UNIVERSITY OF DERBY

A Systems Thinking Based Conceptual Model for Analysing Business Performance in Supply Chain Organisations

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Key Words

Systems Thinking

Business Performance

Supply Chain

Improvement

Analysis

Conceptual Model

Delphi

Case Organisation

LIST OF ABBREVIATIONS

BI – Business improvement

CAQDAS – Computer Aided Analysis

DMAIC – Define, Measure, Analyse, Improve, Control

ERP – Enterprise Resource Planning

I.T – Information Technology

KPI – Key performance indicator

IIA -Interdepartmental Impact Audit

LLS – Lean Six Sigma

LSCM – Lean Supply Chain Management

MRP - Materials Resource Planning

SCI – Supply Chain Integration

SMED – Single Minute Exchange of Die

DECLARATION

It is declared that the research and writing for this study was undertaken by the author and no part has been submitted in any other form to another educational institution. Ethical approval was granted for the study from the College of Business, Law and Social Sciences at the University of Derby, full details can be found in appendix E. Credit is given in the form of references to the previous works of others that have influenced this study, a full list can be found in the References and Bibliography section.

ABSTRACT

Purpose - The Covid 19 pandemic highlighted the importance of supply chains more than any recent decade, including where the shutting down of manufacturing highlighted the vulnerabilities of supply chains leading to a shortage of goods and supplies. Whilst the importance of supply chains to businesses and consumers is significant, factors such as globalisation and intense competition require organisations and supply chains to improve their performance to remain competitive. In addition, environmental related factors such as sustainability and net-zero carbon have become drivers for organisations and supply chains to reduce waste and become more efficient, thus the need for enhancing the performance of related operations and processes. There are various approaches within the literature for improving supply chain efficiency (vis a vis performance) including the concept of supply chain integration (SCI). Whilst such approaches have proved successful, there are limitations which could be exploited through alternative or complimentary methods. Therefore, this research presents a unique conceptual model for analysing business performance within supply chains, with a view to identifying and implementing improvement opportunities. The high-level conceptual model is designed for implementation by organisations working within a supply chain, with a view to improve business performance for the movement of goods/materials to an end customer.

Approach and Methods - The conceptual model was developed through review and convergence of existing literature and frameworks presented by scholars. To verify the model a Delphi study was employed, which incorporated 2 survey rounds seeking views and consensus of the model contents and approach from experts (academic and practitioners). In addition to establishing the level of verification, the Delphi study gave opportunity to enhance the model after the first round, the enhancements were verified in round 2. To further test the model, a case organisation was selected for application of core elements of the model, in order to validate whether the concepts and approach of the model work in practice.

Results and Findings - The Delphi study results highlighted a high level of verification, with consensus of a range of questions designed to test various stages of the model, supported by additional comments from qualitative analysis. Upon

successful verification, the model was validated (identify whether the model can be applied in practice, in essence, moving from concept stage to actual application) using a case organisation working in the context of supply chain. Selected aspects of the model were applied, with a very successful outcome, primarily that the elements of the model tested worked in application and provided detailed knowledge for further application of the model in the future.

Research contribution – The novelty of the research lies in several areas, including the application of an evolved systems thinking theory and method to the context of supply chain that was previously unexplored. The development, verification and validation aspects of the study (in relation to the conceptual model) addressed some of the gaps that exist within the supply chain literature, in particular barriers to supply chain integration. Evolvement of the systems thinking theory gave opportunity (through development of the conceptual model) to further understand the impact supply chain functions have upon each other, particularly in relation to the influence of current performance measurement and use of targets. Further novelty of this study is the convergence of literature to inform the model. The convergence enabled the development of elements unique to the conceptual model, including the design of an Interdepartmental Impact Audit, which combines systems thinking theory and supply chain integration theory, to develop higher levels of holistic knowledge of an organisation and wider supply chain. The convergence of theories enabled the systems thinking theory to be evolved, addressing the gaps through integration within the model, further highlighting the novelty of the study.

The practical contribution of the study is a structured approach to review and analyse current influencers of supply chain performance, through adopting a systems thinking approach and systems thinking mindset. Through the iterative approach of the model, the systems thinking mindset will give opportunity for managers to reduce the risk of functional barriers and associated negative impacts on supply chain performance – in essence, a more holistic approach to measuring performance and flow of information to improve supply chain integration and business performance. In addition, the empirical research enabled generation of knowledge to enable identification of scenarios and aspects previously unknown (to the organisation), thus giving opportunity for managers to analyse the potential impacts and implications on supply chain performance and develop strategies to improve performance.

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Chapter 1 - Introduction

1.1 Introduction to The Section

The focus of this research is the development of a conceptual model for analysing business performance within supply chains, with a view to identifying improvement opportunities. The term supply chain for the context of this study aligns to the work of Mangan and Lalwani (2016) and refers to a network of organisations or internal departments, of which there are relationships and flows of goods or materials. Included within supply chain is the term Logistics, which is concerned with the movement of the goods or materials between the organisations or departments (Walters, 2019). A further overview is illustrated in figure 1.1.

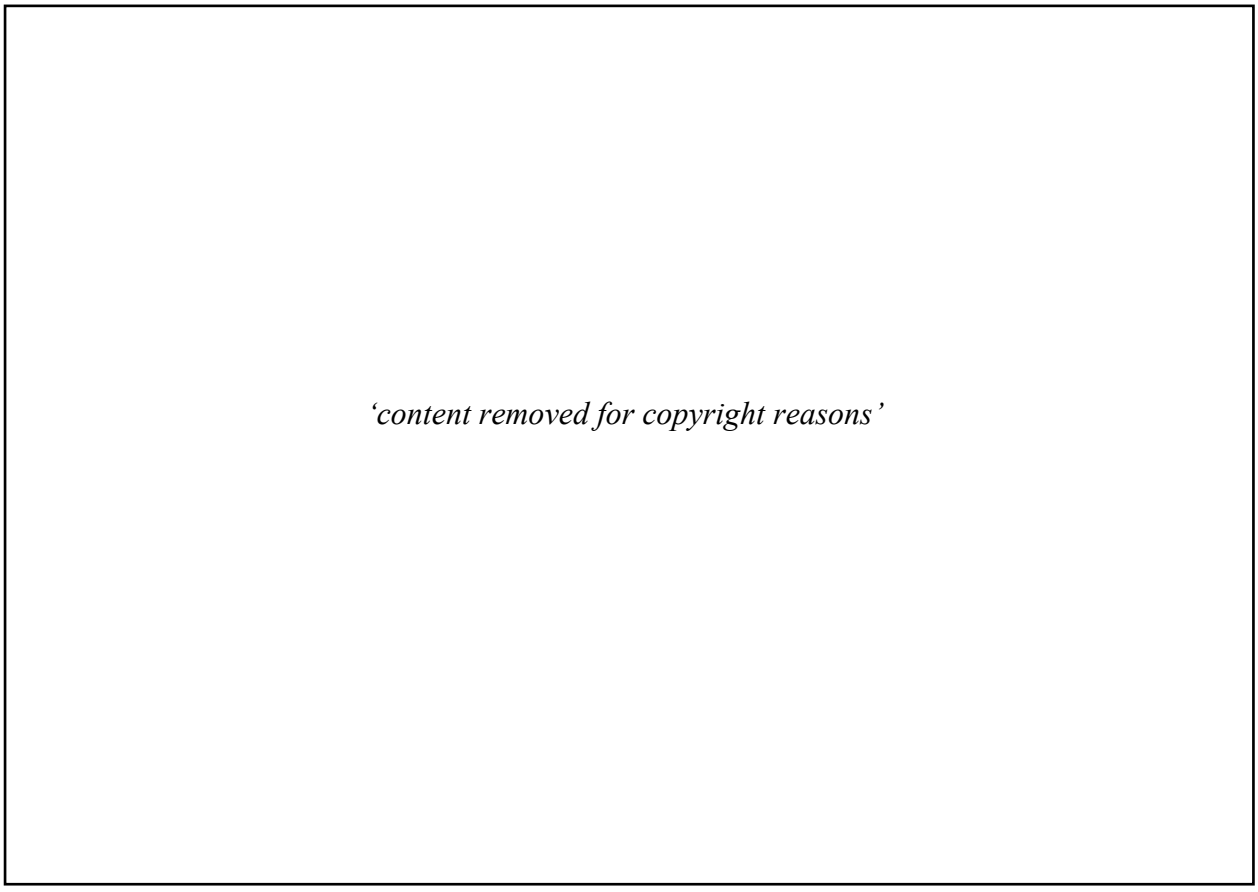

Figure 1.1 - The Integrated Supply Chain – Adapted from Mangan and Lalwani (2016)

The recent Covid 19 pandemic highlighted the importance of supply chains more than any recent decade (Craighead et al, 2020), including where the shutting down of manufacturing highlighted the vulnerabilities of supply chains leading to a shortage of goods, which included medical supplies (Shih, 2020). In today's world, you do not have to look far to see or experience the impact of a supply chain, for example, food on the shelves in supermarkets, fuel available at the pumps, lights coming on when a switch is pressed to name a few. According to Delgado and Mills (2018), supply chain in the Unites States has general recognition as being an integral part of the American economy, especially for the goods and service needs of businesses such as semiconductor organisations (i.e., Intel). Delgado and Mills (2018) further highlight that business-to-business supply chains alone employ 44 million people.

The importance of supply chains and the impact they can have on organisations and people is evident, the focus of this research is the development of an approach for analysing business performance within supply chains and identifying opportunities for improvements - vis a vis improving the efficiency and effectiveness of related supply chain processes and the wider supply chain system. The following sections of this chapter are designed to make explicit the aim and objectives of the study and the rationale for the chosen subject matter and context. These are presented as follows:

About The Author - This section is included to further understand the rationale for the chosen areas of study, as the topic areas build on the previous commercial, industrial and academic experience of the author.

Research Background - This section is included to offer some additional context and situational information to support the rationale for the chosen context area of the study.

Research Gap and Motivation - This section gives further rationale for the study, including identifying a research gap and the opportunity to explore and further develop theories and concepts. This is followed by the nature of the study being made explicit through the research aim and objectives.

Structure of the Thesis - Inclusion of a table to present the structure of the entire thesis.

1.2 About The Author

Prior to a career in academia, the author worked in private sector industrial and commercial environments for a period of 23 years. This included leadership and management roles for an organisation operating within the semiconductor industry, which served as a first-tier supplier to large semiconductor companies such as Motorola and Intel. During this time there was significant exposure to business process improvement methodologies such as Six Sigma, and very stringent quality management systems, including QS9000. This resulted in knowledge development in the application and management of associated methods and techniques for measuring, monitoring, and improving operational processes and the management of processes.

Moving to a career in academia, there was a subject focus in leadership and operational management, with a particular focus on approaches to business improvement. This led to becoming a founder member of a systems thinking focused research group, which included liaisons with Professor John Seddon and exposure to his systems thinking philosophy and approach. During this time, it was evident that the application of Seddon's philosophy and approach was proving successful (validated by teaching informed research conducted by the author), but at the time was mainly focused on public sector organisations and service organisations that incorporated large call centres. Seddon's (2003) systems thinking approach had a particular focus on how targets are used for managing performance and the potential associated negative behaviours they can drive in the workplace.

In more recent times (to the start of this study), the author built on the practice based and academic experience by diverging into the subject field of supply chain and logistics, which included the design and leadership of a Supply chain Improvement MSc, and involvement in the early stages of the now well-established Supply Chain Improvement research group at the University of Derby. During this time (and to date) significant networks have been developed within the sector, particularly through the Chartered Institute of Logistics and Transport, which included becoming a Fellow of the institute, being a member of the Senior Leadership forums, and making significant links with both sector practitioners and academics.

1.3 Research Background

Whilst the importance of supply chains to businesses and consumers is significant, factors such as globalisation and intense competition require organisations to improve their performance to remain competitive (Al-Shboul et al, 2018). Slack (2008) highlights the need for business operations to continually review and attempt to improve the performance (of such operations) asa necessity to sustain short and long-term success regarding financial performance, customer retention and customer satisfaction. In the context of supply chain, Jasti and Kodali (2015) argue that systems for physical distribution (of goods) are vital to organisational productivity, profits and quality, highlighting the emergence over time of supply chain management (SCM), which accord to Al-Shboul et al (2018) can incorporate best practices to improve performance which include the implementation of business improvement methods.

The evolving complexity of the challenges facing organisations and their wider supply chains became very apparent to the author whilst working in the field of supply chain and logistics. For example, the rising customer expectations related to delivery of goods and products, and the need for more efficient and effective product return processes in retail supply chains. Other areas included the last mile distribution and delivery of goods, which according to renowned sector analysts IMRG & Blackbay (2014), failure of first-time delivery is an avoidable cost, but potentially cost e-retailers in the region of £771 million during 2014. In recent years to the time of this study, environmental related factors have become a noticeable, higher-level priority for organisations to consider, for example, the expansion of operational processes to incorporate reverse logistics activities into existing (supply chain) networks (Paula et al ,2018). Sarker et al (2021) discuss the concept of sustainable supply chain management, which includes the cleaning (or removal) of waste (or resource wasteful activities) within production systems, a concept that can be expanded to the wider supply chain through adopting approaches such as Green – Lean. Whilst Green-Lean practices can be driven by external factors such as regulations (Kumar and Rodrigues, 2020), application to a supply chain evokes less wasteful processes, which can lead to a reduction in energy usage, or reduced use of natural resources (Duarte and Cruz-Machado, 2019).

1.4 Research Gap and Motivation

In recognition of the global and competitive challenges facing supply chains, the integration of business processes both within and across the wider supply chain is an essential element of supply chain management, and organisations should no longer function in isolation (Kamal and Irani, 2014). The intent of such management is the attainment of more effective and efficient flows in various forms (e.g., physical, information and financial) which is defined by the term ‘supply chain integration’ (SCI) (Tiwari, 2021). SCI is an extensive field within the supply chain literature, including models and considerations for implementation with commonalities such as the recognition of internal integration (which is also termed interdepartmental or inter functional), and external integration (which integrates outwards with external elements of the supply chain, e.g., suppliers). Whilst SCI offers the opportunity for supply chains and related organisations to improve performance through more integrated flows, there are limitations as to the success of SCI due to associated barriers. For example, strategic leadership, sharing information, firefighting, in addition to conflicting goals, vis a vis performance objectives (Baker et al, 2012; Tai et al, 2022, Sabir et al, 2014). Whist such issues are highlighted, the literature is limited regarding approaches and methods for overcoming such barriers, in particular through a model for application.

More specific to improving business performance, over time research has been conducted by scholars to explore the application of methods, including Lean and Six Sigma. For example, Singh (2020) highlights the notion that Six Sigma is a statistical approach for measuring the imperfections and reducing the variation (in a product or service), and Garcia – Buenda (2021) highlights that the application of lean to supply chains for improving business performance is called Lean Supply Chain Management (LSCM) and is an enabler for elimination of waste, reducing costs and making improvements in quality (of service/product). To further expand the context of supply chain, Tortorella (2017) argues that LSCM includes linkages with organisations either downstream or upstream (of an organisation) regarding the flow of products, information and services. Tortorella (2017) argues that many studies undertaken in the area of LSCM have only focused on an individual aspect of the supply chain and have not considered the downstream or upstream activities of the organisation, which can be argued lack a holistic perspective and therefore have

limitations. Singh (2020) highlights that approaches can be combined (i.e., Lean and Six Sigma), and that the principles and tools associated with the methods can be integrated.

Marshall (2012) argues that problems of our time cannot be understood in isolation and that such problems (e.g., in businesses) are systemic, and therefore interdependent and interconnected – like a supply chain. A methodology for viewing situations in a holistic manner is Systems Thinking, which has the potential to address some of the limitations associated with the SCI and business improvement literature. According to Wang and Ahmed (2003), systems thinking embeds the concept of wholeness and has an approach which is holistic when applied to studies. There are different approaches to Systems Thinking (as highlighted by Mingers, 2015; Reynolds & Holwell ,2010; and Jackson, 2007), and whilst some approaches have been studied in the context of supply chain (for example, Ghadge et al,2013; Moon & Kim, 2005; and Elias et al, 2021), the work is limited and often focused on studying a particular context, or in reaction to a problem (Wilden et al, 2021), highlighting a general gap in the literature in the context of supply chain.

As discussed in section 1.2, the author has gained primary knowledge of the Systems Thinking work of Professor John Seddon, and the successful application of his philosophy for improving the performance of service organisations (i.e., more efficient processes, higher level of customer service) – the method of which is presented in the literature of Seddon (2003,2008). Seddon's theory is discussed in the literature in the context of service organisations (mainly public sector services and insurance companies), however, application of the theory to business to business and business to customer supply chains is scarce and therefore not understood, highlighting a gap in the systems thinking literature. Whilst the application of Seddon's theory and method has been very successful in other contexts (to supply chains), there are limitations within the current literature that can be addressed through convergence of other relevant theories (e.g., SCI, lean, Six Sigma, strategic leadership). Evolvement of Seddon's theory/method through the design and construct of the conceptual model gives opportunity to further enhance the method through addressing the current limitations, therefore further contributing to the systems thinking body of knowledge.

Evolving the systems thinking literature for application to the context of supply chain gives opportunity to address some of the gaps that exist within general supply chain literature, in particular the barriers to SCI through a lack of holistic thinking, limiting levels of integration between functions/departments. Through design and construct of a conceptual model is the opportunity to further develop and evolve Seddon's (2003, 2008) systems thinking theory and method, which has unique concepts not evident in the supply chain literature, or other business improvement approaches/methods (e.g., theory related to targets as performance measures). Evolving the Seddon theory (through the conceptual model design) gives opportunity to develop a novel approach for analysing supply chain performance (with a view to making improvements) that is not evident in the current literature. This therefore has the potential to generate knowledge (of the supply chain) that other methods in the current literature would not achieve, thus contributing to the body of knowledge of the supply chain literature.

1.5 Research Aim and Objectives

The development of a novel conceptual model for analysing business performance within supply chains, with a view to identifying and implementing improvement opportunities is made explicit through the following aim and objectives:

Research Aim - The overall aim of this research is to develop a conceptual model for analysing business performance within supply chains, with a view to identifying and implementing improvement opportunities. It is to be presented in the form of a high-level conceptual model, designed for implementation by organisations working within a supply chain to improve business performance for the movement of goods/materials to an end customer. The term high-level in the context of this study can be identified as key themes or macro level, as opposed to a high level of micro detail (i.e., explicit instructions). The research aims to build on the core concepts of Seddon's (2003,2008) systems thinking philosophy and method, through exploration of additional themes and concepts to inform construction of the conceptual model.

Research Objective 1: To research and give critical review to the literature for informing the design and construct of a high-level conceptual model.

Research Objective 2: Through convergence and further development of concepts identified in the literature, develop a high-level conceptual model for analysing business performance, with a view to identifying and implementing improvement opportunities.

Research Objective 3: Through empirical research with experts, verify the developed conceptual model.

Research Objective 4: Through empirical research within a chosen organisation, validate key aspects of the developed conceptual model.

1.6 Theoretical Contribution of The Research

The need for supply chains to improve performance is highlighted in section 1.3. Over the years researchers have discussed and presented concepts for improving supply chain performance, for example, through methods and techniques associated with the application of Lean Supply Chain Management (Nimeh et al, 2018), Lean Six Sigma O'Mahoney al, 2021), and supply chain integration (Kamal and Irani, 2014; Tiwari , 2021; Vanpoucke et al, 2017), contributing to the body of knowledge in the subject fields of business improvement methods and supply chain management. This study contributes (in the form of new knowledge) to the subject fields of systems thinking and supply chain management, through development and presentation of a conceptual model to analyse (with a view to improving) the performance of supply chain related organisations and the supply chain. The novelty of this research is apparent in 2 forms, construction and context.

Construction - The conceptual model builds from the theory of Seddon (2003, 2008), with novelty in how the theory has been evolved and developed to inform unique concepts within the model. Evolving the theory distinguishes this research from the work of other scholars, where their work focuses on the review of application of Seddon's theory and method, rather than further developing the theory and concepts. Further uniqueness is the marshalling and then convergence of subject fields within theories to inform and compile the model, enabling the further

development of Seddon's theory and integrate themes such as strategy, stakeholders and leadership, together with concepts from the wider business improvement literature (i.e., Lean and Six Sigma).

Building on prior approaches is a concept that has been used in other methods for improving performance, such as Six Sigma, which according to Sibanda and Ramanathan (2020) builds from prior quality management principles and practices. The convergence of theory enabled the development of a conceptual method for analysing supply chain performance, which has further uniqueness in the thematic construct of various stages.

Context – Whilst Seddon's (2003, 2008) systems thinking theory is evident in the literature, most of the application is focused within the context of public sector related organisations, insurance companies and call centres, with application to supply chain largely unexplored. In particular, literature with application regarding the movement of goods and/or materials across a supply chain is scarce. This is also confirmed by Wilden et al (2021), who undertook a significant review of systems thinking literature applied to the context of supply chains. The research highlighted that systems thinking methods/theory does feature in the literature applied to the context of supply chain, however, the contributions are mostly case modelling or theoretical, applying methods such as system dynamics, thus highlighting an opportunity to further expand the knowledge of systems thinking through application of alternative methodologies. The literature searches and review undertaken by Wilden et al (2021) did not present or discuss the work of Seddon (including the Vanguard Method – Seddon's latest title of his method), further highlighting the gap in the literature specific to the application of Seddon's method to the context of supply chain. This study, therefore, in addition to contributing to supply chain literature, also contributes to the systems thinking literature, through the design and testing of a conceptual model which further evolves Seddon's strand of systems thinking theory.

1.7 Practical Contribution of The Research

The need for supply chains and related organisations to improve performance is discussed in the previous sections and further highlighted by Praharsi et al (2021), who argue that organisations need to remain competitive through cost reduction

whilst improving quality at the same time. Wilden et al (2021) argues that most of the systems thinking literature reflects reacting to a situation or a problem, rather than having a strategic and collaborative approach to making improvements. The unique development and construction of the conceptual model for this study addresses these points, enabling organisations the opportunity to identify performance improvements through a method that is incorporated into organisational strategy.

Through a strategized and structured approach, managers will have the opportunity to review and potentially change current approaches for making business improvements, including adopting a systems thinking mindset for understanding the organisation and supply chain more holistically. Application of the model and its unique features will potentially challenge an organisations current thinking regarding performance measures and use of targets. In addition is the opportunity to evaluate the impact of such performance measurement methods, holistically and the impact they have on the organisation and wider supply chain functions. Further application of the model gives opportunity for a more integrated supply chain (Mangan and Lalwani's, 2016), where adoption of a systems thinking mindset and application of the model stages give opportunity for improved flows of material, information and resources across the supply chain.

Whilst some organisations have implemented business improvement methods such as lean or six sigma, the methods do not challenge organisations to think differently to the same degree as the conceptual model for this study. Application of the unique attributes of this study offer organisations and associated supply chains the opportunity to improve performance through investigating areas that are not integral to other approaches, and therefore have further potential to improve performance.

