legitimate distinction between the venture and existing alternatives. At the technological level, boundaries are circumscribed around artefacts through their design and development. At the institutional level, it shows how IoT ventures construct field boundaries, redrawing or dissolving institutional norms in the process. Initial symbolic boundaries are tested and reified through interactions with evaluators and technological iterations, provoking resistance and challenge, leading to redrawing or boundary adaptation.

This research provides a typology of boundaries linked to legitimacy outcomes (Table 17).It shows that start-ups create, shift, manage, bridge and blur these boundaries in response to evaluator feedback, market needs, environmental changes. This boundary work is conducted iteratively and dynamically, contributing to existing literature on relational and contested view of boundaries (Langley et al., 2019). Further, the findings of this study show additional types of legitimacy based on speed and durability that are at present not drawn in literature. Incremental legitimacy is slow and more durable since evaluators validate the changes over time, enhanced legitimacy due to incorporation of regulatory norms and sectoral norms is acquired fast and sustained dependent on changing regulation, across contexts. Crisis legitimacy requires significant changes to identity, process and product and acquired slowly and lasts only during the period of the crisis. Lastly, legitimacy hacking is the fastest route, but loss is also fast.

This study shows that symbolic boundaries formed at ideation and pre-start-up stage through founder experience, identity claims and stakeholder narratives serve as a pre-cursor to objective boundaries such as patents, legal structures and governance frameworks. This builds upon existing work on boundaries (Lamont and Molnár, 2002) and legitimacy through distinctiveness (Snihur., 2016; Navis and Glynn., 2011) but introduces a novel idea - idea propriety and performative actions in translating symbolic boundaries to objective boundaries. This process demonstrates that legitimacy is not just external validation but an outcome of organisational work combining narrative construction and shaping rules and structures. Further, it extends the work on legitimacy as a process (Suddaby et

al., 2017) by showing that legitimisation is not simply a discursive process but also enacted through boundary interactions and evolution of artefacts.

Similarly, this thesis found that boundary management is necessary for legitimacy construction and maintenance (Suchman., 1995; Gieryn., 1983; Lamont and Molnar., 2002). It is crucial for start-ups to manage the complexities, ambiguities and institutional voids in the IoT category. It contributes to institutional theory literature by showing how ventures operating in a poorly defined and overhyped field need to continuously manage external and internal boundaries due to changing stakeholder expectations, environmental jolts, institutional constraints and existing power structures (Aldrich and Fiol., 1994; Navis and Glynn., 2011). Further, as organisational boundaries get knotted with existing social networks, start-ups leverage personal networks and insider knowledge to access resources.

Findings show that boundary management as a dynamic capability that enables new ventures to sustain legitimacy and growth even during crises. Robust boundary management signals a venture's technological and organisational credibility (Eisenhardt and Martin, 2000; Zimmerman and Zeitz, 2002a; Santos and Eisenhardt, 2009). It advances the literature on boundary management in entrepreneurship by shifting the analytical lens from individual entrepreneurs and family firms to new ventures developing complex and disruptive technology (Jacobides and Winter, 2007; Sundaramurthy and Kreiner, 2008; Greenman, 2012; Tisenkopfs *et al.*, 2015; Bacco and Comacchio, 2019). The research focuses on how managing both internal and external boundaries contributes to new venture legitimacy. It highlights the role of temporality in boundary management by showing how disruptions prompt a re-evaluation of existing norms and identity pivots, supporting previous work on institutional change (Tost, 2011). Further, by showing the IoT specific boundary integration, this thesis shows that boundary management is not just symbolic but also embedded in project management and system design practices. It contributes to institutional entrepreneurship literature by showing that micro-level boundary practices such as selective participation, network calibration and identity adaptation facilitate macro-level legitimacy outcomes i.e., adoption and scalability.

This thesis extends the existing understanding of boundary bridging by showing how entrepreneurial artefacts such as PoCs and business models function as boundary bridging tools (Johnson, Joshi and Kreiner., 2023; Ren., 2019). Artefacts are held to coordinate across communities precisely because they do not require consensus (Garud, Gehman and Karunakaran, 2014). However, interpretative flexibility is a liability for legitimation as ventures are obliged to resolve divergent preferences for an artefact such as a business model. Investors' preference for subscription-based BMs and customers' preference for one-time payment could not be left unreconciled, because each audience's judgement of the venture rested on the artefact meaning what that audience took it to mean. Interpretative flexibility is great for co-ordination but not for judgement.

Another key contribution is the overlap between boundary bridging and technology work, enriching existing organisational work literature (Lawrence and Phillips., 2019). Monitor's resolution of the conflict between its customers' safety values and the societal value of privacy was accomplished by redesigning the sensing artefact, and CleanCooking's reconciliation of environmental with economic values by incorporating a pay-per-use feature. In each case values work was performed on and through a boundary, and it was the boundary that carried the resolution to evaluators. The same holds for technology work, which registered as evidence of competence only where it altered a boundary an evaluator was assessing. For new ventures, boundary work is the integrating form of socio-symbolic work rather than one member of a set. Boundary work was the way through which values work and technology work became consequential for legitimacy.

While much of the literature discusses the functional aspect of boundary bridging, this study highlights the darker side of boundary bridging leading to reputational damage and identity instability and contributes to the existing dark side of entrepreneurship literature (Rossi et al., 2022; Garud, Gehman and Karunakaran., 2013; Wright and Zahra.,2011; Gehman and Wry.,2022).

Prior literature differentiates between boundary bridging (formal structured knowledge exchange) and boundary blurring (informal, emergent and continuous

practices), this thesis takes it a step further by analysing boundary work through the lens of development, design and integration of artefacts as well as the symbolic bridging and blurring between organisations and categories (Rossi *et al.*, 2022). This thesis shows that IoT start-ups don't just engage in boundary blurring to facilitate knowledge exchange but also to influence institutional norms, manipulate perceptions held by evaluators and negotiate power dynamics. This thesis aligns with existing studies on boundary blurring as a legitimacy strategy through multicategory membership and role adaptation but diverges by highlighting how start-ups blur technological, regulatory, organisational and ethical boundaries to achieve their goals (Santos and Eisenhardt., 2009). These ventures conform to existing standards and co-create new ones - blurring the lines between compliance and manipulation (Suchman., 1995). This shows that new ventures developing powerful, generative technology are not simply passive recipients of institutional pressures but active agents who manipulate their environment and enable others to do the same (Zimmerman and Zeitz., 2002; Kuratko et al., 2017).

This thesis contributes to existing organisational work literature by demonstrating the overlap between values work and boundary work (Lawrence and Phillips, 2019a; Askeland *et al.*, 2020). As start-ups adjust their identities, they blur boundaries between conflicting values, roles and categories. This flexibility aids in legitimacy acquisition but also causes tensions such as surveillance concerns, identity confusion and values conflicts (Wright and Zahra, 2011; Zuboff, 2019). Boundary blurring not only helps start-ups adapt to multiple environments but also enables them to reshape their environment, contributing to the current strand of literature on external enablers on entrepreneurship (Kimjeon and Davidsson, 2022). Through boundary blurring, start-ups raise entry barriers for others, reinforcing their own legitimacy and market position as leader in the category. Thus, entrepreneurial action feeds back to the external environment, showcasing a bidirectional relationship between boundary work and institutional change.

Finally, this research shows how IoT specific dynamics blur digital, physical and organisational boundaries, with business models and technologies altering power structures, user identities and governance of data. These findings contribute to calls for studies focused on understanding the implications of industry 4.0

technologies on entrepreneurship and entrepreneurial legitimacy (Chalmers, MacKenzie and Carter, 2021)

9.2.3 Entrepreneurship contribution

Entrepreneurship literature discusses that creation, and manipulation strategies are difficult for new ventures to gain legitimacy (Zimmerman and Zeitz.,2002; Karlsson and Middleton.,2015). Existing ecosystem legitimacy literature discusses the role of linked legitimacy in legitimating new business models (Press, Robert and Maillefert, 2020); ecosystem legitimacy emergence (Navis and Glynn., 2010), importance of multiple ties in alliance portfolio and ecosystem value creation (Ozcan and Eisenhardt, 2009; Hannah and Eisenhardt, 2019) but considers new ventures as peripheral actors in an ecosystem. Institutional entrepreneurship literature has focused on mobilization challenges and the importance of social and political skills to sponsor own technology standards as illustrated in the SUN microsystems – Java case (Garud, Jain and Kumaraswamy, 2002) or the importance of identity work in gaining legitimacy as platform leader such as the case with Intel- PC interface (Gawer and Phillips, 2013).