The context for this study is supply chain, however other sectors could benefit from adopting the principles of the method presented, particularly if they are multi-faceted (i.e., have multiple departments or functions), including linkages with external organisations. In addition to sectors, the principles could be applied to scenarios that are also drivers for change, for example, strategies for working towards net – zero carbon, where a holistic approach is required for understanding the current and future position.

1.8 Structure of the Study

Table 1.1 below presents the remaining structure of this thesis, each chapter is highlighted with accompanying narrative, which illustrates the iterative nature of the research process undertaken.

Table 1.1 – Structure of the thesis

Chapter 2 – Literature Review	To present and give critical review to the literature for informing the design and construct of the conceptual model for this study.
Chapter 3 – Conceptual Model derived from the literature	Devised from the literature presented in Chapter 2, this chapter presents the conceptual model, followed by an in-depth discussion of each stage of the model and identification of literature review sections that inform each stage.
Chapter 4 – Research Methodology	Chapter 3 presented the conceptual model, this chapter presents and discusses the research methodology to test the model, (i.e., is it theoretically considered robust and fit for purpose, would it work in practice?). The section also makes reference to the secondary research undertaken to inform the model.
Chapter 5 – Delphi Survey round 1 results and analysis, Model enhancements.	This section presents analysis of results of the first Delphi survey as discussed in chapter 4. The section includes enhancements to the conceptual model design derived from the results of survey 1.
Chapter 6 – Delphi Survey round 2 results and analysis	This section presents analysis of results of the second Delphi survey as discussed in chapter 5. The section highlights the level of verification of the model.

Chapter 7 – Model Validation	Following the model verification stages, this section presents the level of validation of the model – i.e., does it work in practice
Chapter 8 – Conclusions	This chapter contains elements to concludes the study, with reference to the aim, objectives, and findings.

Chapter 2 - Literature Review

2.1 Introduction

The conceptual model development for this study highlighted in the aim and objectives in chapter 1, builds on the core concepts of Seddon's (2003) systems thinking philosophy and method. This literature review informs the conceptual model development, which contributes to new knowledge by building on and enhancing Seddon's philosophy and method for specific application to organisation(s) that form part(s) of a supply chain physically moving goods.

The review of literature is presented thematically, the development of the themes was both organic and iterative. Organic in the sense that subjects evolved over the time of the study, iterative in the sense that subsections were informed by and built on previous sections. The themes presented are designed to offer critical analysis of Seddon's (2003) systems thinking philosophy and method, and to present and review subjects to further inform the attributes and content of the conceptual model.

Multiple searches were undertaken, and a significant number of research articles reviewed, this review presents what is considered the most relevant from the searches/reviews for informing the design of the conceptual model.

The literature review is presented across 8 sections which are illustrated in table 2.0, which includes purpose and rationale for each section.

Table 2.1 – Literature review structure

Section Number	Subject Area	Purpose of Section	Rationale for Inclusion
2.2	Supply Chains	To offer perspectives and review of literature regarding general supply chain subject areas and context(s) deemed relevant for developing a conceptual model for business improvement.	To give an understanding of the context(s) of supply chain for development of the conceptual model.
2.3	Systems Thinking	To present critical review of Seddon's philosophy. To explore and present differing perspectives towards systems thinking.	This section builds from section 2.2, to inform development of the conceptual model design from a systems thinking perspective, particularly building on the core concepts of Seddon's method.
2.4	Methods for Business Improvement	Builds from core concepts of Seddon's theory discussed in section 2.2 and supply chain context in section 2.3. To present review and discussion of other (to those presented in section 2.2) perspectives and methods for business improvements within organisations.	To identify opportunities for addressing gaps in the theory discussed in section 2.2, to further build on and enhance the development of the conceptual model for this study.

		To compare and contrast other business improvement methods with the core concepts of Seddon's method.	
2.5	The Notion of Value	To further elaborate of the concepts of value within organisations building on sections 2.2 and 2.4.	For identification of further points to inform the development of the conceptual model.
2.6	Potential Barriers to Implementation of Business Improvement Methods	Building from the philosophies and methods for business improvement discussed in sections 2.2 and 2.4, review of literature to understand potential barriers to the successful implementation of business improvement methods and initiatives.	Gaining knowledge of potential barriers informs the development of the model in the sense of inclusion of elements within the conceptual model to reduce the risk of implementation failure.
2.7	Strategic Change for Business Improvement Within Supply Chain Organisations	Building from the identification of barriers in section 2.6 and changes of thinking associated with sections 2.2 and 2.4, this section presents literature to review the development of strategy and the leadership of change associated with implementing business	Informs the conceptual model through addressing the gaps identified in Seddon's theory (section 2.2) through identification of themes related to the strategic leadership of change and the themes that are pertinent for informing the

		improvement methods within an organisation.	conceptual model for this study.
2.8	Stakeholders	Previous sections (i.e., 2.6 and 2.7) refer to stakeholders and highlight that large organisations are likely to have multiple departments/functions which could mean different stakeholder groups to communicate with, and to involve in the process of improving business performance. This section explores the notion of stakeholder groups and presents a method for identifying levels of influence on a business improvement intervention.	To inform the conceptual model for inclusion of understanding the different perspectives of stakeholder groups.

2.2 Supply Chains

2.2.1 Introduction

Chapter 1 outlines the rationale for the context of this study, including the need for supply chains to keep improving performance due to factors such as intense competition, globalisation, and customer satisfaction, this is in addition to more recent environmental related factors. This study is concerned with developing a conceptual model for analysing performance within supply chain organisations, with a view to making improvements, therefore this section presents literature to further contextualise the term supply chain (in relation to this study) and investigate themes to inform the development of the model.

2.2.2 What are Supply Chains?

This section presents literature to identify and define the term supply chain, in particular for the context of designing the conceptual model for application to a supply chain related organisation(s). According to Chopra and Meindl (2013, p13), a "supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request". In the example of a retail supply chain, the associated supply chain processes would activate when a customer actions the request of a product, for example, buying from a store or ordering a product on-line. Hugos (2011) describes a supply chain as a network of companies with coordinated actions which delivers products to the market, Prasad et al (2012, p190) is a little more detailed and relates the notion of supply chain management as a "set of synchronized decisions and activities" which integrate the different areas of the supply chain (e.g. suppliers, manufactures, distribution) efficiently; Prasad *et* al (2012) argues that 'sustainable competitive advantage' is the main objective of supply chain management.

Quayle (2007) argues that the role of the supply chain is both 'pivotal' and 'key' to both public sector and private companies and that supply chains need to be cost effective to survive. Mangan and Lalwani (2016) highlight the importance of supply chain management in public and not for profit sectors, whilst indicating that the application of 'supply chain management principles' to the service sector has resulted in efficiency gains.

Earlier definitions of supply chain suggest the term (or metaphor) can be used in different ways, for example, Quayle (2007) discusses the term used from different perspectives, i.e., used for the supply of a single product such as coffee or oil, and argues that the concept of supply chain is owing to the early notions of 'holism' and 'systems theory', but application of such theories or approaches is neither straight forward or consistent. Hugos (2011) argues that modern markets are more fragmented and faster moving, thus becoming less 'vertically integrated' (Johnson & Scholes, 2011). For example, companies performing less internal activities (associated with moving the products/goods through the supply chain, for example, aspects of manufacturing or purchasing functions) within the supply chain, focusing on their core competence and outsourcing the other activities such as transportation and distribution, often referred to a 3PL (3rd Party Logistics), which according to Shanker et al (2021) occurs in a number of modern segments (business), highlighting that 3PLorganisations have developed to offer logistics arrangements that are sophisticated and available worldwide.

When contrasting the views of Hugos (2011) and Mangan and Lalwani (2016), it could be argued that supply chains with high market fragmentation potentially require high levels of supply chain integration to be competitive, (i.e., the more complex the supply chain with multiple tiers or types of suppliers) including agile processes that enhance the capability requirements of meeting the differing customer demands. Supply chain integration is discussed further in section 2.3.3.

Definition of Supply Chain within the context for this study

For the context of this study a supply chain in its entirety can be defined by using an adaptation of Mangan and Lalwani (2016, p11) definition of supply SCM:

"Supply chain management (SCM) is the management, across and within a network of upstream and downstream organisations" or internal departments, "of both relationships and flows of material, information and resources …… to create value, enhance efficiency and satisfy customers".

2.2.3 Supply Chain Integration

Chapter 1 highlights the need for supply chains to keep improving performance due to factors such as intense competition, globalisation, and customer satisfaction. This is in addition to more recent environmental related factors, where less wasteful supply chain processes can lead to a reduction in energy usage, or reduced use of natural resources (Duarte and Cruz-Machado, 2019). Jasti and Kodali (2015) argue that systems for physical distribution (of goods) are vital to organisational productivity, profits and quality, highlighting the emergence over time of supply chain management (SCM), which according to Al-Shboul et al (2018) can incorporate best practices to improve performance, which includes the implementation of business improvement methods. Munir et al (2020) highlight the complex and fast changing environment that organisations operate within and that supply chains are often complex with persistent pressure to reduce cost and improve quality (vis a vis performance). Sabir et al (2014) argue that supply chains are the backbone of every business or organisation, and that no one entity within the supply chain can perform better alone, highlighting the need to integrate both internal and external partners across the supply chain. Kamal and Irani (2014) argue that in a competitive and global business environment the integration of business processes both within and across the wider supply chain is an essential element of supply chain management, and organisations should no longer function in isolation. Ageron (2020) highlight the growing consumer expectations and the reality of digital transformation requirements across supply chains, arguing that the emergence of new technology also gives opportunity for supply chains to gain a competitive advantage – thus highlighting the need for supply chain stakeholders (or functions) upstream and downstream to strategically collaborate regarding processes.

Tiwari (2021) presents the notion of ‘supply chain integration’ (SCI), defining that it reflects the level of collaboration between an organisation (company) and the wider supply chain, including the management of internal and external facing processes. The intent of such management is the attainment of more effective and efficient flows in various forms, e.g., physical (goods), information and financial. Christopher (2011) discusses managing the supply chain as a system, including the flow of material and information from source to the user (end-to-end), which according to Christopher (2011) reflects an integrated supply chain. Vanpoucke et al (2017) describes supply

chain integration as the coordination of product and information flows, using the term "information exchange" for the coordination of communication and the transferring of information, highlighting that there has been very little questioning as to the importance of supply chain integration.

The literature on supply chain integration is extensive, with commonalities such as the recognition of internal and external integration. This is highlighted by Kamal and Irani (2014), who argue that the concept of SCI is multidimensional, a concept that includes internal integration (which is also termed interdepartmental or inter functional integration) and external integration (which integrates outwards with external elements of the supply chain, e.g., suppliers). Tiwari (2021) argues that SCI enables the strategic alignment of functions and processes internally and externally of an organisation and is considered crucial for achieving a high level of performance. Cohen and Roussel (2013) argue that extensive integration is key to the functionality of supply chains, highlighting that critical interactions are required between core processes, including internal functions such as marketing and sales. They further argue that even if there is integration with external elements (such as suppliers), there will be a lack of effectiveness if the internal aspects of the supply chain are not integrated.

Literature searches highlight approaches and models for supply chain integration, which are often broken down into specific area of focus. For example, Zhang et al (2015) present a model for SCI based around different areas of integration, such as:

- Finance integration – for maintaining flow of finances related to payment and credit terms, accompanied by relevant flows of information and materials.
- Planning and Control Integration – High level managerial activities aimed at collaborative forecasting, evaluation of performance and risk management.
- Knowledge Integration – The exchange of knowledge, a deeper relationship than required than for information integration, knowledge sharing for learning as a collective which could include market and operational knowledge sharing.

Mangan and Lalwani (2016) discuss supply chain evolution and argue that supply chains now have a high level of integration compared to high fragmentation in the 1960's – 1980's. They discuss the notion of 'upstream' and 'downstream' linkages

between the networks of organisations, including processes and activities. A distinction is made between ‘vertical integration’ (the number of activities a company performs within the supply chain, e.g., manufacture of goods, storing of goods and distribution) and ‘supply chain management’ (SCM), in that SCM does not necessarily reflect ‘ownership’ or ‘control’ of partners within the supply chain. Mangan and Lalwani (2016) present a model for an integrated supply chain (Fig 2.1), which is indicative of the literature discussed above (Cohen and Roussel ,2013; Tiwari ,2021 ;Vanpoucke et al,2017), with linkages highlighted between functions of the supply chain and the need for a flow of information, resources and materials. Vanpoucke et al (2017) argue that supply chain integration helps companies to develop smooth processes between supply chain partners (which for the context of this study could include internal departments) which would enable boundaries to be blurred (rather than absolute).

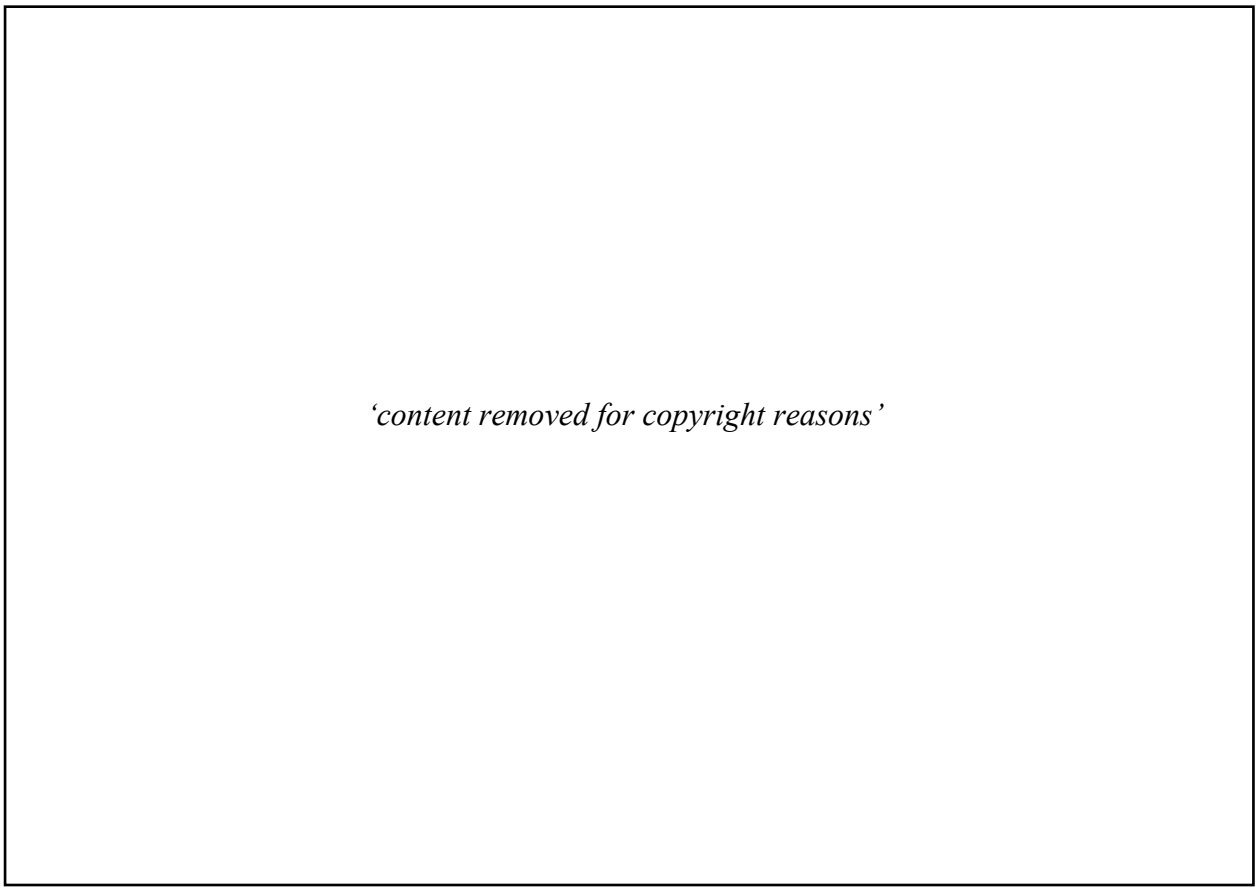

Figure 2.1 - The Integrated Supply Chain – Adapted from Mangan and Lalwani (2016)

2.2.3.1 Barriers to SCI

Whilst the literature highlights the benefits of SCI through application of models and approaches (such as discussed above), the application has limitations due to potential barriers that can limit the success of performance improvement. Example limitations and barriers to SCI are highlighted by Baker et al (2012), who argue that cultural and organisational related issues cause most barriers to internal supply chain integration. For example, poor strategic management and alignment (through the organisation), coupled with measurement methods that are inconsistent. Using Quick Scan Audit Methodology (QSAM) through empirical research undertaken over a 4-year period, Baker et al (2012) highlight two major behavioural factors that create barriers to SCI. The factors are “firefighting” (which could limit purposeful business improvement work) and “functional-silo mentalities”, a point also highlighted by Christopher (2016), who discusses the notion of functional barriers preventing the supply chain being managed as a system (and hence reduce the chance of successful supply chain integration). An example is presented by Tai et al (2022), who highlight a reluctance of supply chain members to share information due to a want for maximizing their own benefits - in essence working in functional silo’s (Skipworth, 2016). Baker et al (2012) argue that these characteristics reflect industrial norms (of the type of organisation) and rooted in the way mangers view the world, which has parallels to ‘command and control’ management presented by Seddon (2003) and discussed in section 2.3.4. Yang et al (2022) discusses the notion of supply chains being adaptable, especially with world events such as Covid 19 and the need to reconfigure supply chain operations to best meet the changing environment. Yang et al (2022) highlight the importance of information sharing between supply chain entities for being adaptable and the generation of levers of operational performance.

Through investigation of barriers to SCI, Sabir et al (2014) acknowledge the positive impact SCI can have on supply chain performance, but through research of the literature identify inhibitors or barriers that could limit levels of performance improvement. Barriers identified have parallels with the literature discussed above and include:

- Lack of communication and information sharing
- Poor working relationships

- Conflicting goals
- Lack of direction from senior management

Sabir et al (2014) discusses the work of Moberg et al (2003), who expand on the theme of goals (or KPI's) creating barriers to SCI, highlighting that goals and objectives can be misaligned (within the organisation/supply chain) and can have a short-term orientation. Sabir et al (2014) highlight that to fulfil SCI, internal and external supply chains need to have a group vision.

As highlighted above the benefits of SCI are very apparent in the literature, however, the models and approaches presented would be limiting if the barriers to SCI are not addressed. For example, the SCI literature reviewed does not offer actual methods or concepts for limiting barriers such as conflicting goals and misaligned objectives, and the related leadership/management approaches, in addition to subsequent lack of information sharing (Sabir et al (2014) .The application of a systems thinking approach into a model for analysing business performance within supply chains has the potential to address this gap, in particular the work of Seddon (2003,2008) which is discussed extensively in section 2.3. Integrating a systems thinking approach has parallels with the work of Christopher (2011), who argues that an ideal and logical way of managing the process of a product or service through a supply chain is to manage it as a complete system, and that fragmentation of the functions into separate sections is inefficient and less effective in terms of being competitive, Christopher highlights this is what happens in conventional businesses, with no transparency of costs as products flow through the functional areas.

2.2.4 Supply Chain Metrics

The conceptual model design for this study builds on the key concepts of Seddon's (2003) systems thinking philosophy and method discussed in section 2.3.4., key features of which include a focus on process flow rather than individual departmental activities (or functions within the organisation), and how well the system performs against achievement of purpose (from the customer's perspective) as a performance measure, rather than using a raft of individual/departmental targets. As highlighted in section 2.3.4, a shift in thinking is required for redesigning the system, which includes the thinking towards performance measures, with this in mind literature was

reviewed and analysed to understand the thinking towards current performance measurement within a supply chain.

Chopra and Meindl (2013) discuss ‘drivers of supply chain performance’ and identify 6 areas:

1. Facilities - For production and storage
2. Inventory - Within the supply chain, including raw materials, work in progress (wip) stock and finished goods stock.
3. Transportation – Movement of inventory through the supply chain
4. Information – Through the supply chain, including all the above items, costs and customer information
5. Sourcing – Who will provide goods and services for items 1-4
6. Pricing – The pricing structure and method for goods and services provided in the supply chain

The 6 drivers are classified into 2 types, Logistical and Functional, which according to Chopra and Meindl (2013) determine the supply chain’s level of responsiveness and efficiency through the interaction of the drivers, through using metrics as illustrated in Figure 2.2.

Figure 2.2 - Supply Chain Decision Making Framework - Adapted from Chopra and Meindl (2013)

Chopra and Meindl (2013) also present a list of metrics (which could be used as performance measures) for each driver (i.e., Average purchase price, Supply Lead time, Average cycle time), some of the metrics relate to specific functional areas (e.g., supply lead time can be directly related to the purchasing function), which by their nature could evoke thinking at departmental/functional level only and lack holistic thinking. Seddon (2008) uses the term ‘functional specialisms’ to identify how different areas of the organisation (or departments) are managed and measured. In the context of this study functional specialisms are identified by departments/functions/businesses within the supply chain working as functional silos (Skipworth et al, 2016) when measuring performance, with the potential for creating functional barriers to other departments/functions/businesses as discussed by Christopher (2016).

Martin (2014) highlights 12 key metrics important to the measurement of supply chain performance:

1. Inventory Investment
2. Profit and Loss Expense
3. Inventory Efficiency (Turns ratio)
4. On- Time Suppler delivery
5. Forecasting Accuracy
6. Lead Time
7. Unplanned Orders
8. Schedule Changes
9. Overdue – Order Backlogs
10. Data Accuracy
11. Material Availability
12. Excess/Obsolete Inventory

To improve the performance of a supply chain Martin (2014) developed a 10-step solution process for the deployment of Lean Six Sigma (discussed further in section 2.4.3), elements of Martin's literature are an example of Seddon's (2008) view that many improvement methodologies focus on the implementation of tools rather than considering the organisation as a system (a systems approach is explained in section 2.3). Although all the areas of supply chain management presented by Martin (2014) are important, the implementation of tools (for example, specific to a lean methodology, discussed in section 2.4.2) to improve each area on an individual basis could unintentionally inhibit looking at the overall flow of the supply chain and the interdependencies between the areas. Martin's (2014) literature is insightful and does discuss the use of systems models, whilst leadership and strategy for implementing business improvement methods does not appear to be a focus of the work.

Lai and Cheng (2009) refer to the SCOR model (developed by the Supply Chain Council, presented in Appendix F) as useful for evaluating performance, specifically JIT (Just in Time) logistics. The SCOR model identifies four criteria for measurement of critical organisational processes within a supply chain. Lai and Cheng apply the SCOR model to a set of performance indicators, which if applied within an organisation would most certainly be used as metrics with numeric values. Table 2.2 is an adaptation of Lai and Cheng (2009) SCOR performance measures to highlight where the measurement criteria could reflect departmental or 'functional specialism' type metrics (Seddon,2008) and performance targets, and/or metrics and performance targets which reflect the wider supply chain.

Table 2.2 - An adaptation of Lai and Cheng (2009) SCOR performance measures

Supply Chain Process	**Measurement Criteria**	**Performance Indicators**	**Dept Metrics**	**Wider Metric**
Customer Facing	Supply Chain reliability	• Delivery Performance • Order Fulfilment Performance • Perfect order fulfilment	X X X	X X X
	Flexibility and Responsiveness	• Supply chain response time • Production flexibility.	X	X
Internal facing	Costs	• Total logistics management costs • Value – added productivity • Return processing cost	X X X	X X
	Assets	• Cash –to-cash cycle time • Inventory days of supply • Asset turns	X X X	

From the literature searches and the literature presented, it can be argued that the metrics used to measure supply chain performance can be both internal regarding department or function (e.g., purchasing specific related), and external (or wider supply chain) related metrics to reflect overall performance, for example – order

fulfilment. One such measure is On Time in Full delivery (OTIF), which is used as a key performance indicator measurement within supply chains (Soroka et al,2021). A measure such as OTIF has the potential to be used as a 'purpose' (Seddon,2008) derived measure throughout the supply chain, giving the opportunity for viewing the supply chain holistically, as a system. However, David et al (2019) argue that whilst measuring a modern supply chain should be simple (although demanding to manage), the lack of a consistent method for measuring OTIF makes it more difficult than it could be, arguing that it is calculated in different ways, meaning that when the different functions of the supply chain look at performance, the results can be interpreted differently (e.g., efficiency type measures). This scenario supports the rationale for having a more holistically understood performance measure such as 'purpose' - i.e., what the purpose of the supply chain from the customers perspective (derived from Seddon, 2003).

Slack (2008) uses the term 'transformational process' to describe the activities (or sets of activities) associated with the manufacturing of products from raw materials (process inputs) to finished items, or in the case of services, completed delivery of service. Application of Slacks 'transformational process' theory to Mangan and Lalwani's (2016) integrated supply chain model (figure 2.1) would identify many transformational processes, including micro transformations (Slack, 2015), many being related to service (e.g., purchasing, distribution). Seddon (2003, 2008) argues that traditional 'command and control' management thinking has too much emphasis on the business functions when designing operational processes and highlights that greater value (for the customer and overall process efficiency) can be achieved by focusing on the end-to-end flow (discussed in section 2.3.4). This notion suggests that the higher the number of micro transformations (Slack ,2015) taking place within a supply chain, the more likely to be micro performance measures, i.e., at functional level, and therefore has the potential to inhibit a holistic picture of flow of goods/products.

2.2.5 Overview

This section has identified that a supply chain can consist of many components, both internal and external of an organisation. Whilst there is discussion of organisations becoming less vertically integrated (Hugos,2011) due to 3PL (3RD Party Logistics) organisations undertaking business functions (such as storage and distribution), it can be argued that the more functions a 3PL organisation undertakes, the 3PL organisation in itself can become vertically integrated (Johnson et al, 2011). This would mean more internal supply chain functions, leading to more potential internal functional barriers (Christopher, 2016), making the systems thinking rationale for the conceptual model of this study even stronger.

The literature highlights that some of the metrics to measure the different supply chain functions (or functional areas) can be activity based, and arguably lack a holistic nature. Whilst there are measures that could be holistic, such as OTIF measures and related KPI's, they are not necessarily a constant throughout the supply chain, making performance measurement across the areas/functions non comparable. This strengthens the rationale for the conceptual model using the core concepts of systems thinking, in particular informing the model in the area of knowledge generation and the value of understanding a constant measure across an organisation.

The review of the supply chain integration literature highlighted the recognition for understanding the linkage between functions and the flow of goods and/or materials across a supply chain, in addition to the importance of communication and information sharing across the supply chain. Whilst the literature searches highlighted models and approaches for achieving supply chain integration, potential barriers to integration highlighted limitations in the application of the theory, and hence a gap in the literature. In particular, barriers associated with performance targets that influence functional silo's, in addition to areas associated with communication of information.

These areas could be addressed through further development of a systems thinking approach for analysing and improving business performance – systems thinking is presented in the next chapter. Whilst the SCI literature has reference to leadership and strategy, the literature reviewed manly focusses on the flows (i.e., information, materials), evolvement of a systems approach would give opportunity to understand the holistic strategic management requirements and potential influence of the different stakeholder groups within the internal/external supply chain functions.

It is acknowledged that supply chains can be comprised of multiple businesses, thus potentially making the leadership of integration challenging (due to multiple management teams with own company interests), including the implementation of holistic measures. The authors previous industrial experience has included successful customer driven adoption of Six Sigma within operational processes, which has parallels with aspects of supply chain integration across different organisations, so whilst the challenge of leadership is acknowledged, success should not be discounted. However, the leadership of integration and holistic measures is likely to be less challenging within supply chains having a high level of vertical integration (due to most of the leadership/management being within the same organisation), for example large global/international organisations and 3PL logistics organisations.

2.3 Systems Thinking

2.3.1 Introduction

As highlighted in the previous section, searches highlighted a gap in the supply chain literature regarding barriers associated with performance measurement methods (i.e., impact of targets) that influence functional silos, in addition to areas associated with communication of information. This section (2.3) explores some of the concepts of systems thinking, with a view to building and evolving the concepts (through design of the conceptual model) to:

a) Address gaps in the supply chain literature regarding functional silos (as above)
b) Further evolve the systems thinking literature through addressing some of the current identified gaps/limitations

Chapter 1 highlighted a gap in the literature regarding the application of Seddon's (2003) systems thinking philosophy and approach in the context of supply chains. This section reviews literature for understanding differing perspectives and philosophies towards systems thinking and presents critical analysis of Seddon's philosophy and approach.

2.3.2 Systems Thinking Perspectives

According to the Oxford English Dictionary (2002, p716) a system is "a set of things that are connected or work together". Whilst it could be argued that this definition is relevant to all systems thinking approaches, there are differences in perspectives. The subject history of systems thinking is long and broad, with many authors discussing the origin of approach(s) (i.e., Mingers, 2015; Reynolds & Holwell, 2010).

Wang and Ahmed (2003, p1283) highlight the view of Checkland (1999) that "systems methodologies are embedded in the concept of wholeness and offer a holistic approach to various disciplines of studies". Gerst (2013) cites the work of Deming (1994), who argues that the aim of the system (e.g., what the organisation is trying to achieve/what is the purpose) in an organisation should be understood by everyone in the organisation and for efforts to be directed toward it. Marshall (2012)

argues that problems of our time cannot be understood in isolation and that such problems (e.g., in businesses) are systemic (e.g., how the organisation functions through processes etc), and therefore interdependent and interconnected.

In relation to this study, a systems thinking approach to improving business performance can be viewed as a holistic approach, viewing the supply chain as a 'whole', which functions through a dependency of it parts (i.e., departments, organisations) and interactions between such parts (Jackson, 2003). Viewing a supply chain in this way has the potential to generate knowledge and understanding of how one department/organisation can impact another, and the resulting impact on overall supply chain performance, arguably giving an advantage over the application of business improvement methods that only focus on the improvement of isolated areas of the organisation/supply chain using improvement tools and techniques. Seddon (2005) argues that whilst tools such as VSM (value stream mapping) have value in manufacturing, they are less successful in service type organisations. This is based on the premiss that such tools normally assume the nature of a problem and work on the process accordingly, rather than investigating the true nature of a problem from a systems perspective (e.g., rethinking how the system works).

2.3.3 Approaches

According to Reynolds & Holwell (2010), a widely used approach to classify different approaches to systems thinking is to consider 3 categories, 'hard', 'soft' and 'critical'. Wang and Ahmed (2003) cite the work of Flood and Jackson (1991), who refer to components of a system as 'hard' elements ('structural components' - e.g., procedures, processes, departments) with relationships between components being the 'soft' elements. The work refers to a 'complex system' as being made up from 'multifarious interactions' between all the components of the system. With reference to the above definitions, Wang and Ahmed (2003, p1284) argue that "it is the different emphasis on the elements of a system that distinguishes soft systems from hard systems methodology". Marshall (2012) refers to change situations, with a hard systems thinking approach being one which pays little attention to human interaction or conflict.

Zexian and Xuhui (2010) highlight how Checkland's work builds from the work (such as action research) of Churchman and Ackoff, leading to the emergence of his soft systems methodology (SSM). Checkland (1999) argues that a soft systems stance views the world as a process of enquiry, for example, in the context of this research, how to view the reality of a supply chain, which whilst may seem complex, it can be explored as a learning system. This contrasts with a hard systems stance, which according to Checkland (1999) views the world as systematic, which in the context of a supply chain would reflect a number of systems (or sub systems) which can be engineered.

Zexian and Xuhui (2010) highlight Checkland's view that whilst a hard systems stance can broadly be applied to human elements (e.g., the interaction of people within the system), dealing with the diversity of the human element is a weakness (e.g., views and opinion), the SSM gives opportunity to understand the human elements and how they impact/interact with the system. This is further highlighted by Flood (2000), who highlights that if the whole (organisation/supply chain as a system) is to be understood, an appreciation is required of social practices and actions, with a necessity to study individual perceptions. Ahmed (2003) also highlight the work of Checkland (1999), which argues that key to a soft systems methodology is the role of people and their inquiry into emerging problems in a systematic way. Checkland and Scholes (1999) also discusses the use of Key performance indicators, arguing that any performance indicators (vis a vis target) should never be one dimensional or arbitrary and cannot be regarded with any use in isolation, they are part of a system.

Reynolds & Holwell (2010) discuss that soft systems methodology is used in the analysis of complex situations where there are potentially differing views as to the problem definition – termed "soft problems". Mingers (2015) argus that there is an intrinsic difference between physical systems and social systems, in that the nature of a physical system (such as a machine or a technical process) will lead to outcomes that are a given. This is not the case with the nature of a social system (i.e., an organisation), as members of an organisation (people working within the organisation) will "bestow their own meanings and senses on the system" (Mingers ,2015, p34). Mingers (2015) derives that Soft Systems Methodology (SSM) is used where there are different perceptions towards solving problems, where application of

SSM will explore such perceptions and views with the potential for formulating an agreed solution.

Reynolds & Holwell (2010) and Marshall (2012) refer to the work of Jackson (2000, 2007) system of systems thinking methodologies (SOSM). The model highlights different systems thinking approaches that could be referred to in different situations, classifying the situations regarding the level of complexity and the level of shared purpose amongst the stakeholders\participants of the situation, i.e., relationships that are either Unitary, Pluralist or Coercive. Reynolds & Holwell (2010, p11) highlight that it is this dimension that draws from the hard and soft typology, highlighting the use of metaphors to help distinguish potential applications or situations, i.e., hard systems being associated with machines and soft systems being based on “living organism”. Marshall (2012) presents Jackson’s model of positioning systems thinking approaches highlighted in figure 2.3.

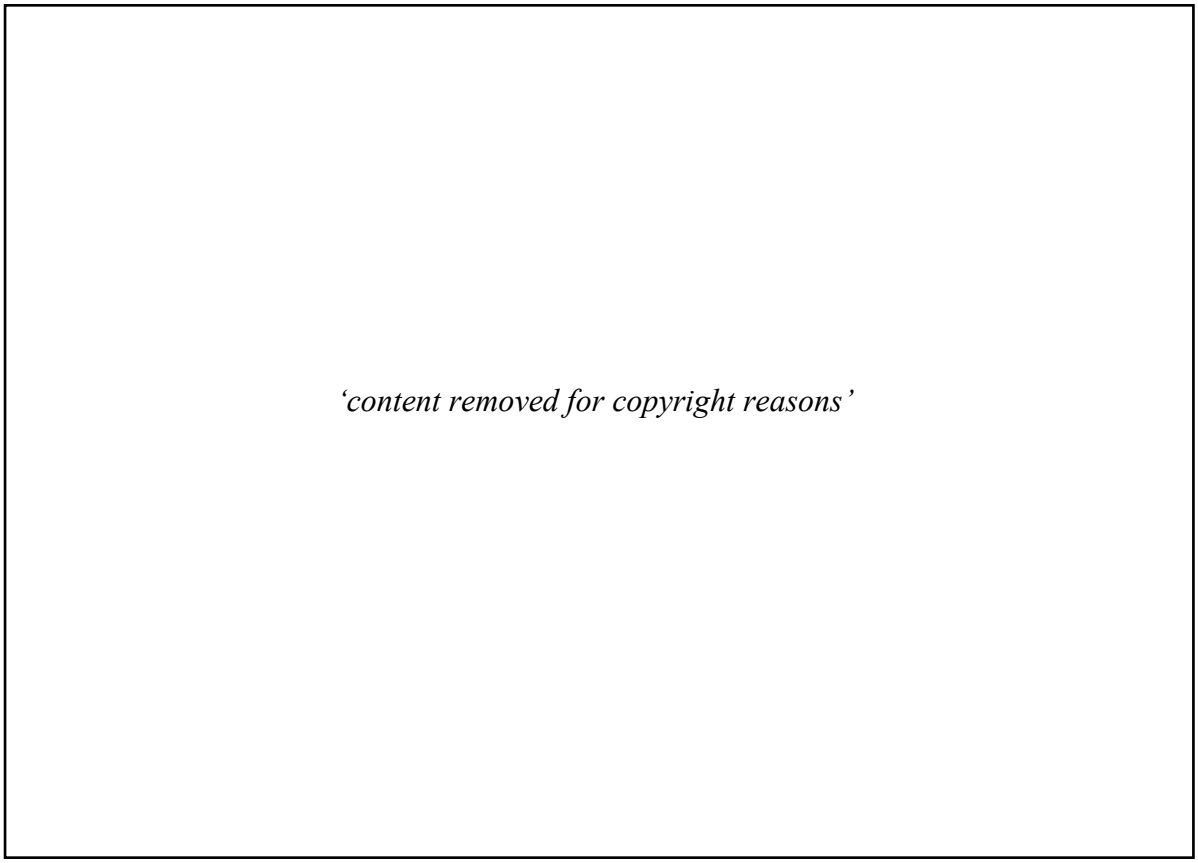

Figure 2.3 - Positioning of Systems Thinking approaches, Marshall (2012, p87) – adapted from Jackson (2007)

The systems axis in the model (figure 2.3) identifies the complexity of the system, with a complex system having many subsystems which can be impacted by turbulence in the external environment, whereas more simple systems have fewer subsystems with structured interactions (between systems). The relationship axis reflects the type of participants relationship with the problem context:

- Unitary – people have common beliefs and shared values, share common purpose and contribute to decision making.
- Pluralist – Whilst interests have compatibility, values and beliefs can be different, need opportunity/space for debate and to give contribution towards decision making. Compromises and accommodations need to be made.
- Coercive - Minimal common interests or beliefs, conflicting values. Compromise not possible resulting in no shared decision making. Decisions made on a power basis.

The model is useful when considering the context of supply chain, in particular the positioning of a soft systems thinking methodology having pluralist relationships. For example, people from different departments having different views and/or experiences that should be considered. Drawing from Jackson's (2007) model and the literature around the typology of soft v hard approaches, further thought can be given to the type of organisation and associated processes to identify the approach. A service organisation where activities are heavily dependent on people (e.g., hospitals, educational institutions, legal services) will arguably have a higher degree of social systems (Mingers, 2015), whereby people working within the systems will have different views, opinions and influences on how the work is done. According to Marshall (2012) the methodology presented by Seddon (2003) sits between a hard systems thinking approach and a soft systems thinking approach, examples of which when applied to the context of supply chains are highlighted in Figure 2.4.

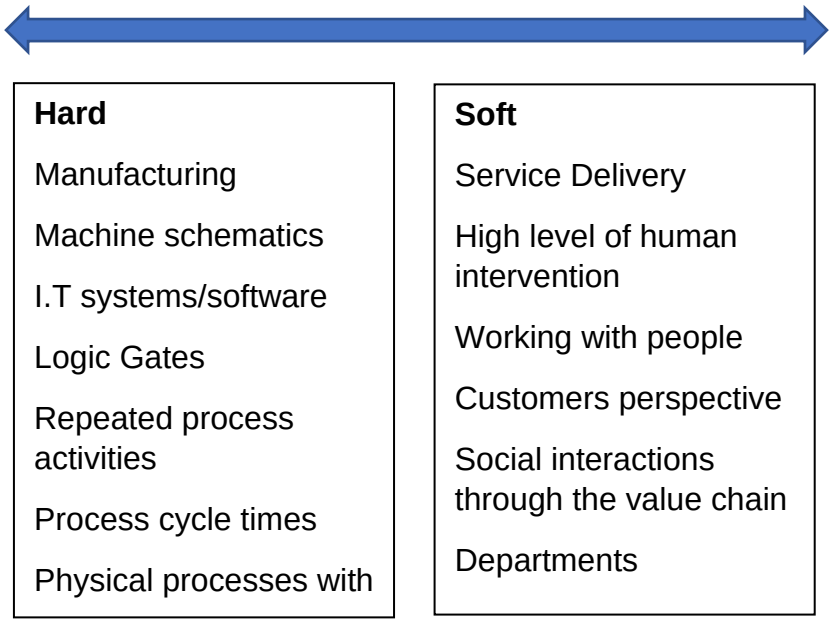

Figure 2.4 – Applications for hard and soft approaches, derived from Marshall (2012) and Mingers (2015).

In the context of this study, the service and people aspects of supply chain can be related to soft approaches, with areas using machinery and equipment and associated interlinkages reflecting hard aspects of systems thinking.

Whilst Checkland (1981, 1999) sought to address some the potential weakness of other systems thinking approaches, such as general systems thinking and hard systems approaches, Jackson (2001) presents the notion of 'critical systems thinking', of which one of the elements of the approach proposes a potential combination of approaches depending on the scenario, in essence, seeking the strengths from the different approach and potentially reducing any weaknesses. Jackson (2001) discusses the evolvement of systems thinking and argues that different approaches have different paradigms with linked or embedded assumptions that can constrain the ability to intervene for problem situations, in particular when a radical perspective is required. Jackson argues that there is nothing wrong with applying a range of different tools if logical. This includes models and techniques in combination form different methodologies, which according to Jackson (2001) is essential to a critical systems thinking approach. Jackson (1992) highlights that critical systems thinking embraces 5 major areas of commitment:

- Critical Awareness - Values and assumptions required for proposing new systems design. Including understanding strengths and weaknesses of systems thinking methods.

- Social Awareness – Recognition that organisational circumstances can influence methods used – e.g., social differences in geographic locations.

- Human Emancipation – seeking maximum development of peoples potential, support peoples interests and the role they play

- Equal commitment to the complimentary and informed development of varieties of systems approaches.

- Complimentary and informed use of systems thinking methodologies.

In addition, Jackson (2001) argues that critical systems thinking application through research does not claim to know the answer or solution to a problem in advance, which arguably is different to the application of some approaches. For example, an organisation applying lean tools to a specific area or process, assuming that is where a potential problem exists.

2.3.4 John Seddon Systems Thinking and the Vanguard Method

Glossary

In the context of this section when referring to the work of John Seddon:

- **Philosophy** - the nature of the knowledge behind the thinking towards a systems thinking approach for improving business performance.
- **Method** - The approach(s) for application of the philosophy for improving business performance.
- **Value Demand** – Activities that add value to the customers (Seddon, 2003)
- **Failure Demand** – A demand on the system caused by failure to do something right for the customer, and/or an activity that creates no value for the customer (adapted from Seddon, 2003)

As discussed in Chapter 1, from experiences and knowledge gained by the author, this study aims to build on the core concepts of a systems thinking philosophy presented in the literature by Seddon (2003,2008).

The routes of Seddon's (2003) philosophy and method are influenced by quality guru's (established/well known) such as Deming (1982) and Ohno (1988), the subsequent method presented by Seddon (2003) for improving organisational performance is unique in construction and in the way it emphasises particular criteria. Key to the philosophy is the need to move from a command and control, to a systems thinking mindset within management, as according to Dunnion and O'Donovan (2012, p25), a command and control style approach to management leads to "sub-optimisation with a system", for example, inefficient processes and people not intrinsically motivated. The concept of command and control style management in Seddon's (2003,2008) literature builds from the work of Deming (1982), who argued a perception amongst people that current (at the time of his writing) management style (i.e. top down) is a fixture and has always existed, but actually it is a style that has been invented in more modern times, and that it has created a prison through the way people have acted (e.g. creation of boundaries within the work place). The creation of boundaries through management styles can be highlighted in the more recent work of Christopher (2016, p255), who uses the

term “functional boundaries” within a functional organisational structure, leading to “senior managers who come to regard their own functional area as their ‘territory’”, with functions often “encouraged to optimize their own costs because of budgeting systems”. Seddon (2008) points out that when using the term command and control, it is in the context of how operational work is designed and managed, and not that they are necessarily directive managers. Leadership approaches are further discussed in section 2.7.

Another key feature to Seddon’s (2003,2008) literature is the discussion and belief that using performance targets within organisations drives negative behaviour amongst staff, for example, de-motivation or acting with self interest to ensure personal targets are met. This is highlighted in particular with targets associated with activity, for example, number of calls answered per hour in a call centre, or in the context of supply chain could be reflected in number of items picked per hour in a distribution centre. Seddon’s (2003,2008) literature argues that targets are often set in an arbitrary way (e.g., not based on factual data, or numbers seemingly plucked from nowhere – for example, increase productivity by xx%) arguing that organisations should have a series of measures that are derived from ‘purpose’, with purpose being why the organisation (or service) exists from the customers perspective. The term purpose is not unique to Seddon, for example, it is a key aspect of the EFQM (European Foundation for Quality Management) business excellence model, which according to Fonseca (2022), sustainable stakeholder value is created through the linkage between an organisations purpose and strategy, where purpose is an understanding of why an organisation exists and the purpose fulfils (EFQM.Org, 2022).

Seddon’s (2003, 2008) approach views the organisation (or service) as a system (holistically), with targets replaced with more holistic measures based on ‘purpose’, which could lead to the removal of the functional boundaries discussed by Christopher (2016). Literature that supports Seddon’s target theory includes Wankhade (2011), who researched the use of targets in the emergency services, highlighting there are some positive benefits to using targets for performance measurement, but argues there can be perverse effects due to the operational complexity of the situation, highlighting what is being measured gets done, but not

necessarily done well! Wankhades (2011, p398) research highlighted that numeric targets associated with response times did not offer a holistic view of the organisation and that having such a focus on the response time target “diverted attention” from other important areas of the service, for example, actual clinical performance was unmeasured (e.g., was the patient fixed). The study argued that clinical targets are harder to measure and that targets are a central directive, which are lacking in flexibility to take into consideration “local differences”. In addition, the targets pressurise staff to perform which “can lead to serious unintended consequences”. Whilst the context of the study was emergency services, it has parallels and relevance to supply chain contexts. For example, if a last mile logistics company has numeric metrics for its drivers such as number of deliveries per day, there could be unintended consequences such as parcel/product damage, or parcels delivered to incorrect addresses. Centrally derived targets set within a large vertically integrated organisation could result in them not being suitable for the different departments or business units – This reflects a phenomenon identified by Seddon (2003) caused by decision making being undertaken by managers too far removed from the work (operations).