IoT based entrepreneurship literature has focused on strategies for building IoT business (Bucherer and Uckelmann, 2011), entrepreneurial opportunities in IoT (Jami Pour, Hossainzadeh and Moradi., 2024; Brown, 2017), the growth strategies undertaken by IoT SME's (Shin, 2017); challenges in IoT design for IoT developing companies (Bergman et al., 2018); success drivers of IoT based business models (Boehmer et al., 2020; Falkenreck, Leszczyński and Zieliński, 2023) start-up responses to regulatory constraints (Andersen *et al.*, 2020b); ethics in IoT development (Ustek-Spilda, Powell and Nemorin, 2019); roles of intermediaries in supporting IoT ventures ecosystem (Rossi *et al.*, 2022). This thesis shows how IoT based ventures use boundary work to adapt their identities and get legitimised. It illustrates how IoT venture identity is pivoted and adapted in response to external feedback. Further, it also reveals how tensions between core and projected identities arise when start-ups conflate roles leading to legitimacy contestation. It connects to IoT business model literature by showing drivers of change in IoT start-ups business models, namely availability and exploitation of data, opportunities for service expansion through collaboration with partners, creating

business ecosystems with partners possessing complementary offerings, outsourcing non-core functions and developing go-to-market partnerships.

This study contributes to limited literature on specialist accelerators by revealing the selection criteria and the value add for IoT start-ups in an IoT or hardware specific accelerator (Colombo and Grilli, 2007; Wenzel and Koch, 2018; Cohen *et al.*, 2019; Hallen, Cohen and Bingham, 2020). The study found that in the pre-acceleration phase, strategies such as developing relationships with accelerator insiders influence selection of the venture in the program. Existing studies on VC and entrepreneurship literature focus on the criteria necessary for investors to select or evaluate a new venture (Fried and Hisrich, 1994; Mason and Harrison, 1996; Mason and Stark, 2004b; Becker-Blease and Sohl, 2015).

This study strengthens existing VC and entrepreneurship literature by providing evidence of the ways in which start-ups develop and lean upon social ties in order to build reputation, reduce perceived information asymmetry, build team cohesion and demonstrate adaptability. Ventures can use creation and manipulation strategies to gain legitimacy but have to combine those efforts with a suitable business model and ecosystem strategy. Start-ups need to establish relationships with powerful actors to co-opt their legitimacy, develop an ecosystem and establish themselves as the innovator in the domain to be able to create widely accepted and adopted industry standards.

Ventures in this study incorporated evaluator feedback to change their identities incrementally and launched products at early stages of development, consistent with validated learning (Ries, 2014); one venture, however, declined to do so, installing finished products in customer environments, and secured legitimacy on the strength of demonstrated reliability rather than iteration. More substantially, ventures remained deliberately flexible at their boundaries, adapting and pivoting identity, product and BM in response to evaluator feedback and environmental pressure. This runs contrary to the recommendation that ventures fix and defend a core (Aulet, 2013). The findings here suggest the recommendation holds for ventures operating in settled categories and understates the cost of rigidity for ventures in categories whose definition is itself contested, as IoT remains.

9.2.4 IoT management and strategy

This thesis contributes to existing literature on IoT management and strategy. Existing IoT based literature focuses on business models, affordances, external enablers, leadership, innovation ecosystems and incumbents IoT focused transformation (Maheswaran and Misra, 2015; Lucero, 2016; Nicolescu *et al.*, 2018; Naik *et al.*, 2020; Falkenreck, Leszczyński and Zieliński, 2023; Jami Pour, Hosseinzadeh and Moradi, 2024). This thesis contributes to this strand of literature by showing how IoT specific affordances form an essential part of legitimacy building and reshape power structures. IoT capabilities cause a blurring of digital and physical spaces, creating a demarcation between data subjects and beneficiaries such as in the case of Monitor, BabyCradle, BabyWearable and others. Further, this thesis discusses the normative concerns associated with IoT design and deployments and their impact on legitimacy.

9.2.5 Business Model Contribution

This study looks at both business models and its components as artefacts that are impacted by boundary work. It shows how IoT start-ups use boundary work to adapt their business models for legitimacy building (Teece, 2010; Massa and Tucci, 2013; Ahokangas, 2014). They reconfigure and adapt their customer segments, value proposition, key offerings to align with evaluator expectations and institutional norms (Osterwalder and Pigneur, 2010). This study strengthens business model theory by highlighting how legitimacy concerns drive these start-ups to evolve their business models, shifting from B2C to B2B, bundling products and services, forming partnerships with incumbents, to gain credibility and access resources. It expands business model literature by linking it with organisational work.

9.2.6 Bringing together opportunity as design and organisational work perspectives

The use of boundary work to study legitimisation of new ventures helps to further shed light on the process of opportunity development in the context of technology-based ventures (Dimov, 2003). In addition, the use of boundary work also aligns

with the design perspective in entrepreneurship in which artefacts are seen to shape and be shaped by individuals and environment (Dimov, 2016; Berglund and Dimov, 2025). By use of boundary work, this thesis takes the design perspective one step further by examining the efforts undertaken to design the context in which the new ventures are deemed legitimate as well as reconciling artefact boundaries between different evaluators and lastly introducing the role of power in the shaping of new ventures and their artefacts.

Artefacts shape and are shaped by individuals and their environment (Dimov, 2016; Berglund and Dimov, 2025). But this stream of research is largely silent on the asymmetry of the exchange. Customers extracted unpaid proofs of concept and used business development discussions as feedback sessions while shopping for alternatives; ventures ceded control of products to align entirely with a single customer's expectations, acquiring that customer at the cost of the ability to serve others. The artefact was shaped, but not by the venture. This study finds the capacity to design relevant artefacts unevenly distributed; this capacity depends on the venture's position in the industry. At the other extreme, ventures exercised instrumentarian power over end users through the data affordances designed into their products, positioning themselves as obligatory points of passage within their ecosystems. This shows that designing the artefact, grants the power to design the context within which the individuals operate.

Type	**Description**	**Connection with legitimacy**
Boundary Creation	Start-ups establish symbolic and objective boundaries to define their identity, establish authority and differentiate from existing solutions. This includes patents, legal structures, and expert boards.	Creates legitimacy by signalling expertise, distinctiveness, and credibility to stakeholders (investors, customers, regulators).

Boundary Management	Start-ups continuously modify their boundaries in response to external environment including macroeconomic jolts. They manage both internal (team, operations) and external (stakeholders, regulatory) boundaries.	Helps maintain legitimacy by adapting to changing market conditions, industry norms, and stakeholder perceptions
Boundary Bridging	Connecting across boundaries to facilitate knowledge transfer, stakeholder engagement, and legitimacy-building. This includes developing boundary objects (e.g., proof-of-concepts) and narratives to make technical solutions accessible to non-experts.	Increases legitimacy by making the start-up's value proposition understandable and acceptable to different stakeholders. However, it can also lead to overpromising and reputational risks.
Boundary Blurring	Start-ups blur boundaries between different categories, industries, and regulations by adopting multi-category membership, collaborating with incumbents, and influencing standards. This can also include regulatory loophole exploitation.	Enhances legitimacy by signalling conformity to dominant industry practices but may also lead to ethical concerns, values conflicts, and potential loss of legitimacy

Table 18 Boundary work type and connection to legitimacy

9.3 Implications

9.3.1 Implications for IoT entrepreneurs and Ventures.

Start-ups inherently struggle with liabilities of newness due to limited resources and non-existent reputation (Stinchcombe, 2000). Symbolic and material manipulation of a new venture is undertaken in order to overcome these liabilities of newness and attain legitimacy (Zimmerman and Zeitz, 2002a; Navis and Glynn,

2011; Kuratko *et al.*, 2017). IoT-based companies have to address additional liabilities other than the ones faced by software only companies and require funding from the initial development of prototypes to field deployments (Navis and Glynn., 2011). Decisions related to stakeholder acceptance, business models, technology and practice all impact organisational boundaries and organisational legitimacy. The challenges presented due to lack of informational and financial resources relate to route-to-market, value creation and capture and technology development.