According to Deming (1982), the collective performance (of a team, dept etc) is influenced strongly by the overreaching system. However, Meekings et al (2011, p92) argue that typically organisations tend to measure what is easy to measure and it is “ rare for a genuinely systemic perspective to be taken”. As with Seddon (2003), Meekings et al advocate challenging the way managers think about the use of target setting and highlight that ‘systemic thinking’ needs to be mandated at the beginning as opposed to allowing it to emerge over time. This would suggest a deliberate strategy is required to embed a change of thinking when applying a business improvement method, with links to a transformational type change (Johnson et al (2011) – to be discussed later in section 2.7.

A Systems Thinking mindset is a different way of thinking and managers that have taken systems approach experienced notions that were counter-intuitive (Seddon, 2008). Examples are illustrated in table 2.3, which identifies counter-intuitive concepts between command and control thinking v systems thinking.

Table 2.3 - Command and Control v Seddon's Systems Thinking – adapted from Seddon (2008)

Command & Control Management Thinking	**Aspect**	**Seddon's Systems Thinking Mindset**
Top -down, hierarchy *(Arguably a traditional structure)*	**Perspective** *(For managing operations, processes)*	Outside in approach *(viewing the service from the customers perspective)*
Functional *(Often management by activity, e.g., units per hour))*	**Design** *(Of operations, processes, system)*	Understanding value demand and process flow *(Measures to be more holistic and focused on purpose)*
Separate from work *(e.g., by managers with minimal knowledge of the actual operations)*	**Decision Making**	Integrated with work (*Involving people doing the work)*
Contractual *(e.g., transactions)*	**Attitude to Customers**	What matters? *(To the customer)*
Manage people and budgets *(E.g., departmental budget and people within)*	**Ethos**	Learning *(Feed the learning back into the operations, continually improve through new learning)*
Reactive, projects *(e.g., reactive to a problem)*	**Change**	Adaptive, integral *(Takes place when requires, adaptation to new scenarios)*

Extrinsic	**Motivation**	Intrinsic

Seddon's systems thinking method for business improvement was devised for application within the service sector, as opposed to other methodologies/approaches that focus on manufacturing, the counter-intuitive nature of managers experiences highlighted in table 2.3 highlights the differentiators associated with Seddon's philosophy and the holistic nature of the method. This is supported by Dunnion and O'Donovan (2012, p25), who highlight Seddon's view that systems thinkers "strive for economies of flow" (e.g., the end-to-end processes for the service delivery), as opposed to command and control managers who focus on economies of scale (for example, speeding up individual process activities) to leverage competitive advantage. Seddon (2008,p70) argues that taking a systems view means to view the organisation from the "outside in", in other words to view it from the customers perspective, with a necessity for decision making to be integrated into the work (e.g. involve people who process the work and have primary knowledge of the challenges), with managers acting in a more complimentary role rather than one that is adversarial and built on hierarchy. Aspects of table 2.3 and Seddon's philosophy can be related to supply chain theory presented by Christopher (2016), who argues that organisations within a supply chain are often burdened with rigid organisational structures that are very functional by area, for example, purchasing have their own budget and work within it, likewise for production, distribution and sales, leading to functional boundaries as discussed above.

Method

Longbottom et al (2011) argue that the routes of some Systems Thinking approaches (including Seddon's) are inherent to the work of Womack et al (1990) and Ohno (1978) who also base their approaches on customer demand and flow. O'Donovan (2014) argues that Seddon's work is unusual, due to being influenced by scholars not normally associated with systems thinking. In particular is the work of Deming (1982) and the Deming cycle, which according to Evans (2014) is one of the earliest approaches focused on quality improvement, highlighting four stages as Plan, Do, Study, Act which are illustrated in figure 2.5.

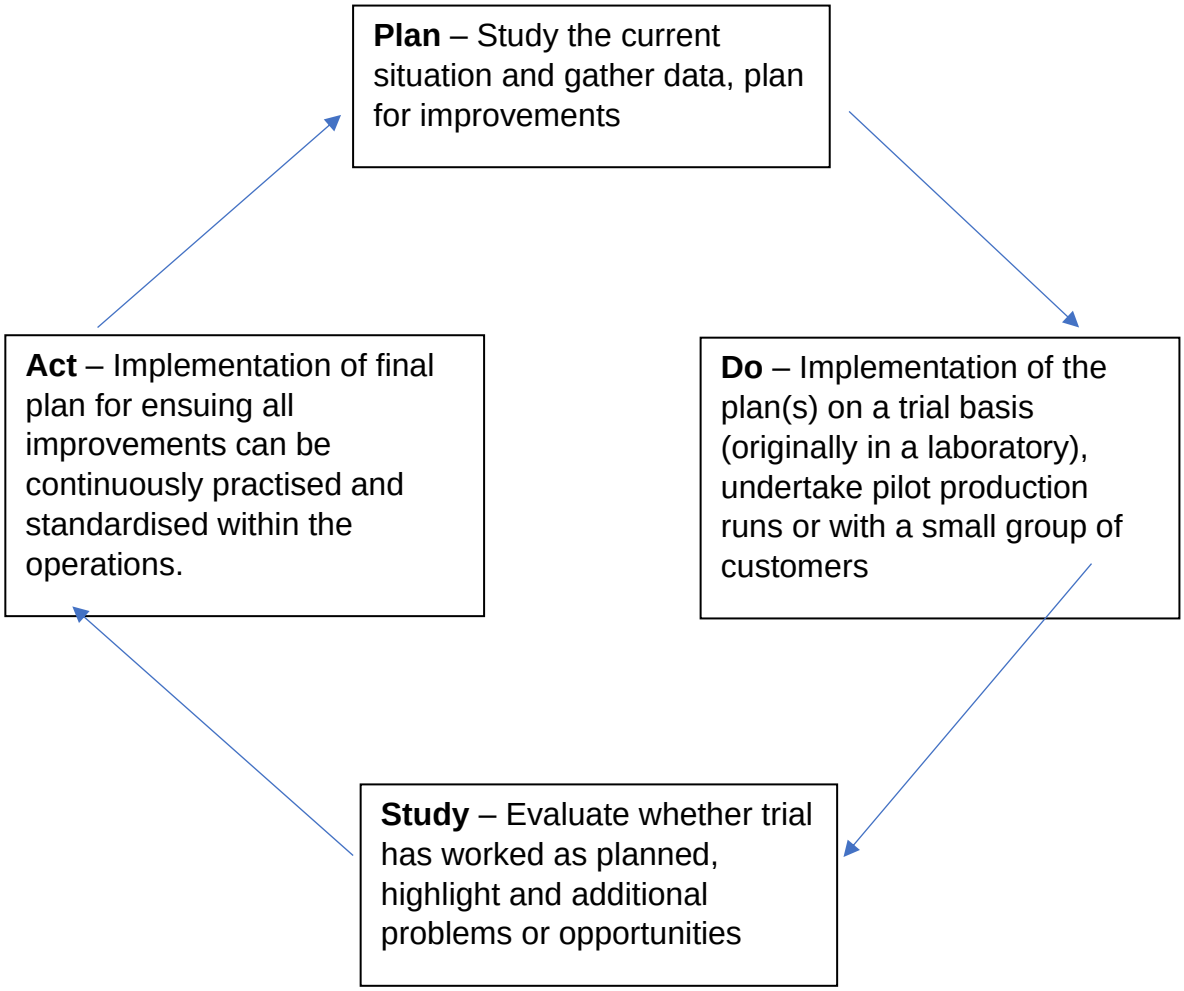

Figure 2.5- Deming PDSA cycle, adapted from Evans (2014)

The method presented by Seddon (2003,2008) has similarities to that of the PDSA cycle presented in Fig 2.5 but has 3 steps rather than 4 as presented in Figure 2.6.

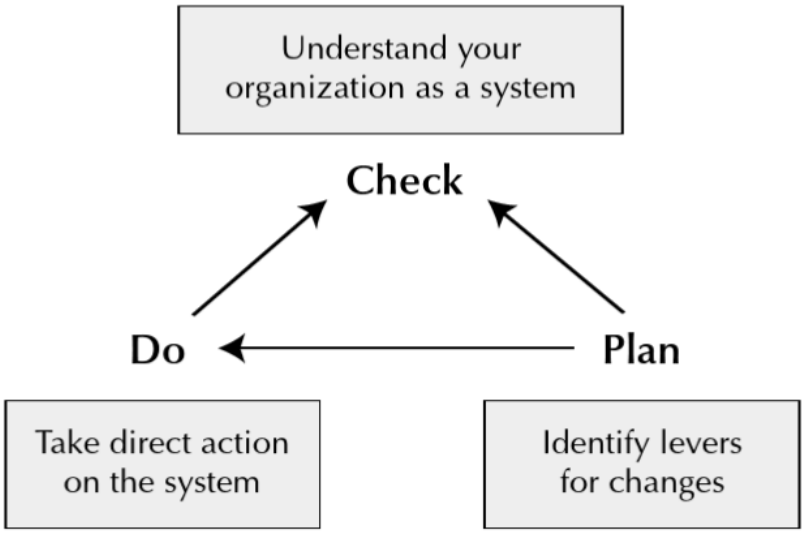

Figure 2.6 – Seddon Check-Plan-Do model, Seddon (2003, p110)

A summary of the stages (Seddon,2003) can be presented as:

Check - Gain knowledge to understand the purpose of the system (from the customers perspective), understand the nature of demand on the system and the capability of the organisation to respond. Understand how the work flows and what influences the system.

Plan - Changes that need to be made to improve performance against purpose (e.g., new process design), actions to be taken (e.g., to implement new processes) and new measures (to measure performance against purpose).

Do - Implement actions, measure outcomes and review, then go back to check stage.

Analysis of Seddon's (2003) check-plan-do cycle highlights the influence of the Deming cycle presented by Evans (2014). For example, the plan stage (PDSA cycle Fig 2.3) and the check stage (Fig 2.6) both include data gathering to understand the current state and inform the next stage. Arguably the uniqueness of Seddon's (2003) cycle is the composition of elements within the 'check' stage, which builds on viewing

the operation as a system (Deming, 1982; Seddon, 2003; Christopher, 2016) and in particular, viewing the organisation from the customer perspective of ‘purpose’ (Seddon, 2003,2008). Zokaei et al (2011, p5) argues that the analysis stage (check) of the check-plan-do cycle is designed to change the thinking of participants and open “the eyes of the organisation” to the impact ‘command and control’ thinking has on the organisation. Table 2.4 presents an interpretation (by the author) of the main steps of the ‘check’ model as developed by Seddon (2003). As this study seeks to build on the core concepts of Seddon’s philosophy and method for application within a supply chain, a column has been included to illustrate potential supply chain related examples. The table makes reference to the terms value demand and failure demand presented in the section glossary.

Table 2.4 - Check model, adapted from Seddon (2003,2008)

Step Number	**Action**	**Supply Chain Example**
Step 1	**What is the purpose?** (of the system/service/organisation in customer terms)	Can be linked to the 'rights' of purchasing (Jones and Oliver,2009) To deliver to right product on time, to the right location.
Step 2	**What are the types and frequencies of demand?** Why do customers use the service/organisation, what makes them contact the organisation, what creates value for them, what are the major types of failure demand – start to understand the predictability of the demand type.	What are the requests of the customers, why are they contacting the organisation. E.g., To order a next day product, to make a complaint, to chase a delivery, to request bulk purchases, to return an item.
Step 3	**How well does the system respond to demand?** Understand end-to-end times from the customers point of view. This step should measure the capability of the system	This element will evoke a holistic view of the service/organisation. E.g., From the moment there is a request for a product or service, to the completion of product or service delivery.

	using measures derived from ‘purpose’.	Whilst delivery times are most likely prominent in organisations, understanding the capability throughout the supply chain could be lacking.
Step 4	**Studying Flow** Once step 3 is completed and understood, identification of areas of poor performance and high variability will inform which are the primary processes to focus and apply mapping. This stage identifies further levels of value demand and failure demand (waste) in the processes.	An example in retail supply chain could be the returns process if identified to have high variability and poor end to end performance from step 3. Alternatively, this step could be applied to a supply chain of knowledge and expertise in delivering a service, for example, the support functions of a value chain (Porter, 1992).
Step 5	**Understanding System Conditions** Understanding what impacts the way work is done in an organisation. For example, I.T systems, organisational structure, policy and procedure.	A supply chain could have multiple system conditions across different departments and even organisations. This could potentially include multiple I.T systems that generate high levels of failure demand, policies such as minimum lead

		times, internal structures that maximise departmental activity rather than end to end flow. Making changes to system conditions reflects the concept of double loop learning presented by Argris (1977).
Step 6	**Management Thinking** Building from the knowledge and learning from stages 1-5, management thinking that shifts towards a system thinking approach would re-consider the choice of measures and build them from 'purpose' rather than potentially arbitrary numeric targets. In essence, moving from command and control thinking to systems thinking.	Managers would question the value of 'command and control' type measures/targets (for example, number of items picked per hour, number of customers visited per day) and understand the potential failure demand this causes. Viewing an end-to-end supply chain as a system could include multi departments and organisations. Understanding the impact of department targets between one department and another could potentially unearth unknown failure demand, changing the approach to

		how an organisation measures performance across departments would challenge command and control type structures and management methods.

2.3.4.1 Further influence and critique of Seddon's philosophy and method

As highlighted above, there are key features within Seddon's method, which when considered collectively give the work a uniqueness compared to other methods discussed in the literature. For example, through the influence of Deming (1981) and a focus on changing management thinking (from command and control thinking to systems thinking), particularly regarding performance measurement and replacing performance targets with the notion of achieving purpose. In addition, the method does not assume a problem, building on the work of organisational theorist Russel Ackoff. Seddon's (2003) 'check' model is designed to identify the actual problem to solve, rather than solving the wrong problem (vis a vis what is assumed to be the problem), which according to Ackoff often causes organisations to fail (Christopher et al, 2022). Eliminating the actual problem (dissolution), prevents reoccurrence through re-designing the system (Ackoff et al, 2006). Application of the check model (Seddon, 2003) defines what is value demand and what is failure demand, failure demand analysis in particular leading to identifying sub optimal performance and highlighting areas of focus for re-design. O'Donovan (2012) argues that key to learning systems thinking is doing (i.e., apply to the workplace), drawing similarities and influence to Seddons theory from the work of Senge (1995) and organisational learning. In particular, people learning together and the nurturing of expansive and new patterns of thinking.

Seddon's method and underpinning philosophy is less complex than others presented in the literature, for example, some of the hard systems thinking approaches associated with operational research discussed by Zexian and Xuhui

(2010), aspects of critical systems thinking (Jackson, 2001), critical realism and philosophy (Mingers, 2015), arguably making the application more straight forward. Whilst the iterative nature of the method has similarities with other iterative approaches such as the Quick Scan Audit Methodology (QSAM) developed by Cardiff University (Childerhouse et al, 1999), the integration of the points highlighted above (e.g., change of management thinking) are a differentiator and therefore give a uniqueness. QSAM has similarities with other methodologies that are applied over a relatively short period of time (e.g., 1- 2 weeks), and whilst QSAM offers a platform that is effective (Thomas and Barton, 2011), Seddon (2003, 2008) espouses a significant period is required (C. 12 weeks) to gain in depth knowledge about the demand, flow and system conditions.

To further highlight the linkages and commonalities of Seddon's philosophy and approach with other systems thinking scholars, Table 2.5 below is an adaption of the literature presented by O'Donovan (2012).

Table 2.5 - Commonalities of approach - adapted from O'Donovan (2012).

Author espoused by O'Donovan (2012)	**Key points and commonalities with Seddon's systems thinking approach**
Ackoff (1999b)	Dissolution – the concept of problem elimination and preventing from reoccurring by re-designing the system in which the problem is contained *(rather than a focus of individual elements thought to be the cause of a problem).* This further supports Ackoff's believe that the performance of the whole (system) is never the combined total of the performance of the individual part (Ackoff and Deming, 1992) – In Seddon's (2003,2008) work this is evident in the notion of purpose, and the importance of working on flow, rather that the individual performance of activities (or functions).
Chapman (2004)	A systems thinking approach is in contrast to a reductionist approach – a reductionist approach is likened to Seddon

	(2003) as 'Command and Control'. Systems thinking has an avoidance of breaking things (*e.g., processes*) down (*when studying*), providing a holistic approach.
Checkland (1981, 1997)	Using the word 'system' to make conscious the concept of wholeness. The recognition of emergent properties being a fundamental systems idea. For example, re design of systems through learning – Akin to learning from Seddon's (2003) check model.
Senge (2006)	The demonstration that feedback loops are crucial to refining a system's performance – links also to Argris (1977) single and double loop learning. Reflects the continuous Check, Plan Do cycle (Seddon, 2003) and the iterative nature of implementation.
Flood (1999)	Making visible that peoples actions are interrelated with others, related to patterns of behaviour and not just isolated events – Links to behaviours driven by targets and the check phase of the model (Seddon, 2003).

O'Donovan (2012) further highlights similarities with the work of Checkland (1981) and Ackoff (1999a), drawing comparisons with Seddons (2003) concept of purpose through 'root definition' (Checkland,1981) and mission statement (Ackoff,1999a). However, O'Donovan (2012) highlights that Seddon's check model has a focus of purpose from the customers perspective. Without detailed mention within Seddon's (2003, 2008) literature, the method does have traits of critical systems thinking (Jackson, 2001; Jackson and Scholes 1999), where a mix of systems thinking methods/approaches is evident. For example, quantitative data capture and analysis (i.e., demand requests) and the application to process design (hard systems approach), versus the consideration of people, their influence on the system and the development of a systems mind-set or culture (Checkland's soft systems method). Whilst the linkages to scholars such as Checkland and Jackson are apparent, Seddon's method has its limitations, as it does not pay enough attention to the potential differences of people (e.g., of opinion, how they might influence change),

particularly in the check stage (see table 2.3). In the context of this research this would be stakeholders of an organisation and wider supply chain. This is deemed an important area of evolvement for this study due to the potential complexity of the stakeholder groups and influence they have within a supply chain.

Whilst Seddon's (2003,2008) literature discusses the importance of flow (and therefore end to end processes), application of the method within the literature does have limitations regarding a fully holistic application. This is highlighted by O'Donovan (2012), citing the work of Jackson (2008) who challenges the macro level of the Seddon methodology, arguing that it has a focus on re-designing sub-systems without giving reference to other levels or parts of the business.
O'Donovan (2012, p15) highlights acknowledgement by Jackson (2008) that Seddon's method recognises the problems of sub-optimisation (e.g., focusing at micro operational level) at the level of operation but argues the method does not pay enough attention to them "at a wider system level" - in the context of supply chain this could reflect only focusing on processes with an organisation or function, which would be limiting. The model for this study seeks to consider the wider supply chain (rather than a specific area) as a system and understand the impacts between organisations/functions to give a holistic picture. Whilst O'Donovan (2012) argues that boundaries to Seddon's method are set by the customer, and that through application of the model, associated constraints at higher levels of the system are recognised (as system conditions), the model (and therefore approach) for this study seeks to scale up Seddon's method through viewing the whole supply chain as holistically as possible/feasible.

Seddon's (2003,2008) method builds on the work of Checkland and Scholes (1999) and Deming (1982) regarding how targets (vis a vis KPI's) are used within an organisation. Whilst Seddon is very damming about the use of targets, and constantly highlights the driving of negative behaviour(s), the literature and method lacks depth (and therefore has limitations) as to a method for generating knowledge for understand the impact of targets upstream or downstream of an organisations internal or external supply chain - in essence, a method for generating more holistic knowledge for the potential negative impacts of targets used across the supply chain. In addition to understanding the impacts of targets (upstream and

downstream), not explicit within Seddon's method is knowledge generation regarding the linkages and interdependencies between the functions of an organisation – for example, information requirements and how well these are being met (this is discussed further in section 2.2). Due to the potential for many different functions\organisations within a supply chain, these areas are deemed key for further development within this study.

Whist Seddon's method has been successful in application (discussed further in section 2.3.5), Marshall (2012) challenges the strategic management of Seddon's model and highlights a lack of sustainability (sustained application of the method) for a range of reasons, including conflicts of interest with local operations and business priorities, together with incompatibilities between different ways of management thinking. This study is concerned with application in the context of a supply chain, which by its nature is likely to have multiple functional areas which could evoke conflict in business priorities (as highlighted by Christopher (2016) earlier in this section). The focus towards strategic management within Seddon's (2003) check-plan-do model is limited, and therefore considered an area for development and inclusion within this study (see section 2.7).

Building on previous research of Seddon's philosophy and method (Marshall, 2013; Seddon & Caulkin, 2007; Smith & Galimore, 2015) literature searches indicate that whilst Seddon's method has been applied and subsequently researched in areas such as social housing repairs, there is minimal evidence (within the literature) of research or application of the method in the context of supply chain. Whilst Jaaron & Backhouse (2016) discuss the involvement of the customer and the notion of clean demand (demand on the operation not caused by waste, e.g. a customer calling to complain) in forward and reverse logistics, the logistics operations discussed are within the housing repairs sector. The paper recognises the value of the application of the Seddon's method if it were to be applied to other Logistics contexts, which further supports the rationale for building on the core concepts of the method for this study.

2.3.5 Application of John Seddon's Systems Thinking methodology

Chapter 1 outlines the rationale for integrating the core concepts of Seddon's philosophy and method into the conceptual model for this study. To further support the rationale, this section presents literature that highlights some of the success stories for organisations that have applied Seddon's method. The application of the method to supply chain related organisations (moving goods to end customers) is lacking and therefore can be considered a gap in the literature, literature searches identified empirical studies in other sectors which are presented in this section.

Application to private sector electrical power distribution company

Hopkinson (2011) discusses the implementation of Seddon's method within a UK electrical distribution company, the name of Seddon's method has changed over the years, at the time of Hopkinson's (2011) research it was called Lean Systems Thinking. It is worth noting that although Seddon has renamed his method several times (Lean Systems Thinking, Systems Thinking, The Vanguard Method) the core method and philosophy has not changed. Hopkinson (2011) gives a short critique of hard v soft systems methodologies (as discussed in section 2.2.3 of this review), citing that Seddon's method is an alternative to a hard systems approach (E.g., measurement of machines and equipment), however, as discussed in section 2.2.4, Marshall (2012) positions the method somewhere between a hard and soft approach.

Hopkinson (2011) reviewed application of the method to the repair and restoration (R&R) section of the business and was described as a reactive part of the service, for example, responding to a customer calling to report they have no electricity supply. The outcomes presented by Hopkinson of the implementation of Seddon's method can be considered very positive regarding operational improvements (specifically refining and re-designing processes). For example, quantitative measures such as number of incidents reported as being reduced, together with reduced variation in service performance (using statistical process control). The end-to-end time (the total time taken form initial enquiry to service completion) to clear faults significantly improved, which according to Hopkinson (2011) means that from the customers viewpoint there is an improved service, Seddon (2008) uses the term

‘capability of response’ as the performance measure of end-to-end time. From a financial viewpoint, significant savings were made over the first-year post intervention.

The repair and restoration process implementation reviewed by Hopkins (2011) can be contrasted with some of the critical review of Seddon’s method highlighted by O’Donovan (2012) in section 2.2.4, particularly the reference to Jackson (2008) challenging the macro level of the method, for example, does the method focus too much on the immediate operations and lack a holistic approach to the wider organisation. This is emphasised in the context of Hopkins (2011) work, with the focus being on one area of the business only. However, the repair and restoration process can be contrasted to elements of a supply chain, as illustrated in figure 2.7.

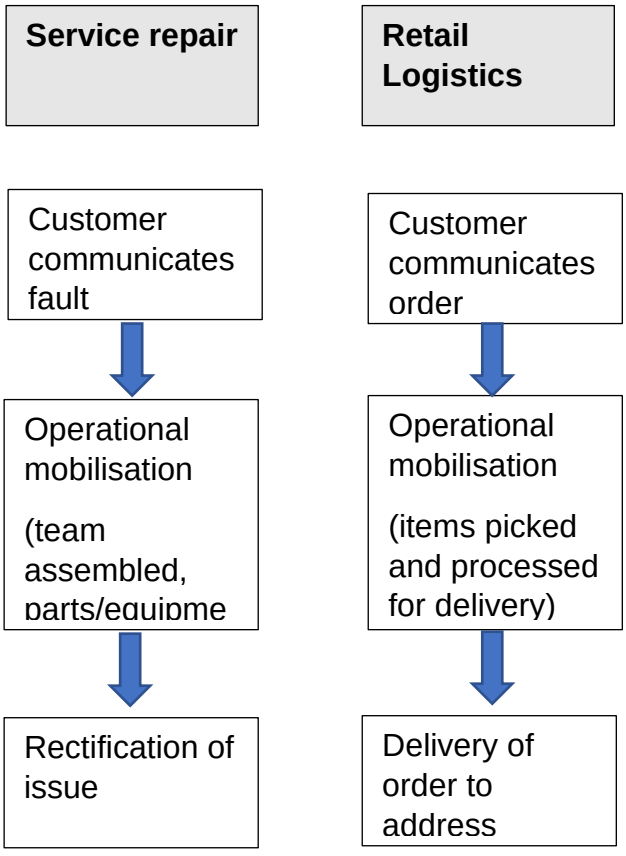

Figure 2.7 – Generic Process Steps of Service Repair Process v Retail Logistics Process developed by the author

The purpose of fig 2.7 is to highlight potential high-level process steps for each context and identifying the similarities in the steps. This supports the rationale for adoption and evolvement of Seddon's method in the context of supply chain.

Application to social housing organisation

Marshall (2012) conducted research to measure the impact and sustainability of Seddon's method across several organisations. The research included the study of a housing repair service, with the main concept of the service not dissimilar to the R&R service discussed above, i.e., customer calls organisation to report a problem – repair team mobilised – problem rectified.

The study evaluated the impact of application of the plan-do-check model (Seddon,2003,2008), with the results highlighting lower levels of failure demand, much higher customer satisfaction, and complete cycle time (end to end process time) reduced from a mean of 88 days to 8 days.

The immediate results post application of the check-plan-do model were very positive, with operational process performance measures reflecting 'hard' aspects of a systems approach. However, Marshall (2012) challenges the long-term sustainability of Seddon's methodology in its current format, arguing that people's perceptions can change over time, in this case regarding the effectiveness of Seddon's methodology applied through a change intervention process.

Application to a Higher Education Institution:

Dunnion & O'Donovan (2012) discuss the application of Seddon's methodology within the higher education sector, arguing that the command and control (Seddon, 2008) management style present in both private and public-sector organisations is a primary cause of an expensive and inferior service. Reviewing an intervention in a London University, analysis of the results highlights a significant improvement in performance in relation to customer purpose (Seddon ,2008). The headline results are illustrated in Table 2.6.

Table 2.6 – Extract of results for HEI applications process, adapted from Dunnion & O'Donovan (2012, p35).

Pre- Intervention	**Post – Intervention**
Purpose: "Hit targets for registered students and maintain the data, provide information when requested and resolve problems"	**Purpose:** "Provide me with all the facilities, services and information I need to study at your university in the easiest and most simple way"
Performance:	**Performance:**
48 days for average application turnaround time	Improved to average of 3 days
Enrolment time - 6hours and 3 queues	With a new bespoke welcome pack, the same process time is reduced to 6mins
18% of students rating their experience of the service at 10/10	36% of students rating their experience of the service at 10/10

The results in table 2.6 highlight significant improvements post- intervention (application of Seddon's method), with a change of mindset regarding purpose (the purpose of the service from the customers perspective (Seddon 2003). The new purpose deviates from an internal driven mindset of meeting student number targets, which according to Dunnion & O'Donovan (2012, P36) is a "dangerous game" and there is not an effective way of setting targets. Dunnion & O'Donovan argue that student number type targets are arbitrary numbers and therefore designing a system to meet such targets would result in the system failing, due to predicted numbers not being accurate and therefore associated budgets and income projections being wrong. This would lead to incorrect operational decisions such as capacity (e.g., classroom requirements) and resources (teaching), all which will impact the student (customer) experience.

The notion of arbitrary targets in higher education institutions and the impact on operational effectiveness can be contrasted with other sectors, including supply

chain and logistics operations and some of the metrics types discussed in section 2.3.5. For example, performance targets set for reduction in activity time in different functions (e.g., lead time in purchasing), or volume per hour (e.g., items picked per hour in warehouse operations) set with no reference to data or with minimal rationale for the target figure. As highlighted by Dunnion & O'Donovan (2012), arbitrary targets can lead to inaccurate operational decision making, which in the context of supply chain could impact many areas as illustrated by Mangan and Lalwani (2016), for example, capacity and resources associated with the areas (or departments), ultimately leading to less efficiency. Arbitrary cost reduction type targets at a functional level, managed through a command and control mindset will lead managers to "seek competitive advantage through economies of scale, whereas systems thinkers strive for economies of flow "(Seddon 2003, p22).

2.3.6 Systems Thinking in a supply chain context

As discussed in previous sections, there is a gap in the literature about the application of Seddon's systems thinking method to supply chain related organisations (moving goods to end customers). However, literature searches do highlight some application of other systems thinking concepts (for example, as discussed in section 2.3.2) within a supply chain context, although it is not extensive. For example, Moon & Kim (2005) apply an individual 'Systems Thinking' ability to measure how a person views the dynamics of a supply chain, regarding viewing such dynamics in a holistic way. Whilst this method potentially evokes a holistic approach (Senge,1991), it is very scenario based and does not offer any generic strategic dimension for sustaining or leading such an approach. In addition, the success could be dependent on who that person is (viewing the supply chain), e.g., are they internal or external, as there are likely to be different viewpoints due to the potential of having different perspectives and priorities.

Ghadge et al (2013, p523) discuss the notion of a systems thinking approach in the context of supply chain risk management (SCRM) and suggest that using a "systems thinking based approach is largely unexplored" and that such an approach could "provide a methodological and structured approach to risk management due to its ability to consider the systemic environments within the larger system". Whilst the

research does link to the informing of strategy and forms part of the continuous improvement cycle, the application is specific regarding SCRM. The approach discussed by Ghadge et al (2013) reflects a ‘hard’ systems approach (Jackson, 1993) and incorporates simulation modelling with analysis of quantitative data. Whilst the research does discuss the organisational culture and human resources, discussion and recognition of the strategic management to sustain the methodology is minimal.

According to Holmberg (2000), to sustain a competitive position, organisations are seeking a more integrated approach to supply chain management (SCM) as supply chains are often complex and have many interdependencies. Holmberg avocadoes the use of Systems Thinking to make sense of the complex interdependencies and to analyse the relevant contexts but argues that “the problems reported by many organisations show the use of Systems Thinking is insufficiently developed” (Holmberg,2000, p847).

Skipworth et al (2016) links supply chain alignment with business performance and the strategic fit of supply chain `partners’, highlighting that a lack of alignment can create ‘functional Silos’, for example, each department having complete focus on its immediate activities and not considering the wider internal or external supply chain. Such alignment incorporates an element of systems thinking regarding how one element of the supply chain can impact another. Skipworth cites the research of Baier et al (2008) who identify through research of 141 organisations that to achieve superior financial performance business strategy and purchasing strategy is key. However, it could be argued that improved financial performance is not a definitive measure of business improvement. For example, in context to this study, the bottom-line figure could be improved for one accounting period through procurement of cheaper raw materials /goods/services etc but depending on the type of demand (for different products and services) this may be negated in the next accounting period. This type of measure also has the potential to create functional barriers (Christopher, 2016) and to neglect the customer and the level of service provided aligned to ‘purpose’ (Seddon 2003,2008).

More recent searches highlight the work of Elias et al (2021), who use a systems thinking modelling framework as a methodology for holistic analysis of a sustainable wood supply chain in the Amazon. The literature highlights some of the different approaches to systems thinking and is an example of applying a systems mindset to help understand the complexities of a supply chain. Whilst a comprehensive systems model is not presented for application, the work does discuss the methods applied to review the supply chain as a system, which includes external impacts and stakeholder analysis. The main concept applied is casual loop modelling, which according to Elias et al (2021, p12) is a process that "involves connecting the variables in a system by arrows using the cause and effect logic". Interestingly, through application of a systems approach and the feedback loops, counterintuitive behaviour was identified, a phenomenon also experienced through application of the Seddon method (discussed in section 2.2.4), this supports the concept of a changing of mind set when moving to a systems thinking philosophy in an organisation.

2.3.7 Overview

This section (2.3) has presented systems thinking literature relevant to support the rationale and context of this study, the following points provide summary and highlights key areas for informing the design of the conceptual model:

General Systems thinking context and approaches

- Viewing organisations and its supply chains in a holistic way, with the aim of the system being understood by everyone. Problems cannot be viewed in isolation; the interdependent and interconnected nature of problems lead to needing an understanding that operational functions need greater oversight of other functions rather than just considering their own individual elements.
- Appreciation and recognition of hard and soft elements of the system, in essence, recognition that people are not machines or equipment and therefore attention paid to human interactions and behaviours – a soft systems approach.

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- Success of application to service sectors highlights the value of the general concepts and supports rationale for use in the conceptual model for this study. Evolving the core concepts of the systems thinking theory gives opportunity to address the gap in the SCI models/approaches regarding the problem of functional silos and their relationship to negative the influences of performance targets.
- Whilst the Seddon literature provides useful structure of method, there are gaps in the literature that can be addressed in the development of the conceptual model for this study. Specifically, a method for understanding the actual impact of performance targets between functions/departments, in addition to consideration of how strategic leadership can be built within the method for business improvement.
- Although highly successful in the service sectors discussed (in chapter 1 and 2.3.5), there is a research gap for application of the method to supply chain related organisations (moving goods to an end customer). Through adoption and building on the core principles of Seddon's philosophy and method within the conceptual model for this study will generate new knowledge and therefore contribute to the body of knowledge in the area of improving business performance within supply chains.

Summary

Evolving the systems thinking theory for application to the context of supply chain gives opportunity to address some of the gaps that exist in within general supply chain theory, in particular barriers to SCI and the problem of functional silos. Further development of the systems thinking theory, including the work of Seddon (2003,2008) gives opportunity (through development of the conceptual model) to understand the impact supply chain functions have upon each other, particularly in relation to the influence of current performance measurement systems and associated targets.

2.4 Methods for Business Improvement

2.4.1 Introduction

Section 2.3 presents a review of literature specific to systems thinking, including critical review of the philosophy and method of Seddon (2003,2008). Whilst the conceptual model development for this study draws from the core concepts of Seddon's philosophy, there are opportunities to further build on and enhance for the development of the conceptual model. This section presents review and discussion of literature to further build on Seddon's work (discussed in section 2.3.4) for analysing business performance. The areas presented were selected to give a high-level overview of the concepts associated with the methods, which were selected through a combination of initial literature searches and the authors extensive experience as discussed in Chapter 1.

2.4.2 Lean

Literature searches highlighted that Lean is a subject that has been researched and studied extensively over the last 20 years, including application to supply chains for improving performance. This section draws from studies that have been undertaken and incorporated lean literature searches into their research, to highlight and discuss from a high-level perspective the main attributes of applying Lean to an organisation. For example, Arlbjorn and Freytag (2013), who highlight that most of the literature they reviewed was found in supply chain or production journals, whilst stating that the application of Lean is also prevalent in service and public sectors.

Patel et al (2020) highlights that the term 'Lean' is a term derived from The Toyota Production System and was made famous in reference to manufacturing or production processes by Womack et al (1990). Patel (2020, p631) state that Lean is a "dynamic process of change, driven by a set of principles and best practices aimed at continuous improvement". Womack and Jones (2003, p16) present 5 principles of lean:

1. **Specify Value**
   Whilst organisations create value, this should be “from the customers standpoint”
2. **Identify the value stream**
   Identification of the required actions to progress a product or service (or both) through critical management tasks
3. **Flow**
   Make the value steps flow
4. **Pull**
   Deliver the product/service the customer wants and allow them to pull it through process – e.g., do not make large batches and then try and create a market to sell them
5. **Perfection**
   As the 4 previous areas develop, striving for perfection becomes more of a reality

Gupta et al (2015) argue that academics and practitioners have attempted to define Lean over the years, but there is no consistency to an actual definition, partially because the concept has evolved over the years. Table 2.7 illustrates a number of definitions cited by Gupta et al (2015, p1027).

Table 2.7 – Definitions of Lean, cited by Gupta et al (2015,p1027)

Author	**Definition of Lean**
Womack et al. (1990)	"Lean is an approach which uses half the hours of human effort in the factory, halves the defects in the finished product, requires one-third the hours of engineering effort, half the factory space for the same output, a tenth or less of in-process inventories"
NIST (2000)	"A systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection"
Cooney (2002)	"Lean takes a broad view of the production and distribution of manufacture, developing a production concept that encompasses the whole manufacturing chain from product design and development, through manufacturing and distribution"
George (2003)	"Lean is to accelerate the velocity of any process by reducing waste in all its forms"
Hopp and Spearman (2004)	"Production of goods or services is Lean if it is accomplished with minimal buffering costs"
Shah and Ward (2007)	"An integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimising supplier, customer, and internal variability"

Hallgren and Olhager (2009)	“Lean manufacturing is a programme aimed mainly at increasing the efficiency of operations”
Radnor (2010)	“A management practice based on the philosophy of continuously improving processes by either increasing customer value or reducing non-value adding activities (Muda), process variation (Mura), and poor work conditions (Muri)”

Gupta et al (2015, p1026) summarises the above definitions by stating Lean as “an integrated multidimensional approach encompassing a wide variety of management practices based on a philosophy of eliminating waste through continuous improvement.” In addition, their research presents Lean as more than just a set of tools or instruments to achieve reduction of waste and improvement in quality, suggesting it is culture oriented, with the philosophy becoming a way of thinking.

Garcia – Buenda (2021) highlights that the application of lean to supply chains for improving business performance is called Lean Supply Chain Management (LSCM) and is an enabler for elimination of waste, reducing costs and making improvements in quality (of service/product). To further expand the context of supply chain, Tortorella (2017) argues that LSCM includes linkages with organisations either downstream or upstream (of an organisation) regarding the flow of products, information and services. Tortorella (2017) argues that many studies undertaken in the area of LSCM have only focused on an individual aspect of the supply chain and have not considered the downstream or upstream activities of the organisation, which can be argued lack a holistic perspective.

Jones (2014, p75) concludes that Lean is reliant on the support of organisational values and “true empowerment” being key to sustaining the methodology within an organisation. Jones (2014) argues that without these being in place the application of Lean will lead to failure due to adverse impacts on morale and worker happiness,

often due to employees viewing Lean as an opportunity to downsize rather than part of strategic development. Jones highlights that this is often due to managers focusing on the tools associated with Lean instead of viewing and presenting it as a philosophy. Tools associated with Lean (Arlbjorn and Freytag, 2013) include:

- 5S – A method for keeping a workplace tidy and organised
- SMED – A method for reducing equipment changeover times
- Tact Time – The speed of processing required to fulfil orders against demand

Viewing Lean as a set of tools aligns to the argument put forward by Seddon (2003, 2008), where managers focus on the tools, which he disingenuously derives them as 'toolheads'.

The discussion by Jones (2014) and Gupta et al (2015), and the linking of Lean to being a philosophy and organisational values parallels with Seddons (2003,2008) philosophy of needing to change the way managers and the organisations thinks, in particular for sustaining business improvement. This is considered a key area for informing the design of the conceptual model, in particular for sustaining business improvement.

2.4.3 Six Sigma

The organic nature of the literature review and the authors many years' experiences in industry, led to literature searches related to Six Sigma. As with Lean, literature searches highlighted Six Sigma is a subject that has been researched and studied extensively over the last 20 years. This section draws from studies that have undertaken and incorporated Six Sigma literature searches into their research, to highlight and discuss from a high-level perspective the main attributes of Six Sigma and identifying areas for informing the conceptual model.

Patel and Patel (2021) present the industry evolution of Six Sigma and how it was developed to improve the quality of products, including a 4-stage approach, evolved to a 5-stage approach by the General Electric company - Define, Measure, Analyse, Improve and Control. Which according to Mishra et al (2014, p530) can be defined as:

"Define: What is the problem? Does it exist? What type of defects exist?

Measure: How is the process measured? How is it performing?

Analyse: What are the most important causes of defects?

Improve: How do we remove the causes of defects?

Control: How can we maintain the improvements?"

The research of Patel and Patel (2021) highlights that the primary focus of the Six Sigma process is the reduction of variability of product/service (and therefore reduce defects) to enhance customer satisfaction. They present further definitions from the literature searches which are illustrated in table 2.8.

Table 2.8 – Six Sigma Programme Focus, cited in Patel and Patel (2021, p636)

Author	**Definition of Six Sigma**
Tomkins (1997)	"to the near elimination of defects from every product, process and transactions"
Antony and Banuelas (2002)	"to accelerate improvement in product, process and service quality by relentlessly focusing on reducing variation and eliminating waste"
Andersson et al (2006)	"to reduce variation, which focuses on continuous and breakthrough improvements"
Zhan and Ding (2016)	"to improve business performance, with an emphasis on the voice of the customer and using statistical analysis tools"

Jones (2014) states that the foundations of Six Sigma were laid by some of the established quality guru's such as Deming, Cosby, Juran and Ishikawa through their quality management initiatives and the evolved theory of TQM (total quality management). According to Evans and Lindsey (2011), TQM emerged through the

recognition that quality needs to be seen as a management discipline, rather than just a technical discipline primarily focused on production line type processes. Evans and Lindsey (2011) further acknowledge this by highlighting a total system approach, in that TQM is embedded across the functions of an organisation, horizontally, and includes every person from top to bottom, whilst also expanding across the wider supply chain. The blue chip company Proctor and Gamble have a precise definition, stating “total quality is the unyielding and continually improving effort by everyone in the organisation to understand, meet and exceed the expectations of the customers” (Evens and Lindsey, 2011,p11).

Jones (2014) argues that elements of Six Sigma that retain a TQM approach include:

- The notion that everyone in the organisation is responsible for the quality of services or goods
- Investment and training and education of people in the use of tools for problem solving and measuring such as: Control charts, flowcharts and cause and effect diagrams.
- A focus on customer satisfaction

According to Jones (2014), Six Sigma differs from TQM in that it gives a metrics and goal (Sigma level) to work towards, where in contrast TQM lacks ‘hard’ facts for organisations/practitioners to follow, suggesting TQM is more philosophical and perhaps too broad - Six Sigma offers a structured methodology to follow in order to achieve process improvements.

The research of Nascimento et al (2019, p597) supports the structured methodology theory, by arguing that Six Sigma is a process that is highly disciplined and that the term “Sigma” is the statistical measure as to how much a “process deviates from perfection”. Further arguing that Six Sigma has advantages over TQM as management decisions are made from data, with accompanying use of statistics to reduce process variation. This has parallels with the ‘check’ model of Seddon (2003,2008), whereby the data collection generates knowledge to which decisions can be made in an iterative process.

Reviewing the Six Sigma literature highlighted the concept of Measurement Systems Analysis (MSA), which according to Gygi et al (2012) is a method for quantifying the

level of variation within the measurement system (i.e., the methods and equipment used for measuring conformance to standard). For example, when making measurements and there is variation of results, how much of the variation is due to the actual measurement methods being employed (which in manufacturing usually incorporates equipment). Meran et al (2013) highlight 2 metrics associated with MSA:

Repeatability - If a measurement is repeated in the same conditions (e.g., same person, same equipment), how close is each measurement to the true value.

Reproducibility – What is the influence of different evaluators, for example, if the same measurement method is used but by different people (or different pieces of measurement equipment) what is the variation of results. Other influences of reproducibility can be related to environmental conditions (Meran et al ,2013)

Whilst MSA is typically discussed in the literature in relation to physical items and use of equipment, followed by mathematical calculations to work out levels of accuracy (which can then be considered within the actual process measurement results), the general principles could be applied to other forms of process measurement, including service operations. For example, if a process is being measured against achievement of purpose (Seddon, 2003, 2008), how reliable and repeatable is the actual measurement method being used. This is an area that the Seddon (2003, 2008) literature does not address, and the method could be further evolved with such inclusion. This gives rationale for incorporating measurement methods testing into the design of the conceptual model.

2.4.4 Combining Lean and Six Sigma

Reviewing the literature for Lean and Six Sigma highlighted the term Lean Six Sigma (Sreedharan and Raju, 2016), where a combination of Lean and Six sigma approaches are used to improve business performance. According to Patel and Patel (2020) Lean Six Sigma (LSS) methodology has grown significantly in manufacturing and some service sectors, highlighting that researchers have produced a number of conceptual frameworks for implementation, although validation of the frameworks through actual case studies is lacking. Research fields have emerged to focus the methodology, in areas such as the environment and

sustainability, having parallels with the concept of this study whereby the application of the conceptual model is a supply chain context.

The combination of Lean and Six Sigma methodologies and associated research has evoked several definitions, as highlighted by Sreedharan and Raju (2016) in table 2.9.