For IoT start-ups, establishing legitimacy is about demonstrating distinctiveness as well as conforming to stakeholder expectations and regulatory requirements. Based on the findings, this section talks about some of the best practices the start-ups adopt to gain legitimacy and highlights the risks associated with the strategies as well. These implications serve as a set of guidelines that IoT start-ups can use to ease the journey of gaining and maintaining legitimacy. Further, this also provides an overview of the challenges that IoT start-ups face and the illegitimate means to gain legitimacy which policymakers can draw from to guide policies that encourage the growth of start-ups as well as ensure ethical business practices, prevent market distortions, and promote a competitive and transparent innovation ecosystem.

IoT start-ups face a number of challenges including but not limited to sector level challenges such as failure to meet hype, lack of interpretability, lack of explainability, long production cycles and complex business models. There are further venture level challenges including requirement of capital to invest in development of physical prototypes and manufacturing, supply chain dependencies, the push to demonstrate effectiveness of PoC or prototype without occurrence of adverse events, incomplete product features to get early customer feedback, lengthy time-to-market, tension between stakeholders demanding different business models. These are all barriers in the way of establishing credibility.

The cohort of start-ups addressed the credibility challenge by creating and extending boundaries around their products, business models, and even entire industries. This process often begins with founders leveraging their personal or

professional experiences to identify a niche. Establishing formal boards or advisory teams composed of domain experts and successful entrepreneurs strengthen a venture's perceived authority. Gatekeeper endorsement helps start-ups gain "insider" status. Start-up founders focused on creating distinct offerings in the pre-startup stage and narrow target market in the beginning. This is in line with popular practice of selecting a beachhead market (Aulet, 2013). Forming partnerships with established players enhances credibility and resource access, while early market validations through pilot projects or proofs of concept allow them to demonstrate tangible benefits. Additionally, aligning products or services with existing and future regulatory norms—particularly during the early stages—helps start-ups avoid future roadblocks and signals dependability to customers and investors. Adapt product features or business models to different cultural and market contexts further mitigates the impact of liabilities of newness. For a start-up in a growth stage with innovative offering, a way of establishing legitimacy is by becoming an industry standard.

One of the ways in which some start-ups went about seeking legitimacy is defining a new field or an existing field's boundaries. The start-ups did this by creating new industry norms that dictated what a legitimate technology looked like in their domain and contributing to the creation of new policies. It is worth mentioning that with one exception, most of these start-ups creating norms were developing technology with high novelty claims and had captured a significant share of the market. These start-ups partnered with incumbents in the domain to lend legitimacy to these changes. In an ecosystem, start-ups used a similar approach of forming partnerships with anchor firms to gain legitimacy from the rest of the ecosystem. While mature start-ups tried to influence business configurations, start-ups at all stages tried to build their networks, gauge initial interest as well as gain legitimacy by participating in events.

Start-ups kept interacting with individuals and organisations at various events to position their offerings as well as get an understanding of the market requirements. They used some of these inputs to influence the future product and business model trajectories. However, to get value from engaging in these activities, the start-ups were very selective about the events they attended and the individuals they approached to build their networks. There are other practices

such as creation of funnel and leveraging referrals that were adopted by these companies. Although such strategies helped these companies attract investment and market traction, early-stage start-ups still developing their identity, need to balance these strategies with a sustainable product roadmap and financial discipline. Besides, participation in industry events, these start-ups also engaged with accelerators and potential strategic partners. If not undertaken with consideration, this participation only leads to short term success as start-ups end up working on diverse use cases without focusing on their core mission.

Further, targeted stakeholder engagement helps IoT start-ups secure the trust necessary for scaling their operations. These companies identified insiders from these organisations as well as funding organisations who could provide them with information about the key criteria that would increase the legitimacy of their application. By actively engaging with potential customers, investors, and industry partners, start-ups translate their complex IoT solutions into compelling value propositions that resonate with each stakeholder's priorities. For instance, pilot projects or proof-of-concept (PoC) demonstrations help establish credibility by providing tangible evidence of the solution's capabilities in real-world settings. However, these bridging activities can be resource intensive. Additionally, leveraging insider networks beyond criteria identification, to bypass formal evaluation processes can eroding trust among broader stakeholder groups. In the case of deploying or piloting for customers, when start-ups invest heavily in pilot deployments or extensive demos without concrete commitments from potential clients, they risk depleting their limited funds. Power imbalances may cause potential customers to exploit start-ups for product trials or insider knowledge without genuine intent to purchase. In these scenarios, founders can waste valuable time and resources attempting to satisfy demanding prospective clients who opt for established competitors or develop in-house offerings. Similarly, repeated pivots to align with varying stakeholder demands can dilute a start-up's focus and lead to product confusion. Start-ups may also face biases from some of these organisations and their gatekeepers that they must navigate. The start-ups in this research persisted in asking the right questions to multiple stakeholders till they found those who provided them with the right responses. But this can also cause start-ups to use convoluted frames and risk long term credibility. Start-ups

should resist the temptation of exploiting information asymmetry and avoid spurious claims.

To overcome the challenges cited earlier, start-ups use multi-category membership where the venture strategically positions itself in multiple technological domains—such as IoT, AI, and 5G—to broaden stakeholder appeal. Multi-category membership also means that start-ups use multiple types of values (social, environmental) beyond those associated with technical or functional benefits (such as safety or efficiency). By carefully framing their role—as both a technology provider and an expert in the problems they aim to solve—they can position themselves as an industry authority. While the integration of multiple technologies can enhance a start-up's appeal, over-association with buzzwords such as AI or 5G without fully developed capabilities creates a perception of tech-washing and erodes stakeholder trust, stigmatizing the venture. This risk is compounded when the start-up's identity becomes too diffuse in pursuit of legitimacy—straddling roles as technology vendors, data brokers, and even advisory figures—which can confuse key stakeholders or cause a wastage of resources. 'Relevant' content is created to feature high in search rankings, increase visibility consequently signalling legitimacy for the venture. This becomes problematic when the content is advice or recommendation beyond a start-up's technical capability or beyond the data it owns. Start-ups' need to be transparent about the source of the information and ensure it is ethically and legally legitimate. Further, the start-up's role while adaptable, must be made transparent, by undertaking many roles across domains, these companies confuse customers, investors, and even internal teams about the company's true mission. In ecosystems where a start-up positions itself as an anchor, it can be seen as a challenge to existing power structures. Finally, as start-ups grow, an absence of coherent internal strategies and transparent communication can exacerbate these challenges, resulting in conflicts among different stakeholder groups and ultimately diminishing the venture's legitimacy.

Legitimacy hinges on how well IoT start-ups align expectations between themselves and their stakeholders. Successful start-ups develop a shared language or set of boundary objects—such as easy-to-understand dashboards, data analytics tools, or ROI models—that clearly communicate how the technology solves pressing

customer problems. Continuous adaptation and close collaboration with key users also promote legitimacy, as customers witness iterative improvements that address real-time feedback. Transparency in business model alternatives can further solidify trust, for example by offering different pricing tiers or feature sets based on customers' readiness for digital transformation. These practices cultivate a perception of fairness and choice, thus mitigating concerns about unproven technology. Nonetheless, start-ups must ensure they do not overpromise during this process. A risk is that the alternatives offered to customers are unsuitable and only provide a perception of choice which could also lead to stigmatization.

External shocks like pandemics, supply chain disruptions and geopolitical instability further complicate a start-up's pursuit of legitimacy, forcing ventures to juggle short-term problem-solving with long-term strategic positioning. Temporary pivots to manage new norms due to environmental jolts may result in short term legitimacy. But if the pivot has no bearing on long term business operations then pursuing it is a waste of valuable resources.

IoT deployments inherently involve a convergence of physical and digital realms; there exists a constant tension between ensuring robust security and preserving user privacy. If not carefully managed, these conflicts can result in regulatory scrutiny and a loss of market legitimacy. While boundary work offers IoT start-ups a pathway to differentiation and rapid market entry, it must be balanced with a clear, consistent identity and a focused strategy to mitigate the potential downsides. Finally, maintaining synergy between hardware and software components—fundamental to IoT solutions—demands continuous boundary negotiation between internal teams, a process that can become fraught if product timelines or engineering priorities diverge. Pursuit of legitimacy and growth must be undertaken with transparency, ethical conduct, and a focus on consistent value delivery to avoid undermining a start-up's credibility.

To conclude, IoT start-ups face unique hurdles, requiring early-stage funding for both hardware and software development, as well as strategic moves to establish credibility. To achieve market legitimacy, they must balance innovation with industry alignment—build partnerships, secure regulatory approvals, and engage

key stakeholders. Successful start-ups carve out industry influence by shaping norms, leveraging endorsements, and strategically positioning themselves across multiple tech categories, though overuse of buzzwords can damage trust. Engaging potential customers and investors through pilot projects and networking helps secure resources but also carries risks like resource drain or misalignment with core business goals. Long-term success depends on continuous and considerate product and business model evolution, transparent communication, ethical business practices, and a well-defined market positioning strategy to sustain credibility and growth.

9.3.2 Policy implications

The findings of this thesis also informed an accompanying policy white paper, *Supporting the Creation and Growth of IoT-based New Ventures*, prepared for the LNETN network. It translates the study's account of how IoT ventures legitimate themselves — and the boundary-work challenges they face — into regulatory and non-regulatory recommendations for EU policymakers and venture-support organisations. The white paper thus serves as the primary impact and dissemination output of the research, extending its contribution from theory to practice and aligning it with the EU's IoT agenda and the UN Sustainable Development Goals.

9.3.3 Future Research and Limitations

This research has several gaps which can be studied further. This research found broadly four boundary work strategies, however there are some overlaps between these strategies. For instance, there is some overlap between boundary creation and blurring when it comes to institutional impact effected by start-ups. While boundary creation looks at it from the lens of creation of boundaries at the institutional level, boundary blurring examines it from the perspective of manipulation. Further studies could focus on clearing the distinction between the two and examining this from the point of view of a start-up on the other side of this institutional change. This research would also benefit from separating the discussion on internal and external boundary work. Instead of focusing on different types of strategies incorporating internal and external boundary work, examining simply internal and external boundary work would provide a more comprehensive view of how different actors manage organisational challenges and stakeholder

expectations. In addition, this research's sample included start-up leaders, accelerators, investors and other venture development organisations. However, due to the higher number of start-ups, the findings are biased by the data collected about the start-ups. This could be mitigated by incorporating responses from more investors, accelerators and venture development organisations. The examined start-ups were a mix of early stage, growth stage and mature organisations. Focusing on start-ups at specific stages would shed a brighter light on the unique challenges of each stage and the role of boundary work. A longitudinal approach could also examine how the start-ups change their boundary work strategies in response to changing market conditions.

This research found several practices undertaken by IoT start-ups to gain legitimacy, therefore there is some scope for examining the interplay of practice and boundary work which has not been explored here. Further, empirical studies are needed to establish causal links between specific boundary management strategies and long-term venture performance. Quantitative or mixed-method research could assess how variations in boundary creation, bridging, and blurring correlate with financial performance, customer adoption, and sustained competitive advantage. Such work would provide actionable evidence for practitioners and policymakers aiming to promotes innovation in the IoT sector. This research discussed the role of boundary management in managing external jolts, but this could be extended further by diving deeper into the aspect of temporality i.e. how these jolts accelerate the need for legitimacy and force temporary or permanent pivots. While this research establishes the practices followed for the translation of symbolic boundaries to objective boundaries, a promising direction is to investigate how social norms, and regulatory frameworks influence this translation.

Additionally, there is room to examine the ethical and trust-related implications of boundary blurring. As IoT ventures increasingly blend multiple technologies and domains, understanding how overpromising or ambiguous communication affects stakeholder trust and data privacy is critical. Future research could focus on the potential downsides of excessive boundary blurring, including the risks of stakeholder scepticism and reputational damage. A related examination could be on the boundary work

Further exploration into the role of social networks and power dynamics in legitimising IoT ventures could prove insightful. Investigating how investors, venture development organisations, and customer communities co-construct and negotiate these boundaries would deepen our understanding of the collective nature of legitimacy. Such research might also illuminate how insider networks and informal access points shape the overall ecosystem, particularly during periods of external shocks like the COVID-19 pandemic or supply chain disruptions.

Finally, the advent of generative AI will impact the legitimation process of IoT start-ups. This research highlights the exaggerations employed by IoT start-ups as it pertains to non-existent capabilities. Generative AI might make it easier for start-ups to fulfil those claims (Chalmers, MacKenzie and Carter, 2021; Simaremare, Triando and Rico, 2025), on the other hand it might make it easier for start-ups to continue legitimacy lies and deceive evaluators. This research would benefit from an exploration into how generative AI enables IoT start-ups to fulfil their promises.

9.4 Conclusion

Boundaries are a taken-for-granted institution that have existed since time immemorial. Individual and institutional actors create, manage, bridge, blur boundaries every day to navigate their environment. The impact of boundaries can be seen in subtle boundary work being performed to adhere to the culturally embedded Jante law to the physical boundary work performed to demarcate nations. Boundaries do not just separate but also define what they encapsulate and set limits of what is deemed acceptable or legitimate and what isn't. When it comes to new ventures particularly those developing new technologies with an inherent power to create and disrupt institutions, using boundary work helps understand the processes followed to gain legitimacy or provoke challenges to their legitimacy.

This study focuses on the legitimisation efforts of IoT start-ups through boundary work across venture stages impacting the venture and artefact legitimacy. This is important because IoT start-ups develop products and technologies that serve as a catalyst for higher impact technologies like AI. Further, IoT products and

technologies are known to drive business model changes. This crucial, foundational role of IoT cannot be stressed enough.

IoT ventures operate in disparate fields. Some fields have clearly defined norms and in other fields, norms are in flux. This variation with the combination of a technology with a significant potential for user exploitation and lack of norms and definitions, makes legitimacy for IoT ventures an ongoing challenge. Since a common consensus on IoT definition is lacking amongst organisations building IoT and organisations evaluating it (Pandey, Chalmers and Gordon, 2024), ventures building IoT-based products and solutions, find it difficult to explain the inner workings of IoT to prospective stakeholders. This includes the functionality but also interpretability and explainability.

Given the uncertainty and ambiguity surrounding IoT, start-ups heavily rely on gaining acceptance from their stakeholders and getting access to resources to survive. At the pre-start-up stage, founders undertake boundary work by engaging with multiple evaluators to refine their identities and artefacts. Founders articulate and develop distinct identities and value propositions formalised through actions such as feasibility testing, patents and legal structures. Sometimes start-ups also create new institutional norms through the formation of alliances with incumbents and ecosystems to gain legitimacy. These ventures also adapt their boundaries to conform with existing standards and regulations. Start-ups must also undertake boundary bridging as they scale, to translate technical innovations to narratives understood by stakeholders, to align with diverse evaluator expectations, gain insider status to increase likelihood of acceptance, increase the understandability of IoT, support the creation of new norms and institutional change. This enables start-ups to communicate across different stakeholders, build trust and gain legitimacy.

Start-ups also undertake boundary management which is important for them to maintain a coherent identity while adapting to market demands and evaluator expectations. Boundary blurring allows stakeholders to operate at the intersection of multiple domains making it easier for new ventures to gain legitimacy from diverse groups and align with trends. It facilitates ecosystem partnerships and multicategory memberships. However, while it supports early-stage flexibility, it can also result in undermining start-up credibility. Furthermore, boundary work

and legitimacy share a recursive relationship as boundary work enables the acquisition of legitimacy that further requires boundary adjustments. This allows ventures to continuously adapt and sustain legitimacy within evolving institutional contexts. However, these forms of boundary work need careful consideration as it can also lead to value misalignments, lack of coherence, role blurring, increased chances of exaggeration and misinformation, power imbalance, exploitation - ultimately undermining the start-up's legitimacy. These findings can be extended to other start-ups and organisations developing products or technologies that have a panoptic nature.

This study shows that IoT start-ups legitimisation is a dynamic process involving boundary work across institutional, firm and artefact levels. The changing technology landscape, rapidly evolving institutional norms and practices and diversity of evaluators mean that legitimisation is never truly complete. Legitimisation requires pivoting and shaping of new venture identities, narratives, relationships with evaluators, institutional norms and artefacts. This study illuminates how IoT start-ups' and their business model legitimisation unfolds through boundary work, as they navigate the process of gaining traction as well as faltering in their efforts to shape their product or technology and demonstrating their value to evaluators.