Table 2.9 – Definitions of Lean Six Sigma, adapted from Raja and Raju (2016,p433)

Author	**Six Sigma Definition**
Lee et al. (2010)	"Six Sigma is a well-structured methodology that focuses on reducing variation, measuring defects and improving the quality of products, processes and services. Lean Production is an approach that focuses on reducing the cycle time and eliminating waste in processes. Combining the principles of Six Sigma and Lean can achieve synergistic results that neither system can achieve alone"
Zhang et al. (2012)	"Acting together, Lean manufacturing and Six Sigma become highly powerful and eliminate the cons of each approach. It applies the tools and techniques of both Lean manufacturing and Six Sigma"
Gupta et al. (2012)	"Six-Sigma concentrates on reducing process variation, Lean focuses on reducing process time by removing non- value-added steps and waste. When these two methodologies are combined in the form of LSS, organizations boost customer satisfaction by providing high quality products and services on time"
Silva et al. (2012)	"Six Sigma and Lean, acting together can become even more effective, as their strong points are able to cover the other's gaps or deficiencies. This

	union may create a synergy, which exercises a great influence over the general performance of the business processes”
Yeh et al. (2011)	“With a combination of Lean thinking and Six Sigma (SS), LSS is a well-known methodology for providing a powerful process improvement solution. LSS has become one of the best tools for health care system because it develops core competence in health care that deal with crucial needs in patient care and safety”
Imam et al. (2012)	“Lean eliminates the use of Six Sigma’s DMAIC cycle on the other hand, Six Sigma eliminates defects but does not address how to optimize the process flow. Hence, applying both Six Sigma and Lean tools sets results in far better improvements than could be achieved with either one method alone”
Zhang et al. (2012)	“Acting together, Lean manufacturing and Six Sigma become highly powerful and eliminate the cons of each approach. It applies the tools and techniques of both Lean manufacturing and Six Sigma”

Analysis of the definitions presented in table 2.9 identifies a common thread, in that by combining the two methodologies organisations have a potentially powerful approach\method to business improvement, where the combination of methodologies reduces gaps identified if used in isolation. This is highlighted by Patel and Patel (2020), who argue that the philosophy of Lean is about the restructuring of processes for reduction of wasteful activities and variation, with the focus of Six Sigma being on process variation. The research argues that application of a Six Sigma methodology in isolation will not remove all waste types, likewise

application of a Lean methodology in isolation cannot remove variation within the process.

Raja and Raju (2016) undertook a comprehensive systematic literature review of Lean Six Sigma in different industries (235 articles reviewed), and highlighted a number of gaps in the literature at the time of publication, which can be summarised:

- Lean Six Sigma (LSS) does not give a holistic approach if used as a tool (this could reflect using micro elements in isolation such as the concepts presented in section 2.4.2 such as 5s) rather than a technique (or methodology) – this mirrors the view of Seddon (2003) and his disingenuous use of the term 'toolheads' as discussed in section 2.3.
- Lack of availability of clear guidelines for deployment of LSS in different environments/contexts.
- Managers and workers lack awareness for potential need for and importance of LSS, for example, may not understand the wider strategic need for improving business performance – *an area of note for the conceptual model for this study.*
- Conceptual methodology (e.g., a particular construct of the methodology) is lacking for application of the methodology in multidisciplinary environments and needs to be integrated with philosophies such as supply chain, sustainability, agile engineering – *this supports the rationale for the supply chain context of this study*
- Organisations/industries need a strong LSS framework to meet changing demands.

The author of this study has previously investigated the application of Lean Six Sigma and designed a short academic course which was applied to a large human resource department of a county police constabulary. At the time, the specific Six Sigma detail was to be contracted to a specialist provider and the research to do this highlighted the lack of a recognised standard, which adds verification to the 2nd and 4th bullet point above. Whilst there has since been the creation of an ISO 18404:2015 standard - Competencies for key personnel and their organizations in relation to Six Sigma and Lean implementation (ISO.Org), there are undoubtably

many organisations still offering their own certification. Arguably this does not matter, and variation on models drawing from the principles of LSS could potentially offer more bespoke methods for different contexts and sectors.

Raja and Raju (2016) argue that there is a lack of literature concerning specific applications or contexts for application of Lean Six Sigma, however Martin (2014) does offer literature for specific application through the publication of a book titled “Lean Six Sigma for Supply Chain Management”, including a 10-step solution process. Martin has published many books related to Lean, Six Sigma and supply chains which are informed through many years being a Six Sigma practitioner working at executive level. Martin’s work includes a 10-step solution process for application of LSS. The points are illustrated as:

1. Align project with business goals and Voice of the customer
2. Ensure buy in from the process owner, finance and other stakeholders
3. Communicate project to stakeholders
4. Ensure accuracy of measurement system, collect data on inputs and outputs
5. Improve measurement systems and refine analysis for route causes and associated solutions/improvements
6. Develop improvement plan, conduct pilot study
7. Integrate solutions to larger processes based on pilot study
8. Create standardised procedures and mistake proofing
9. Implement training and audits to sustain solutions
10. Create control plan, apply control strategies

The roots of the solution process presented by Martin (2014) can be seen in the Deming Plan, Do, Study, model (Evans, 2014) (see section 2.3.4 above) and the Six-Sigma DMAIC model (Define, Measure, Analyse, Improve, Control) discussed in section 2.4.3.

When contrasting the fundamentals of LSS approaches presented with the work of Seddon (2003,2008), similarities and differences can be found. For example, Martin (2014) discusses using segmentation (understanding different types of customers) to identify VOC (voice of the customer). Jones (2014) and Martin (2014) highlight that analysis of customer data such as customer complaints, surveys and interviews will

generate information as to VOC requirements. This contrasts with Seddon (2008, p79) who uses the term “purpose” to identify “what is the purpose of the service from the customers point of view”. This is not multi-faceted and could be used as a single reference point throughout an organisation and the wider supply chain, where research of VOC requirements could generate multiple themes and blur the high-level focus of what the supply chain is trying to achieve.

The notion of planning an improvement project to achieve target financial gains or other pre-determined metrics associated with the primary stages of a LSS project (at the define stage) is an area that differs with Seddon’s method. Whilst improvement projects should be aligned to company goals (for example, improving customer experience, reducing carbon emissions), the use of pre-determined deliverables are not advocated by Seddon’s method discussed in section 2.34. Seddon (2008, p78-79) argues that pre-determined metrics such as “cost/benefit analysis, projects deliverables, timescales and milestones” preceded change and are associated with “command and control” thinkers, and that systems thinkers dispense of this way of thinking. With reference to his ‘check’ model (fig 2.6), Seddon argues that “nothing is assumed other than we almost certainly don’t know what the performance is”. In essence, how can pre-determined outcomes be established without knowing the actual current situation. It is this way of thinking that reflects no targets and only measures being related to purpose.

Whilst Seddon associates Lean and Six Sigma approaches with the use of tools and is uncomplimentary about organisations and people using such tools in service organisations, there are direct similarities in the measurement stages of the methods and the use statistical analysis, in particular, application of statistical process control methods (although Seddon uses the term capability charts).

Jones (2014) highlights key areas related to leading and managing the integration of LSS throughout a supply chain, identifying that it is key for executives to be able to prioritise and accept their responsibilities and roles, while leaders when measuring performance must not ignore new values and consider new expectations. Jones (2014) argues that projects should be supported and led with active management, including training and feedback sessions. This implies a new way of thinking for implementation of LSS, which has parallels with shifting from a command-and-

control way of thinking to being a systems thinker (Seddon 2003,2008). In addition, Jones (2014, p20) argues that “all goals must tally with the organisation’s overall mission and strategic plan for steering into the future successfully”. In essence, it can be argued that if any improvement methodology is not integrated into the strategic intent and plans of an organisation, the buy in and longevity would be compromised. However, if goals are focused on pre-determined numeric metrics, according to Seddon (2003) this would drive negative behaviour (as discussed in section 2.3.3). Leadership and strategy are further discussed in section 2.7.

2.4.5 Overview

This section reviewed literature that highlighted high level perspectives on popular methods for improving business performance. The contrast with the core concepts of Seddon’s (2003,2008) literature highlighted similarities of philosophy, for example, the need to move to a different way of thinking and the notion of not just applying tools (i.e., lean tools as discussed in section 2.4.2) to individual areas of a process or organisation, as this will inhibit holistic thinking. Other similarities included an iterative approach to the method for application of business improvement methods, for example, the DMIAC 5 stage approach to Six Sigma (Patel and Patel, 2020) has parallels with the ‘check’ aspect of Seddon’s method, this evokes an iterative approach to application of methods which is built on knowledge and factual information, and therefore considered a very suitable approach for the conceptual model design of this study.

The literature also highlighted the need for business improvement interventions to align with organisational goals and the strategic plan, with strong leadership to sustain success; in the context of this study, this can be considered especially important for sustaining the method and business performance. This is informative for the development of the conceptual model and further discussed in section 2.7.

In addition, the literature highlighted the difference between identifying waste in processes and the system and understanding the variation in process performance. Whilst the conceptual model for this study is high level, understanding the 2 distinctions when measuring performance is important at micro level implementation.

The accuracy testing of measurement methods is prominent in the Six Sigma literature through Measurement Systems Analysis (MSA), however such methods are not included within Seddon's method. The inclusion of accuracy testing is deemed an important consideration for the conceptual model of this study and would further evolve and build on Seddon's (2003, 2008) systems thinking philosophy and method.

2.5 The Notion of Value

2.5.1 Introduction

A common term associated with the methodologies discussed in sections 2.3 and 2.4 is 'value', and the need to seek and understand it within the system and associated processes. For example, in methods associated with Lean (see section 2.4.2), and the notion of value demand associated with Seddon's (2003,2008) systems theory (see section 2.2.4). Whilst the conceptual model for this study builds on Seddon's work (as discussed in chapter 1 and 2.3.4), the frequent use of the term value in the business improvement literature led to compiling this brief section to further discuss the notion of value and identify points to further inform the design of the conceptual model.

2.5.2 Concepts of Value

Seddon (2003) links value with 'purpose' and uses the phrase 'value demand' (see section 2.3.4). For example, the purpose of a retail supply chain from a customer's perspective could be considered as: - to deliver the right product ordered, in the right quantity, to the right location, with the perceived quality, at a fair price, the work within the processes associated with such purpose would be considered as value demand work. If purpose is achieved customers will be satisfied and pay for the product or service, which according to Porter (1998) would be considered as value, i.e., what customers (buyers) are prepared to pay for a service or product. In essence the more a customer is willing to pay, the higher the perceived value of the product/service. This notion is supported by Chopra and Meindl (2013), who argue that the value of the product can be determined by what a customer is willing to pay and can vary for different customers.

Porter (1998) argues that activities associated with delivering a product or service can be grouped into categories, which he refers to as the ‘value chain’, the theory being that an organisation is profitable if it is able to perform the collective activities at a cost which is less than the value (or purchasing price). Chopra and Meindl (2013, p15) state that “the objective of every supply chain should be to maximise the overall value generated” and use the term ‘supply chain surplus’ to represent the difference between the total supply chain costs and the ‘customer value’ (or amount they pay for the product/service).

Figure 2.8 illustrates the activities identified by Porter (1998) that contribute to value for the buyer, where activities more directly associated with “on going production, marketing, delivery and servicing of the product” categorised as primary activities, with all other functions considered as support activities.

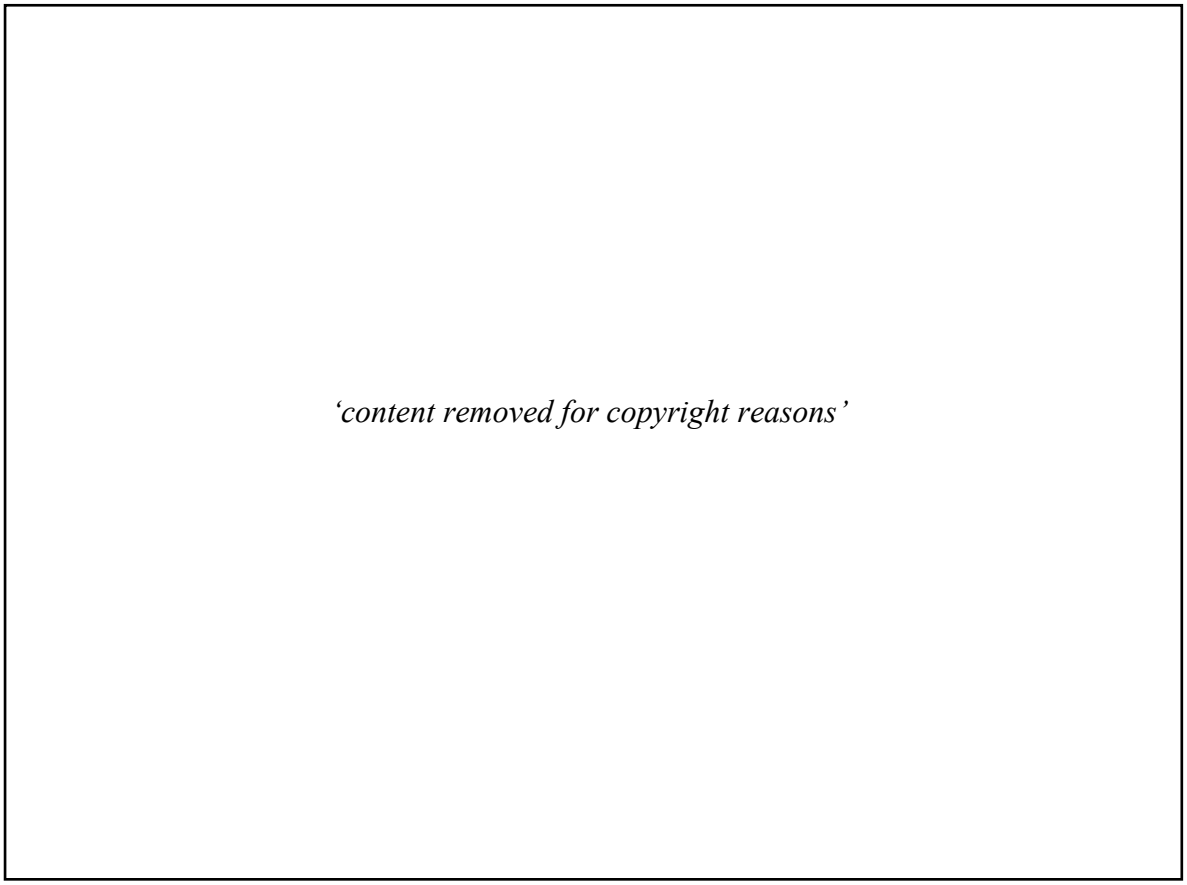


Figure 2.8 - The Value Chain Model Adapted from Porter (1998)

Whilst discrete activities in an organisation could be perceived as being efficient if using activity cost type measurements ‘i.e., supply chain functions, (Christopher, 2016), Porter (1998, p36) argues that a firm is more than a sum of its activities” and is “an independent system or network of activities, connected by linkages”. Linkages are identifiable when the actions of one activity has an impact on other activities regarding cost and effectiveness, Porter (1998) argues that competitive advantage of an organisation is gained when the value chain of an organisation is managed as a system, and not a collection of separate parts.

Porter (1998) and Chopra and Meindl (2013) use the term ‘value’ by linking to customer revenue in what could be considered a linear relationship (i.e. the higher the perceived value, the more the customer will pay). Porter (1998) value chain theory could be summarised as: the more efficiently the primary and secondary activities create value for the customer, the higher the level of profitability, hence giving potential competitive advantage over rival organisations. From a profitability perspective Porter (1998) has parallels with Chopra and Meindl (2013, p15) where profitability is “supply chain surplus”, where “Supply Chain Surplus = Customer Value – Supply Chain Cost”.

Whilst Porter (1998) does highlight the importance of the linkages between organisational activities and the notion of viewing the internal and external value chains as a system, it could be argued that the theory could drive an activity cost and non-systems thinking mindset. Terms such as “low-cost marketeers” and “low-cost product developers” (Porter 1998, p36) are used to describe what could be considered the mindsets of people who have applied the theory to their related activity in the organisation. For example, making process changes to improve the linkages between marketing and other functions may reduce the cost of the marketing function, the overall cost of the product/service delivery may increase due to unintended consequences on other areas.

2.5.3 Overview

The literature discussed in this section (in particular drawing from the theory of Porter (1998) and Chopra and Meindl (2013)) is informative regarding the context of the conceptual model application, where ‘value’ can be viewed as activities within the

supply chain of a product or service that make a positive contribution towards the fulfilment of a product or service that has been requested by a customer - This aligns to the concept of value demand (Seddon, 2003,2008) discussed in section 2.3.4.

The notion of efficient primary and secondary activities giving potential competitive advantage to an organisation (Porter, 1992) and the creation of supply chain surplus (Chopra and Meindl, 2013) highlights factors that impact the sustainability of a supply chain (in the context of sustaining the business), which supports the need for business improvement methods and improvements to be sustained within an organisation. The importance of the linkages between functions (Porter, 1992) has parallels with the supply chain integration theory discussed in section 2.2.3, in particular the requirement for effective and efficient communications flows and sharing of information.

2.6 Potential Barriers to Implementation of Business Improvement Methods

2.6.1 Introduction

The conceptual model for this study will be designed to be applied and sustained within supply chain organisations to seek improvement to business performance. Whilst literature has been reviewed to inform the model as to philosophy and methods for making improvements (sections 2.3 and 2.4 in particular), it was deemed important for understanding potential barriers to the successful implementation of business improvement methods and initiatives. Gaining knowledge in this area informs the development of the model in the sense of inclusion of elements to reduce the risk of implementation failure.

2.6.2 Barriers

As discussed in chapter 1, the conceptual model for this study is developed from the core theory of Seddon (2003,2008). Critical analysis of Seddon's method is discussed in section 2.3.4 (in particular, Marshall, 2012; Jackson,2007; O'Donovan, 2012), including sustaining the method, further literature searches highlighted that general literature specific to Seddon's methodology and identification of barriers to implementation is lacking. The conceptual model for this study will also build on and incorporate other concepts (to Seddon's), including approaches towards business

improvement, which includes researched and discussed approaches such as Lean and Six Sigma (see chapter 2.4). The research for application of Lean and Six Sigma methodologies within organisations and supply chains is significantly more extensive than Seddon's methodology, providing opportunity to gain knowledge from related literature and contribute to the development of the conceptual model for this study.

Through a systematic literature review Jadhav et al (2014) explore barriers associated with the implementation of a Lean methodology with manufacturing companies. The implementation of Lean in an organisation (see section 2.4.2) has many similarities with undertaking a systems thinking intervention (implementing business improvement), for example, seeking process and operational efficiency, implementing new procedures, and fundamentally challenging the way people currently work. Many relevant areas from the research undertaken by Jadhav et al (2014) can be described as people influencing areas, or areas associated with 'soft' systems methodologies (as discussed in section 2.3.3). Compiled from their extensive research, table 2.11 highlights 5 main areas (associated with Lean implementation) that are deemed informative to the design of the conceptual model for this study.

Table 2.11- Barriers related to business improvement interventions, adapted from Jadhav *et al (2014)*

Barrier for implementing a business improvement method	**Main points in relation to barrier for implementing a business improvement method**
Lack of Senior management commitment, support and involvement	Concerned with changing the norm, uncertain about the change, change not clear. Change needs intellectual and physical support from senior management to ensure resources and reduce communication breakdowns.
Lack of management focus and leadership	Lack of actual strategy and guidance to manage an intervention, lack of vision and goals all lead to poor sustainability.

Lack of employee empowerment	Command and control (Seddon, 2008) style management restricts decision making from flowing to the workers. Staff need license to experiment.
Lack of communication	Poor communication in all directions within the organisation can lead to failure of interventions. Communication is especially important to staff who are not directly involved with the project.
Cultural Differences	Lack of engagement with staff inhibits the creation of an improvement (or Lean) culture. A diverse workforce (especially global) creates challenges for introducing a different way of thinking.

The findings highlighted in Table 2.11 could be considered generic with change management initiatives within organisations. The items identified can be categorised as ‘soft’ systems elements, as discussed in section 2.3.3, or in more general management terms ‘soft’ human resource challenges/issues. Interestingly, to help develop sustainable implementation strategies, Jadhav et al (2014) recommend the use of quality tools for development of sustainable implementation strategies for future work, including FMEA (failure mode and effect analysis, Jadhav et al (2014)). Such tools are arguably more aligned to ‘hard’ systems resource challenges (e.g., processes) and would not be aligned to the ‘people’ (or ‘soft’) related challenges\barriers identified in the research findings in table 2.11.

Exploring the critical failure factors associated with the application of Lean Six Sigma (LSS), Albliwi et al (2014) argue that their systematic literature review paper is one of the first of its kind, highlighting that the paper discusses factors from “different angles”, such as country and organisational size. The research identifies the top 3 most common critical failure factors associated with implementing Lean Six Sigma as:

1. Top management lacking attitude - specifically commitment and involvement, critical factors identified across different countries, industries, and size of organisations. In addition, ensuring correct resources are in place for projects and the potential for any obstacles is minimised.
2. Lack of education and training - arguing that training is a critical factor and should be viewed as such for implementation of LSS.
3. Selecting and prioritising the wrong project can lead to total failure of LSS implementation.

Other identified primary factors for LSS failure include communication, lack of leadership and vision, lack of understanding of LSS tools/techniques and lack of understanding of customer types. These primary factors are mostly aligned to the findings from Jagdish et al (2014) as identified above (Table 2.11), and from a leadership perspective are aligned to Seddon (2008) who argues that systems thinking interventions must have the buy in and full support of the senior management team. Whilst some of the factors discussed relate to the implementation stage of LSS, Albliwi et al (2014) also discuss the notion of organisational readiness and levels of capability prior to undertaking a project, including having appropriate resource and management support.

Tsironis et al (2016) argue that there are ‘special factors’ that influence the level of success achieved by applying LSS within an organisation. Whilst some of these relate to what could be considered ‘hard’ systems factors (e.g., processes, IT systems etc.), they argue that ‘special factors’ are mostly organisationally orientated, like policies, culture and climate, arguing that such factors are seemingly neglected from current literature at the time and the majority of the research identifying critical success factors in manufacturing organisations rather than service organisations. Tsironis et al (2016) concludes from the literature searches undertaken that that there are ‘generic’ critical success factors associated with the application of LSS to the service industry, these are highlighted in Figure 2.9 below.

Figure 2.9 - Critical success factors of LSS application to the service industry - Adapted from Tsironis et al (2016)

Whilst the research undertaken by Tsironis et al (2016) enabled identification of the factors presented in figure 2.9, their research argues that the factors identified are missing a "holistic framework" which allows integration and interrelation of the critical success factors for implementation of LSS. Citing the work of Pojasek (2003) and Clegg and Orme (2012), they refer to 'Systems' approaches as a method for coordinating a LSS intervention, with a 'soft systems' methodology (as discussed in section 2.3.3) being identified as an approach most suitable for the improvement of human activity systems. Such activities are reflected in figure 2.9 through area's such as culture, leadership and teamwork.

The areas presented by Tsironis et al (2016) have parallels with the general supply chain research presented by Fawcett et al (2008), who discusses general barriers to supply chain management, identifying misalignment of processes, structure, and culture, in addition highlighting information technology barriers, including incompatibility and measurement systems that are inadequate. Fawcett et al (2008) also argue that there can be an unwillingness to share information (between functions) for fear of exposing potential weakness, stating that changes in attitude and thinking are necessary. This view has parallels with Seddon (2003), Christopher

(2016) and Porter (1998) and the notion of functions working and measuring performance in isolation, with the potential for functional barriers (Christopher, 2016).

2.6.3 Overview

A reoccurring theme in the literature presented is people, or soft systems elements (see section 2.3.3). The influence of people on the success of a business improvement intervention is significant and is important to be considered within the development of the conceptual model for this study. In essence, 2 main areas related to people are apparent:

Senior Managers - Need to be committed, motivated and demonstrate effective leadership. This suggests that managers/leaders need to understand the need for a business improvement intervention and have the strategic leadership skills/knowledge to design a strategy for change and effectively lead the implementation of change (see section 2.7). If managers are committed, they are arguably more likely to provide the correct level of structure and resource.