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Appendix

A1 Memo Snapshot
Date – March 15, 2023

Business Model Evolution:

As the product has evolved, the business model of the venture has evolved as well. This is visible from the change in the product's customer segment, pricing model and value proposition.

The founder started off with the vision of a **B2B approach** i.e. selling the products to private and government hospitals and clinics. Developing B2C product.

Geographically, the founder is focused on developing countries where he could bring in an affordable mobile application and built in modularity so that it could be utilized in low resource as well as high resource health care settings. Initially the product was created and tested for the Indian market, but after receiving CE and ISO certifications, he has received interest from other countries in Southeast Asia and Africa where he has begun exporting.

Problem:

In the interview with the researcher, he says IUC (intrauterine contractions) is actually monitored inaccurately and ignored 85% of the time. He says that nurses are overburdened with a lot of documentation including registration, during and post op care. When there were machines like cardiotocograph being used, they were expensive and required skill for use and interpretation of results (which are in graphical format). From a work perspective, he studied the current processes of pre-delivery care in hospitals in India and found that in many places nurses would measure intrauterine contractions (IUC) frequency, intensity, and duration by placing their hand over the expectant mother's abdomen. Based on this research he concluded that the problem is of decentralized monitoring, affordability and accessibility.

Vaue proposition:

In his 2016 pitch in Berlin, he said – "Uterine contraction is one of the important parameter during labour period to track the labour progress and diagnose labour complication […] our solution is a low cost, easy to use device […] it takes the data

of uterine contraction […] does the processing internally and provides number, duration and intensity of contraction […] it is priced under $300 in comparison to existing device priced at $2000."

Adaptation:

After getting feedback from potential customers on intra uterine monitoring, he realized that by increasing the number of parameters monitored, he could increase the target market size.

Change in value and market:

In 2019, he pitched that "foetal heart rate and intrauterine contraction are important parameters to monitor health of mother and foetus, but they are measured inaccurately or ignored 85% of the time […] existing device available in market, is not affordable for developing countries, it's difficult for nurses to use, not comfortable for mother, it prints the output in graphical format that requires an obstetrician to interpret the graph and India has 50 to 60,000 obstetricians for over 30 million births per year[…] this [the venture's product] is a patch based device[…] monitors foetal contraction, maternal and foetal heart rate[…]super easy to use[…]generates a WHO recommended partograph[…]we've already reached 116 hospitals."

Customer Feedback:

The founder also realized after deployment in different settings that some customers didn't want the complete set of features offered by their software application. So, he decided to create two variants to address this customer need. In 2023, he pitched in a popular TV funding show. In the pitch he spoke about three products – Patch sensor-based product made of silicon and plastic that can be placed on mother's abdomen, Software which can be connected to the patch device and wearable for foetal monitoring.

Prioritizing customer needs:

After confirming market need of a home monitoring solution, he has started focusing on the B2C segment of expectant mothers – and has expanded his product portfolio to include the wearable watch for mothers to use at home. one time patch device cost and annual software subscription. difficulties in getting funding

from investors who wanted him to adopt a monthly recurring revenue based pricing model. However, he based it on his customer's preferences as his market included maternity hospitals and clinics of different sizes.

A2 Tables

Source	On Legitimacy/Legitimation	Categories
Singh, Tucker and House, 1986	Organisations that do not have external legitimacy face a constant/increasing hazard of death. Internal organisational changes do not correspond to increase in death rate except CEO change.	External Internal
Elsbach and Sutton, 1992.	Legitimacy is conferred when internal and external stakeholders endorse and support organisational goals and activities. However, illegitimate actions can lead to publicity and subsequent endorsement amongst segment that supports these actions.	Legitimacy, Illegitimacy
Aldrich and Fiol,1994	Legitimacy is used in two senses: (a) how taken for granted a new form is and (b) the extent to which a new form conforms to recognized principles or accepted rules and standards.	Cognitive Socio-political
Suchman, 1995	Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions. Strategies proposed for organisational legitimacy.	Pragmatic Moral Cognitive
Zimmerman and Zeitz, 2002a	Legitimacy is a relationship between the practices and utterances of the organisation and those that are contained within, approved of, and enforced by the social system in which the organisation exists.	Socio-political-Regulatory Socio-political-Normative Cognitive Industry
Pfeffer and Salancik, 2003	Legitimacy is a conferred status and thus controlled by those outside the organisation, known more readily when it is absent rather than present. With change in socially accepted norms and values, organisations need to change their actions to fit into the established definition of legitimacy. Legitimacy can be a greater problem for organisations engaging new forms of organising or activity as well as when different types of organisations compete for the same resource, activities or domain.	Social Legitimacy

Greenwood and Suddaby, 2006	Cognitive legitimacy develops from rhetoric and opposition or support of new organizing forms due to rhetoric. Legitimacy is based on comprehensibility in early stages of new ventures. Rhetorical Strategies combine theorizations' of change and institutional vocabularies	Ontological, Historical, Teleological, Cosmological , Value based rhetoric
Hudson, 2008	Legitimating, Delegitimating and Illegitimating processes are social contests between evaluative audiences. The outcome of the social contests decides if an organisation is legitimate or illegitimate. If an organisation is illegitimate- not just lacking legitimacy but negatively evaluated by audiences, it can be core stigmatized.	Core Stigma Event Stigma Transfer Stigma
Meyer, 2012	Modern organisations legitimate themselves as specific instances of models that are universally true, and they spread their models wisely through the use of actors and others.	External Internal
Drori and Honig, 2013	Internal legitimacy is the acceptance or normative validation of an organisational strategy through the consensus of its participants, which acts as a tool that reinforces organisational practices and mobilizes organisational members around a common ethical, strategic or ideological vision.	External Internal Charismatic Symbolic
Becker-Blease and Sohl, 2015	Legitimacy is a resource that enables access to more resources, which increases legitimacy further.	Socio-political Cognitive
Suddaby, Bitektine and Haack, 2017	*Legitimacy as a property*: Legitimacy is understood as a commodity that can be possessed or exchanged between organisations and can even "spillover" to other organisations and objects. *Legitimacy as a process*: structured set or sets of formal or emergent activities that describe how an actor acquires affiliation with an existing social order or category. *Legitimacy as a perception*: set of microlevel socio-cognitive processes that lead to a formation propriety judgements and emergence of a collective consensus judgment (validity) about legitimacy of that object.	
Yang and Aldrich, 2017	External Legitimacy can be affected through delineating boundaries in terms of showing a consistent face to stakeholders and by complying with the requirements of and subsequently getting accepted by well-established institutions.	
Kuratko et al., 2017	New ventures are unknown, poorly understood and suffer from a lack of legitimacy in their ecosystem. They need to establish legitimacy both within their ecosystem and outside through	Conformance , Creation, Selection and Manipulation

	the process of creation/maintenance of legitimacy and its diffusion.	
Fisher et al., 2017	New venture legitimacy criteria vary across different new venture audiences, and entrepreneurs can use techniques like emphasis framing and rhetoric to establish venture legitimacy among different audiences when seeking resources for a new venture	
Wang, Thornhill and De Castro, 2017	Legitimation provides resource acquisition and capability development to exploit entry opportunities. It magnifies returns from an entrepreneurial orientation.	Cognitive, Normative, Regulative
Bitektine and Nason, 2019	Legitimacy is not only a perception or an attribute of an entity (organisation or category), but a complex social process of production, reproduction, and adjustment of evaluators' legitimacy judgments about it.	Public Administrative Legal Interactional
Partanen et al., 2020	Network partners provide legitimacy and performance benefits for small firms.	

Table 19 Definitions and categorisations of legitimacy in existing literature

Legitimate Authority	**Definition**
Traditional	Legitimacy of those actors whose authority rests on traditional institutions.
Legal-Rational	Belief in the legal system and authority of those chosen to exercise the rules of the system.
Charismatic	The belief in authority of those possessing heroic or exemplary character.

Table 20 Types of Weberian Legitimacy

Pseudonym	**Country**	**Founded Year**	**Funded**	**Funding Stage**	**Accelerated or not**
BabyWearable	United Kingdom	2017	Yes	Seed	Yes
Monitor	Sweden	2013	Yes	Series B	Yes
YourPleasure	Latvia	2021	Yes	Pre-Seed	Yes
FullBattery	Finland	2016	Yes	Seed	Yes
WiseBees	Netherlands	2020	Yes	Pre-Seed	Yes

BabyCradle	USA	2018	Yes	Seed	Yes
MarineMeasure	Finland	2005	Acquired	Exit	No
RoboticMeasurement	Finland	2019	Yes	Pre-Seed	Yes
CleanCooking	Kenya	2021	Yes	Seed	Yes
Nexum	Finland	2010	Yes	Series A	Yes
MotherHealth	India	2016	Yes	Seed	Yes
SkyTaxiInfra	Germany	2019	Yes	Series A	Yes
TrackingParcels	Finland	2014	Yes	Pre-Seed	No
AgeMonitor	Canada	2019	Yes	Seed	Yes
IoTSecurity	Finland	2015	Yes	Seed	Yes
HVACHealth	USA	2016	Yes	Seed	Yes
AgeObserve	USA	2019	Yes	Pre-Seed	Yes
AIBlockchainIoT	USA	2015	Acquired	Exit	Yes
TrafficIoT	Estonia	2016	Publicly Held	Exit	Yes
Water Sensor	Denmark	2016	Yes	Seed	Yes

Table 21 Start-Up Corpus

Start-Up	**Origin**	**Professional Experience**	**Gender**
BabyWearable	Founder Led	No prior relevant experience.	Female
Monitor	Founder Led	Technical experience in a corporate.	Male
YourPleasure	Founder Led	No prior relevant experience	Female
FullBattery	University Spinout	Project management experience.	Male
WiseBees	Founder Led	No prior relevant experience.	Male
BabyCradle	Founder Led	Technical experience in a corporate.	Female and Male founders
MarineMeasure	Founder Led	Leadership experience as CEO.	Male
RoboticMeasurement	University Spinout	Research experience at university.	Male
CleanCooking	Founder Led	Industry and Leadership experience as founder.	Female and Male founders
Nexum	University Spinout	Research experience at university.	Male
MotherHealth	Founder Led	Prior founder experience.	Male
SkyTaxiInfra	Founder Led	Industry and technical experience.	Male

TrackingParcels	University Spinout	Research and project experience at university.	Male
AgeMonitor	Founder Led	Technical and entrepreneurship experience	Male
IoTSecurity	Founder Led	IoT and electronics project management experience.	Male
HVACHealth	Founder Led	Technical experience in a corporate.	Male
AgeObserve	Founder Led	Leadership and technical experience.	Female
AIBlockchainIoT	Founder Led	Leadership and technical experience.	Male
TrafficIoT	Founder Led	Technical experience in a corporate.	Male
WaterSensor	Founder Led	Technical and leadership experience in corporates.	Male

Table 22 Demographics

Indicative Theme	**Question**
Background	Can you please tell me about yourself?
	Secondary Indicative Questions: What were your responsibilities? What were your team's responsibilities? What was the purpose of your organisation's conception? (an origin story)
IoT	What does IoT mean to you?
	Secondary Indicative Questions: Do you think IoT is a mature sector? Why/ Why not. What are the key challenges IoT sector faces in growing? What are the key challenges specific to IoT startups? (Repeat question specifying corresponding startup sub sector- consumer IoT/connectivity/smart home/wearable)
Organisational Work	Can you please tell me how you have set up your organisation to work?

(Practices, Processes and Resources)	**Secondary Indicative Questions:** How did you go about seeking and getting funding? Could you please share what challenges you faced in getting funded/ you are facing in getting funded? Can you please tell me the process you followed and the work you undertook to be selected in the IoT accelerator? Can you please tell me how you went about getting your first mentors/advisors/ employees on board? Can you please tell me how the mentors/advisors/employees are helping you? Can you please tell me key practices and processes that were created or followed by you to help you accomplish your goals? Can you please tell me how your accelerator/funder has helped you create key practices and processes within your organisation to accomplish your goals? Can you please describe the key support activities organized by the funder/accelerator for you? How does an IoT specific accelerator benefit an IoT you versus a general accelerator? What are the activities you undertook for attaining requisite support from external stakeholders?
Environmental Change (Regulatory Changes/Technology Changes/Industry Changes)	Could you please tell me which technological change, regulative or regulatory inputs or industry changes impacted your business? For example: UK Product Security and Telecommunications Infrastructure, EU Cybersecurity to the Radio Equipment Directive (RED).
	Secondary Indicative Questions: Can you please describe how has the fund/accelerator helped you in adapting to these changes? Can you please give me an example of how you adhered to a regulatory or industry requirement such as GDPR? Did it impact your business model in anyway? Can you please tell me how you protect your IP while engaging with industry leaders OR potential competitors in the same investor/accelerator cohort?

	Can you please tell me how do you compete with larger companies? (Is there any support from Fund/Accelerator?)
Business Model & Power	Can you please tell me how you adapted your business model through different stages of your growth? (Ideation, Prototyping, Manufacturing, Funding etc.)
	Secondary Indicative Questions: Can you please tell me how you change/adapt your customer segments ? Can you please tell me if and how you recalibrated your resource requirement through different stages of your growth? Can you please tell me what key resources the accelerator or fund were able to provide to you, which you were not able to attain anywhere else? Can you please tell me what (if any) were any potential consequences of your business model or product which you didn't anticipate or you considered surprising? How did you incorporate it into your business model or future product iterations? - Can you please tell me how you went about resolving any technical issues related to the product/service? Can you please let me know if there were any product or service changes which required an adaptation of your business model? Can you please describe the recommendations for your business model or product by your funder/accelerator/industrial partner which you incorporated? Can you please tell me why they were recommended and why you incorporated these changes?
Organisational Leadership	Can you please tell me how do you manage your team? What would you say is your leadership style? Could you give me an example?

	Secondary Indicative Questions Can you please tell me how your leadership style has evolved since your funding/induction into an accelerator cohort?
Narratives and Rhetoric	Can you please tell me the key product/service narratives that you share with your stakeholders?
	Secondary Indicative Questions: Can you please let me know how that narrative has evolved over your growth? What roles have your investors/accelerators played in this evolution? Can you please tell me which narratives have impacted your product adoption? How narratives related to privacy/security/safety/hacking/integration with existing infrastructure have impacted your product adoption? (if at all) Can you tell me please how you allay those concerns (if you do)? Can you please share any stories you know where adoption may have been impacted because of the association with stories in media?

Table 22 Interview Schedule Start-Ups

Indicative Theme	Question
Background	Can you please tell me about yourself?
	Secondary Indicative Questions: What were your responsibilities? What were your team's responsibilities? What was the purpose of your organisation's conception? (an origin story)
IoT	What does IoT mean to you?
	Secondary Indicative Questions: Do you think IoT is a mature sector? Why/ Why not.

	What are the key challenges IoT sector faces in growing? What are the key challenges specific to IoT start-ups?
Organisational Work (Practices, Processes and Resources)	Can you please tell me how you have set up your organisation to work?
	Secondary Indicative Questions: Can you please tell me how did you get your first mentors/advisors/ employees on board? Can you please tell me how you help your start-ups get funding, recruit employees or board members? Can you please tell me what were the key practices and processes/procedures that were created or followed to accomplish your goals? Can you please tell me how do you support your cohort? What are your key support activities? How did you zero in on these activities? Can you please tell me how does an IoT specific accelerator benefit an IoT start-up versus a general accelerator? What are the activities you undertake for attaining requisite support from external stakeholders for your start-ups. Can you please tell me how do you manage start-ups with similar ideas/value propositions in the same cohort or different cohorts?(even if they are part of the cohort at different times)Can you please tell me how you help your start-ups compete with larger organisations in adjacent industry? Can you please tell me how you govern the interactions your start-ups have with partners that have been introduced by you ? How do you intervene when required and manage the relationship?
Environmental Change (Regulatory Changes/Technology	Could you please tell me which technological change, regulative or regulatory inputs or industry changes impacted your cohort start-up's business? For example: UK Product Security and Telecommunications Infrastructure, EU Cybersecurity to the Radio Equipment Directive (RED),

Changes/Industry Changes)	**Secondary Indicative Questions:** Can you please tell me how this modified your own inputs to your start-ups with an example? Can you please tell me what practices in place or processes in place that help start-ups know what they need to do or how they'd need to adapt? Can you please tell me how you start-ups identify changing environment such as regulation?
Business Model & Power	Can you please tell me how you help your start-ups shape their business model with an example?
	Secondary Indicative Questions: Can you please tell me at what stage your cohort start-ups are and can you please let me know why you are focused on a specific stage? (if any specific stage) Can you please. tell me how did you go about helping start-ups shape their value propositions? Please share an example. Can you please describe how your accelerator was able to help the start-ups in building their product/business model/organisation which other accelerators might not have been able to do? (Additional resources/facilities provided?)Can you please describe how you helped a start-up change their market focus with an example? (B2B to B2C or geographic or market expansion) Can you please describe an instance where there were technical challenges or issues with the product which were resolved with your help? Can you please describe an instance when a product or service had surprising consequences which you helped the start-up to manage? Can you please describe the practices or processes you have in place or helped the start-up put in place to better understand their target market? Can you please describe the monetization models that you recommended to the start-ups with an example? Can you please tell me how you help your cohort differentiate themselves with an example? Can you please tell me what the business model of your organisation is?