Other Stakeholders - Large organisations are likely to have multiple departments/functions. Linking to management and leadership, if different stakeholder groups are not recognised or understood, and if they are not empowered to contribute, strategies for communication and embedding a systems thinking culture have a risk of failure.

Marshall (2012) questions the sustainability of Seddons method (see section 2.3.4), consideration of the factors identified above (from the literature) within the conceptual model design will contribute to the philosophy and method of the model being sustained within an organisation.

2.7 Strategic Change for Business Improvement Within Supply Chain Organisations

2.7.1 Introduction

Section 2.6 presented barriers for successful implementation of business improvement methods within organisations, highlighting how ineffective leadership and management can have a negative impact on implementing and sustaining the method. The literature presented in sections 2.3 and 2.4 highlighted the need for a change of thinking, in particular managers changing from a command and control to systems thinking mindset (see section 2.3.4). The implementation of a new business improvement method will evoke changing of the norm, which if not strategized will create a lack of vision and not be sustainable (Jagdish et al,2014). The conceptual model for this study builds on the core philosophy and method presented by Seddon (2003,2008), however, a subject not prominent Seddon's theory is strategic leadership (Marshall, 2012) (as discussed in section 2.3.4), this section builds on the sections highlighted above and presents literature to inform the development of the model regarding strategic change and leadership.

2.7.2 Approaches to Strategy

Literature was reviewed to help understand where the informing and implementation of business improvement methods (in this case the conceptual model) is positioned from a strategic perspective within an organisation. To define strategy, Mintzberg et al (1998) refers to strategy as a plan or pattern for integrating an organisation's goals, actions, and policies into a 'cohesive whole', which has parallels with the systems thinking principles discussed in section 2.3. Johnson et al (2011, p3) define strategy as "the long-term direction of an organisation", and argue that the existence of strategy can be at 3 levels:

Corporate - Level strategy - looks at overall scope, how value is added as a whole (which links to Mintzberg ,1998), including type of products and services, allocation of resources throughout the businesses, and potential acquisitions.

Business Level - strategy – is how business units compete within their markets, can include innovation initiatives and responding to competitors.

Operational Level - strategies – how the different components of an organisation can deliver the corporate and business level strategies effectively, in terms of processes, people and resources.

De Wit and Meyer (2010) also present the concepts of Corporate, Business and Operational level strategies, but in addition present a Network - Level strategy, which is where 2 or more organisations jointly work towards a common goal, which is beyond just transactional activities (e.g., supply of goods from one business to another), this can include through a partnership(s) or alliance between businesses. Using the term 'Relational actors', De Wit and Meyer (2010) highlight four main categories of relationships between an organisation and partners:

- **Upstream vertical relations** – External Suppliers
- **Downstream vertical relations** - Customers and users of the product /service, or intermediaries who trade the output – e.g., retail organisations
- **Direct horizontal relations** - industry insiders, relations between competitors of similar goods

Applying the concepts presented by Johnson et al (2011) and De Wit and Meyer (2010) to the conceptual model for this study, it becomes apparent that the concepts of the model can be embedded in multiple strategic levels. Table 2.12 indicates the rationale for embedding at each level.

Table 2.12 – Levels of Strategy, adapted from Johnson et al (2011) and De Wit and Meyer (2010)

Strategy Level	**Rationale**
Corporate Level	For full adoption of the systems thinking philosophy that underpins the model, inclusion within corporate level strategy will support the systems thinking philosophy itself and can be considered as adding value as a whole (Johnson et al (2011).
Business Level	As with corporate level strategy, inclusion in strategy at business level will continue the holistic approach towards the systems thinking mindset and principles associated with the methodology of the conceptual model.
Operational Level	As the model will evoke process and possible structural change, detailed inclusion within operational level strategy is key for the stages of the model implementation that evoke organisational change, e.g., significant process changes.
Network Level	If the model were to be implemented in the wider external supply chain, an adaptation of the network level strategy, with a specific focus on adopting the core principles and mindset associated with the model could be considered.

In summary, table 2.12 highlights that implementation of business improvement methodologies can have a presence across corporate, business, and operational level strategies of a supply chain organisation.

2.7.3 Strategic Change

In reviewing the literature for understanding the strategic perspective of implementing organisational change, Mintzberg (1998) argues that the implementation of timely strategic changes is a challenge for managers, highlighting that there can be preservation of some business and organisational systems, but transformation of others in order to remain competitive and stay up to date. Mintzberg (1998) uses the term ‘strategic renewal’ for the process of enacting strategic change constantly, to keep in harmony to the external conditions, which in the context of this study has parallels with understanding and aligning to ‘purpose’ (Seddon, 2003) which is driven by the customer.

Investigating the subject of strategic renewal, Mintzbeg (1998) identifies many actions that can be classed as strategic change, including business process redesign, which is a fundamental aspect of business improvement methodologies (discussed in sections 2.3.4 & section 2.4.), and further discusses areas of strategic renewal which includes areas pertinent to the context of supply chain organisations:

- **Business System** – Value adding activities, configuration of resources
- **Organisational system** – Organisational structure and processes, linking individuals to processes, coordination of tasks for integration.

Whilst the literature presented by Mintzberg (1998) highlights areas of change, Senior and Swales (2016) discuss the nature of change, using the term ‘frame-breaking change’ as a change that punctuates ‘relative tranquillity’ within the organisation, highlighting key change criteria which is presented in table 2.13 and presented with context made to supply chain organisations.

Table 2.13 - Frame-breaking Change criteria applied to supply chain – Adapted from Senior and Swales (2016)

Change Criteria	**Linkage to context of supply chain**
Reformed Mission and Core Values	Inclusion of 'Purpose' (Seddon,2003) and consistency of purpose (discussed in chapter 2.3.4) within mission and values of the organisation
Altered Power and Status	Potential shift from command-and-control style leadership
Reorganisation	Potential structural, procedural, and process changes
Revised interaction patterns	Linking to reorganisation above, new workflows and decision-making protocol will be concurrent and sometimes the by-product of structural, process and procedural change.

Frame-breaking change has parallels with 'big bang' change discussed by Johnston et al (2011), where change is required rapidly, including culture change (revolutionary change), or change that is required rapidly, creating upheaval, but does not require a change in culture (reconstruction change). For a required culture change to happen over a longer period of time (than in a rapid change), Johnston et al (2011) refer to Evolutional change strategy and argue that it is the most challenging type of change, due to the lack of a pressing need for the change. The 3 types of change strategy are presented in figure 2.10 below, with the additional strategy of Adaptation.

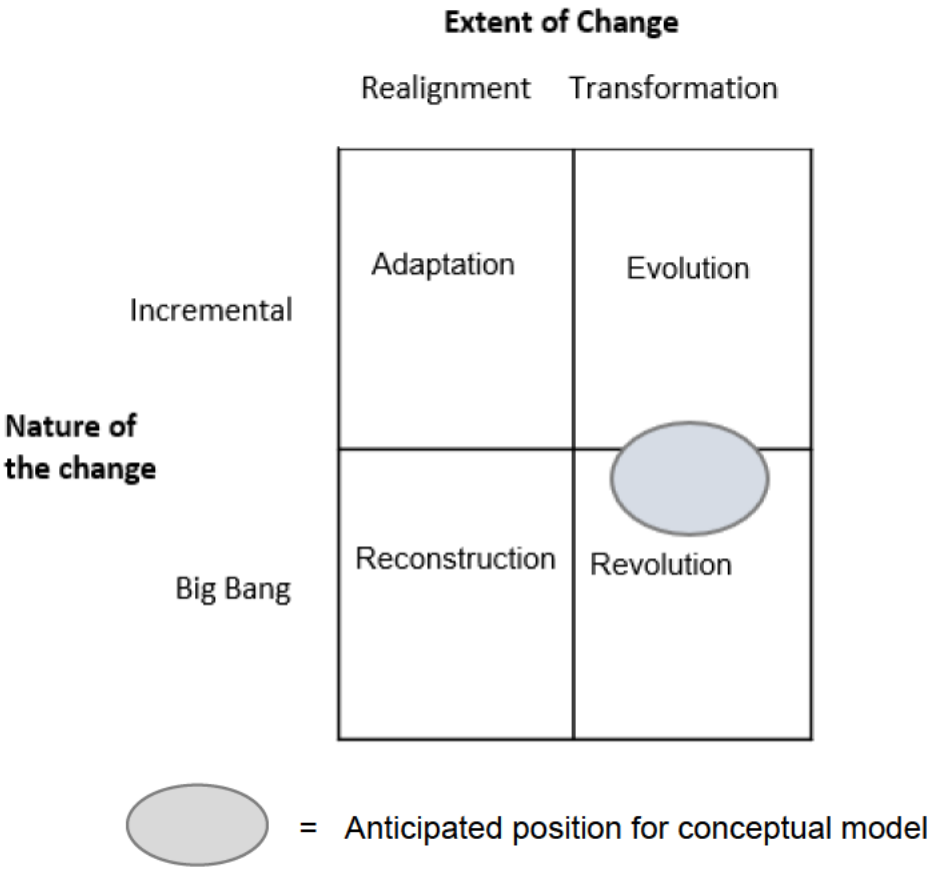


Figure 2.10 - Types of Change, adapted from Johnson et al (2011)

The type of change for implementation of the conceptual model for this study would be dependent on the current position of the organisation, for example, if the organisation already adopts a holistic approach to business improvement, the change could be more evolutional. However, the conceptual model has elements unique in design for application to supply chain organisations, therefore adaptation of the concepts are more likely to reflect traits of revolutionary change (Johnson et al, 2011), the grey area in fig 2.10 highlights the anticipated position of the nature of change when applying the conceptual model. The positioning considers the requirement for a mindset shift towards a systems thinking approach and how targets are used for performance measurement; and the need to implement the model at pace to maximise the positive impact(s) for the customer and organisation.

2.7.4 Leading Strategy

Sections 2.7.2 and 2.7.3 have informed as to the nature and level of strategy associated with the conceptual model. This element explores literature to highlight themes associated with the leadership of strategy in two perspectives which are deemed relevant to the conceptual model:

- Leadership associated with development of strategy
- Leadership associated with implementation of change

2.7.4.1 Strategic Leadership

Section 2.7.2 discusses the levels of strategy and argues that the implementation of the conceptual model could be visible across multiple levels (i.e. business, corporate, operational). Norzailan et al (2016) discusses that the competencies for making decisions at strategic level differ from those at operational level, some which are particularly relevant to the context of this study and include: realignment of internal capabilities, leading the whole organisation and being focused at organisational level. Schoemaker et al (2013) highlights skills associated to strategic leadership, in particular to challenge – Questioning the status quo, particularly relevant to this study and the core concepts associated with how to measure performance and use targets influenced by the core concepts of Seddon (2003,2008).

To further understand the role of strategic leadership, Norzailan et al (2016) present a competency model to identify the personal characteristics of a strategic leader, elements of which can be used to highlight poignant topics to in relation to strategizing for business improvement within a supply chain, notable, is the willingness to lead and change management competencies. These areas of strategic leadership are particularly important in relation to the literature presented in section 2.6, which identifies related leadership barriers to the successful implementation of business improvement methods, including lack of vision and communication, which have parallels to the development and subsequent dissemination of strategy across an organisation. Tickle et al (2016) highlights visionary leadership as a key aspect of the European Foundation for Quality Management (EFQM) excellence model and the Baldridge business excellence model, the updated EFQM model of 2020

identifying the need for effective leadership for organisation to remain true to its purpose (see section 2.3.4).

Whilst acknowledging there is an extensive field of strategic leadership literature, Samimi et al (2020) argue a lack of consensus regarding the actual concept. Through reviewing extensive literature on the subject, they present functions related to strategic leaders which can be applied to the context of supply chain and therefore this study. Table 2.14 presents the most relevant functions in relation to the context of this study, and the associated rationale.

Table 2.14 - Functions of strategic leaders, adapted from Samimi et al (2020)

Function of Strategic Leader	**Definition**	**In relation to this study**
Making strategic decisions	Making decisions on strategic changes and the overall direction of the firm	Related to the levels of strategy (discussed in section 2.7.2) and changes identified through application of the model
Engaging with external stakeholders	Representing the firm and managing relationships between the firm and both public and private entities	In the context of the model for this study, this would also represent internal of the wider organisation, e.g., vertically integrated business units (i.e., suppliers or central resources) If part of a network level strategy, this would include external

		organisations such as suppliers or distribution companies.
Managing information	Processing strategic information and distributing it to the different areas and hierarchical levels of the organization	Dissemination of business improvement strategy and progress across the organisation
Overseeing operations and administration	Managing the development and implementation of structure and procedures, monitoring different areas.	The implementation of the model at operational level and associated operational changes through the implementation process, including new performance measurement methods and process redesign.
Managing conflicting demands	Attending to conflicting needs of different internal and external stakeholders and resolving conflicting strategic issues	Links to section 2.8 and understanding stakeholder groups, associated influence and power regarding change from implementing the model.

According to Malnight et al (2019), the core strategies of organisations are being re-defined, with purpose being core to the strategy, De Wit & Myer (2010, p598) state that “organisational purpose can be defined as the reason an organisation exists” and argue that managers “consciously reflect” on the organisational purpose to identify organisational principles that form part of the organisations identity, and therefore informs strategic decision making (highlighted in the corporate mission). Malnight et al (2019) argue that whilst purpose can be compelling and give clarity to what an organisation stands for, if purpose statements are too generic, they could be applied to any organisation (and thus loose the intent of focus). Purpose in relation to this study is one of the core aspects of Seddon’s (2003) theory discussed in section 2.3.4.

Malnight et al (2019) highlight that aspects of a business associated with people (soft systems aspects – see section 2.3.3) can lead to the undoing of leaders, and that they need to make purpose central to the strategy, and that at a tactical level, the best methods include a transformation of current leadership agenda’s and the dissemination of purpose throughout the organisation. Malnight et al (2019) argue that by putting purpose at the core of its strategy, benefits can be realised such as unification of the organisation (towards purpose) and a higher level of motivation between stakeholders, both pertinent to the implementation of business improvement methods within a supply chain organisation and relevant to this study.

2.7.4.2 Leadership of Change

This section explores the literature more specific to the leadership of strategy implementation, which in the context of implementing business improvement within a supply chain organisation would entail leading change within the organisation, i.e., transformation of approach and mindset to performance measurement and new processes.

According to Evans and Lindsay (2011) organisational change can be unpleasant for managers, as it can make people (in the organisation) feel uncomfortable. Al-Alawi et al (2019) argue that leadership is crucial when managing change, and a motivated leader can make it easier for employees to adapt to change, Al-Ali (2017) discuss the notion of leaders that are perceived to support the change have a positive impact

on employee behaviour associated with the change, which in the context of this study would include faster adoption of new processes and a systems thinking mindset. According to Burnes (2014) there are organisational states which have a need for different leadership styles:

- **Convergent** (where there is a stable state) - in the context of supply chain this would mean day to day operations as normal, no changes to processes, structure, or mindset.
- **Divergent** (where there is an absence of stability and predictability) - in the context of supply chain and this study, a divergent state would reflect the unknown of an organisational mindset shift and detail of process and system redesign.

Whilst implementation of business improvement methods in supply chain organisations is smaller scale than major business strategies (i.e., a merger or shift to completely new product/market), the implementation is likely to mean considerable change to the organisation, which would reflect a divergent state and according to Burnes (2014), requires a transformational style of management which creates new visions and challenges the status quo. Dumas and Beinecke (2018) identify traits of transformational leadership in relation to organisational change, which includes the inspiration and encouragement of followers and the ability to reframe problems, Nanjundeswaraswamy and Swamy (2014) argue that transformational leadership encourages problems to be viewed by followers from a different perspective, whilst communicating a vision and giving encouragement. Mullins (2010) also highlights the emphasis of organisational vison for a transformational leader and argues that transformational leaders transform and motivate followers through creating a higher level of awareness to purpose.

The encouragement of stakeholders across the organisation and communication of vision is deemed important for the application of the conceptual model for this study, in essence, the need to lead a strategy for transforming the organisation from one state (way of thinking) to another for business improvement. Robbins et al (2013) and Mullins (2010) highlight the characteristics of transformational leadership, with Robbins et al (2013) offering contrasts to transactional leadership. Table 2.15

presents the characteristics of transactional leadership and transformational leadership, with application made to the context of this study.

Table 2.15 - Characteristics of transactional v transformation leadership in relation to this study, adapted from Robbins et al (2013) and Mullins (2010)

Transactional Leadership Characteristic	**Attributes of Characteristic**	**Application to This Study**
Contingent Reward	Reward for effort, promise of reward, higher performance for more rewards, recognizes accomplishments	Reward for performance arguably reflects management of activity rather than the more holistic approach of managing flow as discussed in section 2.3.4.
Active Management by Exception	Monitors and looks for deviations from standards and rules, takes corrective action if necessary	A potential barrier to innovation of new process and system design as could inhibit bottom-up ideas.
Passive Management by Exception	Intervenes only when standards not met	Reflects command and control style management if an intervention includes punishment for not meeting standards
Laissez – Faire	Avoids decision making, abdicates responsibility	Potentially too passive for leading significant organisational change

Transformational Leadership Characteristic	Attributes of Characteristic	Application to Business Improvement Related Change
Idealized Influence	Provides vision and sense of mission, gains trust and respect, instils pride amongst employees	Creates overall understanding of strategy for implementation of business improvement
Inspirational Motivation	Purpose expressed in simple ways, symbols to focus efforts, communication of high expectations	Dissemination and communication of customer purpose across the organisation and associated shift in thinking
Intellectual Stimulation	Rational and careful problem solving, new and novel approaches to work	Leading of new approaches to process and organisational systems design
Individualised Consideration	Treats employees individually, coaches, advises	Includes stakeholder groups across the organisation

Table 2.15 highlights the key attributes of transactional v transformation leadership and how they apply to this study. Whilst acknowledging there is a vast quantity of leadership literature, the transactional v transformational application presented in table 2.15 was deemed particularly appropriate and relevant in the context of this study to provide a high-level point of view. It is also acknowledged that at a micro level (e.g., people not long joined the company, different departments) additional types of leadership would most likely be needed to support and drive the change, for example situational leadership, where the leader's behaviour will vary depending on the variables of the situation (Mullins, 2010) – e.g., the level of direction given through assessment of subordinate's readiness to take on new tasks. Al-Alawi

(2019) highlights that part of the leader's role is to construct paths for implementation and can have a transformational approach to leadership for supervision of the change.

Key to the success of business improvement within organisations is the involvement of people (within the organisation, as discussed in section 2.4), the motivation and encouragement from leaders highlighted within a transformational approach supports the idea's lens presented by Johnson et al (2008), which suggests that organisations contain many different people with many different ideas, and rather than being conceived by senior managers, changes can bubble up from inside an organisation. In relation to this study, this notion is particularly interesting for the informing of strategies for implementing process and systems redesign.

2.7.5 Overview

This section has reviewed and presented literature to inform the model as to considerations for integrating elements of strategy and leadership into the conceptual model in the context of organisational change. The review and analysis of the literature has highlighted that whilst the overriding strategy of a business will include chosen markets to operate within (business level strategy), the implementation of the conceptual model of this study would need to be part of the overriding strategy, with links to other levels discussed in section 2.7.2. The section highlights the approaches to leadership, and that part of the leaders role is to construct paths for implementation, including having a transformational approach to leadership of the change (Al-Alawi ,2019).

2.8 Stakeholders

2.8.1 Introduction

Previous sections (i.e., 2.6 and 2.7) refer to stakeholders and highlight that large organisations are likely to have multiple departments/functions which could mean different stakeholder groups to communicate with, and to involve in the process of improving business performance. In addition (as highlighted in section 2.7) this could also mean managing conflicting demands of stakeholder groups, which could be associated to a current functional structure with functional boundaries (Christopher, 2016) (as discussed in section 2.2). Building from the literature in the sections above, understanding the potential diversity of the stakeholders (e.g., in terms of demands, power, influence) is likely to enable more effective leadership of a shift in mindset, associated with the implementation of a systems thinking based business improvement model.

2.8.2 Understanding Stakeholder Groups

Hayes (2014) and Jones et al (2020) discuss stakeholder theory and both highlight that the term stakeholders is defined by an individual or group of people who is affected or can affect the objectives of a firm (or organisation). In the context of this study, stakeholder groups can be identified as people working in different teams, departments/functions across the internal supply chain and value chain and at different hierarchical levels (e.g., Senior managers, operational staff). In addition, stakeholder groups would also include people working in external companies as part of the external supply chain.

Johnson et al (2010) argues that stakeholder expectations influence the decisions for strategy and purpose of the organisation made by the senior management team, further arguing that there could be conflicting expectations amongst the different stakeholder groups.

In the context of the conceptual model for this study (i.e., the application within a supply chain organisation) there is potential for a diverse range of stakeholders (discussed in section 2.6). For example, people working in different functions/departments of the organisation or wider supply chain, with the potential for ‘functional boundaries’ (Christopher,2016) that could create barriers, this could be

especially prevalent when trying to adopt a systems thinking mindset withing the organisation (and potentially wider supply chain), with a focus on ‘purpose’ (Seddon, 2003,2008).

Jones et al (2020) highlight that the engagement of stakeholders is fundamental to the successful achievement of organisational goals, which in the context of this study would be associated with the organisational strategy (discussed in section 2.7.2) for implementing the conceptual model. When considering stakeholders in the context of implementing the conceptual model for this study, the main focus would be organisational staff (including senior management) from the different areas/functions (wider internal supply chain), with external consideration given to the wider supply chain where appropriate.

Johnson et al (2010) argue that stakeholders can affect the success or failure of a strategy. To help understand potential levels of influence on success or failure of strategy, Johnson et al (2010) present a stakeholder mapping model based on 2 criteria:

- **Level of interest** – The level of interest a stakeholder group might have to impress their expectations for choice of strategies and purpose of the organisation.
- **Power** – The level of power a stakeholder group might have to impress their level of interest.

Whilst Johnson et al (2010) discuss application of the power/influence matrix in the context of developing corporate strategy, the approach can be applied to the implementation of a model for business improvement. In this context applying the concepts of stakeholder mapping would identify potential influencers of an implementation strategy, including the stakeholders directly and indirectly involved with the implementation of specific process changes or areas of focus within an organisation and wider supply chain. This can be illustrated in an adapted power/interest matrix (Johnson et al ,2010), with a focus on the implementation of a model for business improvement, as presented in Figure 2.11.