Organisational Leadership	Please tell me how you help your start-ups manage and lead their teams?
	Secondary Indicative Questions: Can you please tell me how you have identified and addressed any concerns with a founders leadership or management style? What would you say is the most prevalent leadership style in your cohorts?
Narratives and Rhetoric	Can you please tell me how you went about helping shape a start-up's product or business model narrative with an example?
	Secondary Indicative Questions : Can you please tell me what challenges you faced during this process? Can you please tell me if any of your start-ups faced challenges in acceptance and adoption which was or could have been helped with change in their narrative? Can you please describe key industry trends/issues that have an impact in the adoption or diffusion of a start-up product with an example?

Table 23 Interview Schedule for Experts, Accelerators and Investors

Pseudonym	**Founder Education**	**Venture Focus**
Monitor	Electrical Engineering	Privacy conscious monitoring
BabyWearable	Child Psychology and Development - Dropout	Childcare using Tech
BabyCradle	Electronics and Telecommunications	Childcare using Tech
IoTSecurity	ICT	Wireless network monitoring
MarineMeasure	Science	Sensor based maritime vessel energy efficiency
YourPleasure	Entrepreneurship	AI based sex toy
Nexum	Technology	IoT 5G connectivity
RoboticMeasurement	Computer Science	Micromechanical composite measurement
SkyTaxiInfra	Aerospace Engineering	Flying vehicle infrastructure
TrackingParcel	Software Engineering	Logistics automation
CleanCooking	Science	Smart Metering and fintech
AgeObserve	Computer Science	Social Care using tech
AgeMonitor	MBA and Technology	Social Care using tech

MotherHealth	Biomedical Engineering	Healthcare
WiseBees	Computer Science - University Dropout	Beehive monitoring
HVACHealth	Mechanical Engineering	Equipment Monitoring
AIBlockchainIoT	Computer Science, MBA	Technology platform and services
FullBattery	Electronics Engineering	Battery Management
WaterSensor	Geophysics and Oceanography science	Water Monitoring
TrafficIoT	Applied Sciences	Pedestrian Walkway monitoring

Table 24 Start-up founder's educational background

Interviewee	What is IoT?	Categorisation
BabyWearable Founder	"So IoT, I'm quite glad that there's a category because when I did start and looking at the business and they were always asking what kind of business it is, there's not a word to describe it and it's wearables, it's tech, but it's not super techy, but it is doing something. So IoT fits right in there because this particular one doesn't have a kind of subsection for what we're doing."	Contextual. Absence of any other category. Use of a subcategory- (Wearable)
Nexum Business Development Head	"IoT is that you know, we want to, we want to provide a cost-effective way of acquiring the data. For example, the sensor data, if you think about from IoT perspective, that if the if the cost of the data acquisition is higher than the value of the data, then what's the point of collecting that data? So there needs to be a way you are acquiring the data needs to be cheaper than that say, the cost of acquiring that. And the other thing is that, you know, IoT is anywhere from the from the sensor level to the back end, Cloud Analytics and anywhere in between, you know, there's an edge computing and unloading. So, I don't think there's a there's	Economic Value – cost of data acquisition. Architecture (Components) of IoT Feature of IoT solution - (Edge Computing)

	a single answer, you know, how do you define an IoT?"	
IoTSecurity Founder	"Well basically, like I said, it's, like, old or new, new old term for all things, but I think that it's means that you know, it's multi-layer connectivity. So, we are talking about devices and sensor data and data gathering, protocols and systems that talk to each other in in a way that you know, it's not processing in one place, it could be processing in multiple places or multiple times that you have wired or wireless connectivity from the sensor or from the sensor device."	Architecture (Components) of IoT IoT Component - (connectivity) Newness
MarineMeasure	"I think the original IO T and I think it's partly the industrial IoT definition is, is basically you having you know smart hardware, Which is basically, the way how it's been operated that it's been optimised by machine learning AI."	Defined through Subcategory- (Industrial IoT) Role of adjacent technology category (ML, AI)
TrackingParcel Founder	IoT provides the means to automate things and make things smarter so that you can spend less time […] looking after them and. h, monitor them remotely.	Contextual Functional Value – Replace manual work

YourPleasure Founder	“Honestly, I don’t really use this […] I think I have heard it. It's just to me associated with like finding everything on the Internet”	Functional Value - Finding Objects Related to the internet
WiseBees Founder	I would define Internet of Things as the […] category of products where the interaction between software and hardware is a compulsory requirement for this product to exist […] where one cannot exist without the other.	Architecture (Components)
RoboticMeasurement Founder	We are using [name of partner] which are a temperature, humidity and Air pressure sensors that are in our labs. And then there's a hub for that and then we go to the website where we can see the that's basically that you have a website and everything is connected to each other and yeah, that's how I would see the Internet things.	Contextual Architecture (Components)
CleanCooking Founder	I'm looking at it from the African context. I see IoT as the future of banking rights on the continent, […]So with IoT. it can be embedded into the TV, right? I'm giving to this customer and the customer pays for it every day or every week or every month until they pay it off […]	Contextual Functional Value - Remote access and location tracking Role in industry Economic Value - customer access to credit
BabyCradle Chief Growth Officer	So, like, the way I see it is, you know, so it's the network of like devices that work together and speak to each other in order to solve problems […] my interest kind of came from the fourth industrial revolution, this whole idea that the	Architecture

	number of machines that are going to solve problems for us is going to drastically increase.	
FullBattery Founder	This is a part of telecommunications which is focused, […] connecting various devices and equipment […] So with vehicles we often will be speaking with telematics and like a I think that one could easily call it IoT as well.	Architecture (Component) Subcategory (Telematics)
HVACHealth Founder	The ability of a physical product to have all the capability and powers that are behind the Internet. […] What that means, I guess is that you abstract the hardware […] it's really just a way to ultimately to connect people, to connect ideas. […] IoT just empowers that because it enables a level of ubiquity that's never been realised before.	Functional Value Newness Role of the internet
AgeObserve Founder	IoT is primarily just means of collecting the data.	Functional Value
AgeMonitor Founder	It's a new name that's put a name on a trend that's been happening, really for a long time. […] There's a business model that's wrapped around that hardware that maybe the customer doesn't own that equipment and they're paying a monthly fee.	Economic Value Newness
AIBlockchainIoT Founder	IoT is for good for data acquisition, and information dissemination […] It's good for data dissemination as well. Because the last mile, the last mile problem is what IoT is good for. That's what I say and then the rest of the analysis of the data whether through AI, other things happen back in the cloud. […]	Role of adjacent technology category Functional Value
SkyTaxiInfra Founder	If I could get real time updates or if I can change things real time just with the help of connectivity is IoT for me.	Functional Value Architecture (Component)

Monitor	Intelligent sensors, typically headless. I don't think of a mobile phone as IoT. I think about the things that are connected online. But maybe don't have an interface that you use with the product, but where you use an app or a website, or indeed a service that is supported by a device that is Internet connected or in some sort of mesh.	Role of the internet Architecture
WaterSensor	Wireless battery-operated sensors, that are flexible in terms of placing but also moving.	Architecture (Components) Implementation
TrafficIoT	It's a network of things, basically the umbrella word to bring those hardware pieces together with some kind of software related capabilities.	Architecture (Components

Table 25 How do you define IoT?

Function	Link to legitimacy	Reference
Describe how pieces of a business fit together	Establishes internal coherence between different parts of a business making it more comprehensible.	Magretta., 2002
The various business actors, their roles, potential benefits for the actors and source of revenue	The benefits for each actor within an ecosystem or industry imparts pragmatic legitimacy to the business model.	Timmers., 1998
The rationale of how an organisation creates,	This can align the firm with the expectations of	Osterwalder and Pigneur., 2010

delivers, and captures value. The logic of how a firm intends to make money.	its key audience i.e. customer.	
Architecture of the value creation, delivery and capture mechanisms employed by the firm Defines the profit earning and go-to-market *logic* of a business A good business model i) defines the relationships between its components as well as between components and the environment. ii) determines target market segments, customer benefits, embedded features and technologies and how they can be best assembled and offered to the customer iii) defines business's revenue and cost structures.	Focuses on the alignment of a business's internal operations and external environment including customers. Signals the importance of optimisation and efficiency on the sustainability of a business.	Teece., 2010
Activity system that transcends the focal firm and spans its boundaries	Business models are socially constructed by the interactions of various groups that enable it to gain legitimacy. Credible partnerships and creation of ecosystems with	Amit and Zott., 2010

	trusted actors leads to relational legitimacy.	
A system that solves the problem of identifying who the customer is, engaging with their needs, delivering satisfaction, and monetizing the value	Aligning with the expectations of the evaluators leading to legitimacy and adoption.	Baden Fuller and Haefliger., 2013
How a firm makes money and gains competitive advantage.	Shows investors the future path of the organisation possibly leading to pragmatic and cognitive legitimacy. Also signals the distinctive identity of the venture.	Afuah and Tucci., 2001
A good business model aligns with company goals, is self-reinforcing and robust	Indicates internal coherence and the prevalence of legitimacy through adaptation, distinctiveness and leading to sustained growth.	Casadesus-Masanell, Ricart., 2011
Management plays an important role in a good implementation leads to a successful business model regardless of its perceived strength	Legitimacy of a business model is as much in its execution as its strategy.	Osterwalder, Pigneur and Tucci., 2005

Table 26 Business models and legitimacy

	Pseudonym	Value Proposition	Value Creation	Value Capture
1	Monitor	'The co-host that cares for your [accommodation providers and owners] guests and communities'	Monitors and automates accommodation portfolios while preserving guest privacy	Subscription
2	BabyWearable	'Give [new] parent's a total night's sleep'	Wearable tracks infant tiredness; app predicts optimal bedtime and notifies parent	Hardware sales
3	BabyCradle	An AI-enabled bouncing crib that manages sleep automagically	Sensors detect first stirrings; crib either soothes by bouncing or allows waking, per sleep schedule	Product and Subscription
4	IoTSecurity	"We detect wireless interferences in critical wireless networks in real time."	Supplies data on networks, people, devices and device locations	(Hardware as a service) Subscription
5	MarineMeasure	"Helping ships become energy efficient"	Onboard sensors measure ship trim, integrated with navigation and automation systems	Set Up and Hardware Maintenance and Support and Reporting as a service
6	YourPleasure	Machine learning to understand women's preferences, learn	Device learns preferences from usage	Sales

		from them and teach them about it	data, then recommends and educates	
7	Nexum	"Fully decentralised networking […] focused on massive IoT"	Hardware-independent protocol stack with distributed network management; devices locally adapt frequency and time domain for scale, reliability and energy efficiency	Licensing
8	RoboticMeasurement	Measurements and measurement devices for micromechanical characterisation of composite materials.	Robotic platform characterises fibrous and fibre-reinforced materials, improving output and measurement repeatability	Measurement as a service
9	SkyTaxiInfra	“Building a network of air mobility”	Onboard flight-guarding equipment transmits command and control instructions to pilot or flight computer; ground infrastructure algorithmically plans air traffic.	Subscription
10	TrackingParcel	“We provide a flexible asset management platform with IoT capabilities”	A web application and a mobile application with tools for companies to help them manage their assets like tools and machines and track them IoT	Subscription
11	CleanCooking	“Using IoT to build a smart meter that will enable access	Carbon credits incentivise switching from solid fuels to LPG	Commissions for LPG sales and

		to clean cooking for low-income households across Africa.”	on a pay-as-you-use basis	pay as you go for meters and Subscription for infrastructure
12	AgeObserve	“AgeObserve is an AI-powered monitoring system for elderly.”	Home sensors build a baseline of normal vitals and habits; deviations such as falls or inactivity alert family, carers or physicians	Subscription
13	AgeMonitor	“A monitoring system that provides privacy for loved ones and peace of mind for caregivers.”	Room sensors notify carers via app of waking, routine deviation and verbal calls for help.	(Hardware as a service) Subscription and one time set up fee
14	MotherHealth	“IoT which can monitor critical vitals during the phase of pregnancy delivery and post-delivery.”	Abdominal patch monitors foetal and maternal heart rate and uterine contractions; transmits to app, alerts on anomalies, generates WHO partograph	Annual Fee and Subscription
15	WiseBees	Modular beehive monitoring system.	Smart hive scales measure weight, temperature and humidity to assess	Setup Fee and Subscription

			colony strength and blooming periods	
16	HVACHealth	“a check engine light for HVAC systems”	“Filter-mounted sensor detects faults early, triggers filter replacement and technician referrals	Subscription
17	AIBlockchainIoT	“Platform that combines AI, IoT and Blockchain and solves problems that blockchain cannot solve”	Secure edge devices and gateways feed a SaaS platform and marketplace; collected data is written to blockchain and analysed by AI, with actuation commands returned to the field	Data as a Service - Subscription
18	FullBattery	“Monitor the batteries by using simple sensors”	AI/ML predictive analytics optimise lifespan and maintenance for industrial battery fleets in material handling, railway and utilities	Annual Subscription
19	WaterSensor	"Make complicated water data easy to use by monitoring the water infrastructure in real-time"	"Sensors transmit water data to cloud; quality control and AI pattern detection identify inconsistencies and generate solutions to inform stakeholder decisions	Data as a Service - Subscription

20	TrafficIoT	"Primarily engaged in the development and sale of products and services for increasing road safety. The company's core competency lies in high value-adding and continuously improved software and expertise in the field"	"Smart pedestrian crosswalk detects pedestrians and approaching vehicles, issues LED and acoustic warnings, enables vehicle-to-everything communication, and collects road-user data	Licensing

Table 27 Start-up Identities

B. Analysis steps – SkyTaxiInfra Case

Step	Description	**SkyTaxiInfra Data**	**Source**
1. Artefact-level observation	Material and discursive artefacts and surrounding activities identified in interview and secondary data.	Prototype air traffic management platform comprising a ground segment and an airborne avionics unit; venture whitepaper setting out architecture and certification requirements; investor pitches.	CEO primary interview (2023); venture whitepaper (2022); business development manager interview (2022)
2. Coding	Activities coded in vivo and descriptively.	Demonstrating an integrated solution to inform the industry consensus process (in vivo: "that was the bet that we made when we started the company"); enrolling incumbent aviation and automotive actors; contributing to an OEM-led consortium; equipping a start-up-led automated flight test site.	CEO primary interview (2023); OEM urban air mobility division press release (2021); unmanned aircraft news article (2023)
3. Mechanism aggregation	Codes aggregated into boundary work	Validation (demonstration, test-site verification,	Boundary work and

	mechanisms (validation, translation, framing, alignment, demarcation) and classified by form, boundary type and level.	certification groundwork) and demarcation (defining what counts as advanced air mobility infrastructure). Classified as boundary creation of an institutional (category) boundary at industry level.	legitimacy framework in Chapter 2.
4. Audience response (coded independently)	Evidence of evaluator judgement sought independently of the venture's own claims and interpreted via propriety and validity judgements (Bitektine and Haack, 2017).	Propriety: admission to the OEM's airspace management consortium with disclosed selection criteria ("unique approaches, geographic presence and expertise", 2021); regional government co-funding of the test site (2023); partner enrolment incl. the OEM's air mobility subsidiary and a technical university; airport operating agreement negotiation. Validity: trade press relay of the OEM endorsement (2021). Withheld propriety: 120–150 investor pitches described as "dismal"; demonstrations to early customers still being sought.	OEM press release (2021); industry trade publication (2021); unmanned aircraft news article (2023); founder interview (2023); business development manager interview (2022)
5. Claim construction		The prototype earned audience-specific propriety judgements from industry, state and research audiences, and validity through media while cognitive legitimacy among investors remained unsettled.	Chapter 4

Table 28 SkyTaxiInfra Analysis Example