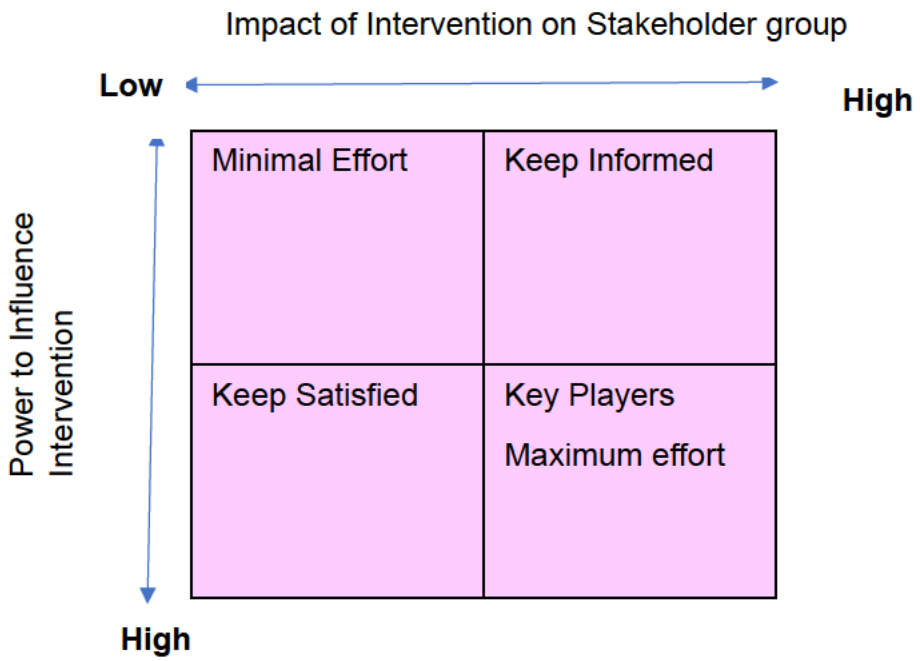


Figure 2.11 – Stakeholder Mapping Matrix, adapted from Johnson et al (2010)

The application of Fig 2.11 to the context of a business improvement intervention would be very beneficial for understanding where within the organisation and wider supply chain the focus of effort is needed, to ensure sustained buy in (Martin,2014) of the intervention and mind shift towards a systems thinking approach (discussed in section 2.3 and 2.4). In addition to sustaining by in, further adaptations for the matrix could help identify other stakeholder related criteria such as communication strategies and information sharing for better levels of supply chain integration (see section 2.2.3).

2.8.3 Overview

This section builds from previous sections (i.e., 2.6 and 2.7) and highlights that different stakeholder groups have the potential to influence the success of the implementation, in particular when trying to establish a common purpose across the organisation (and potential wider supply chain).

The application of stakeholder mapping theory such as Johnson et al (2010) is a method to help identify the different stakeholder groups, the information from which

can inform the strategic leadership strategies discussed in section 2.7, including getting people involved to help inform the implementation of business improvement methods and new process system design. Understanding stakeholders is therefore a key consideration for the development of the conceptual model for this study.

2.9 Literature Review Overview and Conclusions

This chapter has presented and reviewed literature thematically to present critical review and analysis of Seddon's (2003) systems thinking philosophy and method, together with review and analysis of other methods and subjects to inform the development of the conceptual model. The review enabled the identification of gaps in the literature which are evolved and addressed through the design and construction of the conceptual model presented in chapter 3 (the presentation of the model is followed by detailed discussion and rationale for the contents, with links made back to the relevant literature review sections).

The initial stages of the review referred to the challenges facing supply chains and related organisations (as highlighted in Chapter 1), followed by discussion and analysis of supply chain literature. The review of the supply chain integration (SCI) literature highlighted the recognition and need for understanding the linkage between functions and the flow of goods and/or materials across a supply chain, in addition to the importance of communication and information sharing. However, the review highlighted gaps and limitations of theory/models, in particular when considering the barriers identified within the literature that can limit the success of performance improvement when applying SCI. For example, poor strategic management and alignment through the organisation, coupled with measurement methods that are inconsistent, this is in addition to functional-silo mentalities and the notion of functional barriers limiting performance and preventing the supply chain being managed as a system.

Review of the systems thinking literature highlighted that evolving the systems thinking theory for application to the context of supply chain gives opportunity to address some of the gaps that exist in within supply chain theory discussed above, in particular barriers to SCI and the problem of functional silos. Evolvement of the work of Seddon (2003,2008) gives opportunity (through development of the

conceptual model) to understand the impact supply chain functions have upon each other, particularly in relation to the influence of current performance measurement systems and associated targets. Whilst literature searches do highlight some application of systems thinking concepts to the context of supply chains (as discussed in section 2.3.6 and 2.3.4), it is not extensive and could be argued as being in pockets, for example, understanding levels of risk, or application of systems loops to understand the supply chain more holistically. The review reaffirmed the gap in the literature for application of Seddon's method to supply chain related organisations (moving goods to an end customer), and therefore presenting opportunity to address the gap and leverage value from the theory through the design and development of the conceptual model.

Whilst the review highlighted the uniqueness of Seddon's (2003,2008) philosophy and method (e.g., philosophy around targets driving negative behaviour), limitations and gaps were also highlighted, which could be addressed through the design of the conceptual model. For example, the literature is not explicit for fully identifying and understanding the impact of performance targets between functions/departments of an organisation and its internal/external supply chain.

When researching the barriers to successful implementation and sustaining of business improvement methods, the literature highlighted leadership and strategy (lack of) as significant barriers to success. Whilst the method presented by Seddon discusses a change of management thinking, the literature is minimal regarding business and leadership strategies and styles within the method/models presented. The literature presented in section 2.7 gave further exploration of this area, giving opportunity for analysis and convergence of subjects within the design of the conceptual model.

Further building on the concept of functional boundaries (discussed in sections 2.2 & 2.3), the review highlighted that Seddon's work is limiting for understanding the differences between stakeholders of an organisation and the wider supply chain, including associated goals, influence and interdependencies. Reviewing this area (stakeholders) highlighted that different stakeholder groups have the potential to influence the success of a model implementation, in particular when trying to establish a common purpose across the organisation (and potential wider supply

chain). Review of the literature highlighted the importance of identifying the different stakeholder groups, the information from which can inform the strategic leadership strategies and leadership styles (as discussed in section 2.7). Inclusion of this area within the conceptual model further evolves the core concepts of Seddon's method.

The review of literature regarding methods for business improvement enabled the contrasting of methods and approaches to identify similarities and opportunities to further evolve Seddon's core concepts. For example, the accuracy testing of measurement methods is prominent in the Six Sigma literature through Measurement Systems Analysis (MSA), however such methods are not included within Seddon's method – inclusion is deemed important for the conceptual model. In addition, the literature also reiterated the need for business improvement interventions to align with organisational goals and the strategic plan, with strong leadership to sustain success, which is further emphasised in section 2.7 and also deemed an important area for the conceptual model.

Summary

To summarise, the gaps and limitations identified within the supply chain literature provoked review of the systems thinking literature, which identified opportunities to address the said gaps and limitations through evolvement of the core Seddon (2003,2008) theory and method. The evolvement of theory is presented in chapter 3 by means of the conceptual model design and subsequent testing (presented in later chapters). Analysis of the supply chain and systems thinking theory enabled the literature review to develop organically, which through convergence of subjects, give opportunity to evolve Seddon's (2003,2008) systems thinking theory and address the limitations identified with the theory and method.

An additional observation when considering the overview of the literature, is the practicalities and challenges of implementing a full model conceptual model, over a supply chain that could include several external organisations. Whilst this is potentially achievable (the author has experience of adopting approaches to business improvement required by primary customers), more manageable application would most likely be within large organisations that have a high level of

vertical integration (Johnston et al, 2011). All the theory reviewed is relevant and applicable in this scenario.

The critical review and analysis of literature presented in this chapter satisfies Research Objective 1:

- To research and give critical review to the literature for informing the design and construct of a high-level conceptual model.

The following Chapter (3) presents the conceptual model derived from the literature, which evolves the systems thinking theory of Seddon (2003,2008), through convergence of themes presented in the literature review. After the model is presented, each element is explained with linkages identified to the key sections of literature. Further justification (and validation) for the choice of the subjects included in the conceptual model is indicated by the level of consensus for the model content (from the panel of experts reviewing the model in the Delphi study – see chapter 4), presented in chapters 5&6.

Chapter 3 The Conceptual Model

3.1 Introduction

The overall aim of this research is to develop a high-level conceptual model for analysing and potentially improving business performance within a supply chain. The term high-level in the context of this study is identified as key themes or macro level, as opposed to a high level of micro detail (i.e., explicit instructions for model implementation). The model builds on the core concepts of Seddon's (2003) systems thinking philosophy and approach presented in Chapter 2, which highlighted gaps in the literature (Seddon's) and presented review of additional themes and concepts for informing the development of the conceptual model (for example, strategic leadership, aspects of Six Sigma, supply chain integration and Stakeholder analysis). This chapter presents the convergence of themes and concepts identified in the literature through the development of the conceptual model.

The model is presented in the early stages of this chapter, followed by explanation of each stage, including how each stage was developed from the literature.

3.2 Development of the Conceptual Model

The term conceptual model for this study is derived from the work of scholars Elangovan & Rajendran (2015), in that it is a framework that outlines courses of action in a structured way, with illustration to highlight the structured sequence of the actions.

The approach to the development of the conceptual model followed the comprehension and conception approach presented by Nadeem (2019) and is illustrated in Figure 3.1.

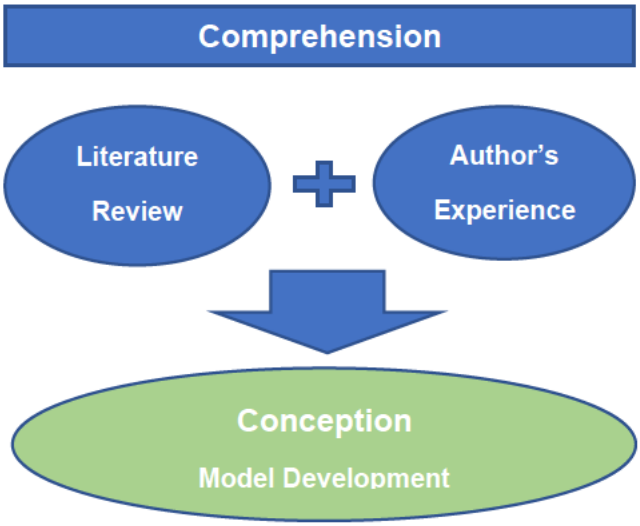


Figure 3.1 – Stages for conceptual model development, adapted from Nadeem (2019)

As illustrated in Figure 3.1, the conception of the model was a through a combination of a literature review (presented in chapter 2) and drawing from the author's extensive experience as highlighted in chapter 1. The literature review enabled exploration of topics to further analyse (in addition to the authors previous knowledge) and critically review the core concepts of John Seddon's systems theory, and through an organic and iterative process (discussed in chapter 2.1) explore and review concepts and theories to further develop and enhance an approach for application within a supply chain context. This approach enabled the incorporation of the most relevant theoretical knowledge into the proposed model (Chen and Lyu, 2009). Garza-Reyes et al (2016) highlights that practitioner's roles can play a critical role in the development of frameworks designed for application in industry, the extensive experience of the author influenced the development of the conceptual model both through influencing the literature search process (in chapter 2) and the considerations for application to an organisation.

Whilst the model is informed through the business improvement literature discussed in chapter 2 and therefore has some similarities in places, the model contributes to new knowledge through unique characteristics developed from the core systems theory of Seddon (2003) and applying to the context of an organisation(s) that form

part(s) of a supply chain physically moving goods/materials. The following elements of this chapter present the conceptual model (figure 3.2) with narrative and rationale for each stage that links to the relevant section of the literature review.

The model structure and sequence follow a systematic and iterative approach informed by the approach of other BI (business improvement) models discussed in section 2.4 such as the DMAIC sequence associated with Six Sigma (see section 2.4.3). The design of the conceptual model for this study incorporates a 5-stage process:

Stage 1 - Feasibility Check

Stage 2 – Knowledge Generation

Stage 3 – New Design

Stage 4 – Pilot

Stage 5 – Roll out

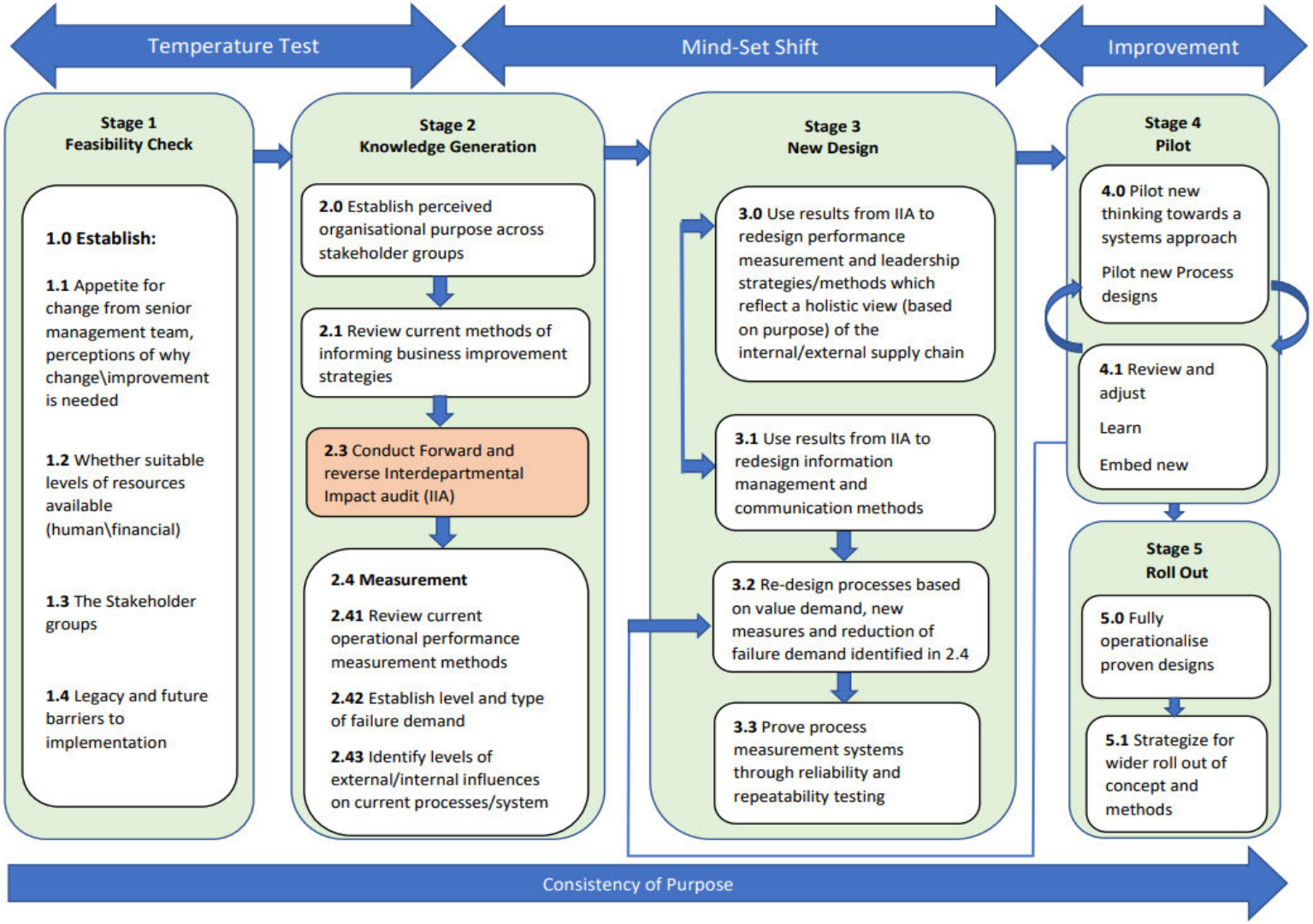
These stages are discussed in detail in the following sections within this chapter. During the 5-stage process it is anticipated the organisation will transition through 3 phases which are highlighted in figure 3.2. The 3 phases are:

- **Temperature Test -** Understanding the current position of the organisation
- **Mind-Set Shift -** The organisation(s) developing a systems thinking mindset
- **Improvement-** Implementation of new process designs and philosophy for improved business performance

Throughout the implementation of the model there should be a consistency of purpose, in essence, consistency of understanding throughout the organisation (and potentially wider supply chain) of what the model is trying to achieve and why it is being implemented. This draws from the notion of purpose as within the EFQM model (European Foundation for Quality Management), discussed in section 2.3.4.

The conceptual model is presented in figure 3.2 (and Appendix C) followed by explanation and rationale for the content of each stage and model structure.

Figure 3.2 – Conceptual Model for Business Improvement in Supply Chain Organisations



3.3 Stage 1 – Feasibility Check

This primary stage of the model is concerned with taking a temperature test of the organisation to understand whether the potential for significant change is feasible within the organisation. The subsections are informed by the literature reviewed in chapter 2, which will be highlighted accordingly. It was deemed important having a feasibility check at the primary stage of the model, as this determines whether the time is right for the model to be applied to the organisation. The format of this stage is different to the primary stage of the models and discussed in sections 2.3.4 and 2.4 (i.e., Seddon, Lean and Six Sigma), where feasibility does not appear to be included in the actual models, but in the authors experience (discussed in chapter 1) is very important to the success of implementing new concepts to the organisation.

Stage 1.1 - Appetite for change from senior management team, perceptions of why change\improvement is needed:

This element is informed by and builds on the literature discussed in chapters 2.6 and 2.7, in particular, the need for senior managers to be fully committed and supportive – highlighted as the highest-ranking barriers to implementing relevant business improvement methods (see section 2.6.2).

Gaining insight to the level of commitment from senior managers will inform as to the level of feasibility for implementing the model (and associated organisational change), and the potential level of ease for gaining the required resource for the implementation. A lack of support and motivation from senior managers will evoke barriers to resource and impact the stakeholders of the organisation (see section 2.6.2). It is likely that appetite for change will be linked to an understanding of why change is required and inform the development of the strategic leadership of change (see section 2.7.3 and 2.7.4).

Stage 1.2 - Whether suitable levels of resources available (human\financial):

Linking to stage 1.1, senior management commitment will influence resource availability, as committed leadership becomes an enabler for implementing change (see section 2.6 and 2.7). A high-cost resource for applying the model will be time of human resource (mainly internal stakeholders, discussed in section 2.8). Evaluating

whether resources are going to be made available is deemed important in this primary stage of the model as no resource allocation would prevent further application of the model.

Stage 1.3 - The Stakeholder groups

Identifying the stakeholder groups is deemed important in stage 1 for two main reasons:

- Building on the literature presented in chapter 2.4 with reference to business improvement methods such as Lean and Six Sigma, buy-in needs to be ensured from the process owner(s) and other stakeholders (e.g., staff in different functions/areas of the organisation - see section 2.8.2). In addition, it is important to know with whom to communicate (see section 2.4.2 and 2.8). Stakeholders include the senior management team as discussed above, who will strategically lead the model implementation (see section 2.7.4) and make decisions on levels of staff empowerment and shape the culture and values of an organisation. If a supply chain comprises numerous businesses, external stakeholders would need to be considered external of each organisation.

- Understanding levels of power and influence of stakeholder groups are discussed in chapter 2.8, and application of a stakeholder map would identify potential influencers of an implementation strategy. This would include the stakeholders directly and indirectly involved with the implementation of specific process changes or areas of focus within the organisation, for example, project team (see section 2.4).

Identifying stakeholders will help establish the level of ‘organisational readiness’ for change (Senior and Swales, 2016) (discussed in section 2.7) and deemed important for the successful implementation of the model, particularly when potentially changing the mindset of the organisation from (possible) command and control way of thinking, to systems thinking and the potential for counter intuitive experiences (discussed in section 2.3.4).

Stage 1.4 - Legacy and future barriers to implementation

If an organisation is potentially going to have a shift in thinking (see section 2.3.4) and evoke change it was deemed important to understand potential inhibiters or barriers to changes with an organisation. This element is informed from section 2.6, and also from the authors comprehensive experience discussed in chapter 1. The author has managed many projects and business improvement interventions within the private sector, finding legacy barriers (e.g., the way we do things around here) an inhibitor for success.

This stage links to stages 1.1 and 1.3, in particular understanding legacy barriers from differing stakeholder groups, including understanding levels of power and influence (see section 2.8.2).

Barriers to implementation could be soft systems related as discussed above (see section 2.3.3) but could also relate to hard systems thinking elements. For example, I.T systems limitations or infrastructure type system conditions (see section 2.3.4). Identifying barriers in the primary stages of the model implementation will enable the design of strategies to reduce the barriers or establish whether they would be too limiting to continue.

3.4 Stage 2 - Knowledge Generation

Once the level of feasibility of implementation is understood from stage 1, the second stage of the model continues to take a temperature test, whilst also generating knowledge in the areas discussed below. This stage is influenced by the models presented in chapter 2.3 and 2.4, in particular the primary stages of the PDSA cycle and the Check phase of Seddon's (2003) Check-Plan Do cycle (see section 2.3.4), in addition the primary stages of the DMIAC process (see section 2.4.3).

Whilst this stage is influenced by the literature identified in the sections above, the overall construct and the inclusion of the Interdepartmental Impact Audit (discussed below) are unique to this conceptual model.

Stage 2.0 - Establish perceived organisational purpose across stakeholder groups

Stage 1 established the stakeholder groups, including people directly and indirectly involved with the model application. Building on the concept of working towards a common purpose (of the organisation/service from the customers perspective, discussed in section 2.3.4), for example, to deliver my order on time and to the right location. Establishing current perceptions of purpose across the stakeholder groups will highlight potential differences or commonalities and measure the level of consistency. As stage 1, this element is a temperature test - reflecting the nature of the study which reflects one point in time (referred to by Saunders et al (2012) as a cross-sectional study).

Stage 2.1 - Review current methods of informing business improvement strategies

This element of the knowledge generation stage was included to gain an understanding of how current BI (business improvement) strategies are informed. This builds from the literature presented in section 2.3.4 (highlighted in table 2.3), where counter intuitive thinking (to the norm within organisations) includes involving people doing the work in the decision making. In addition, it draws from the Lean and Six Sigma theory presented in sections 2.4.3 and 2.4.4, and the notion of empowering people and getting people involved in the process and method of improving business performance.

From a strategy development perspective (discussed in section 2.7.2 and 2.7.3), understanding whether strategies are informed through accurate knowledge of the operations, or whether decisions are made based on uninformed opinion will highlight potential challenges for stage 3 of the model regarding leadership and strategies for implementing new processes and change.

Stage 2.3 - Conduct Forward and reverse Interdepartmental Impact audit (IIA)

The IIA considers upstream and downstream of a supply chain element/function. For example, the incoming and outgoing elements of the supply chain in relation to a distribution centre. However, the concept can also be applied to internal organisational functions feeding into and out of a function, for example, quality or technical departments, this could be particularly relevant to large vertically integrated organisations as discussed in section 2.2.5. In essence, whilst in most parts a supply chain might be considered as linear, systemic considerations may exist across other functions.

The purpose of this element of the model is to generate knowledge for:

- Whether there is an aligned perception of organisational (or supply chain) purpose (discussed in stage 2.0 of the model and section 2.3.4)
- Understanding the impact of departmental targets (if they exist) upon the wider internal (or external) supply chain
- Identifying whether information needs are understood and are communicated effectively between departments/functions

This element of the model is unique in its construction and contributes towards the generation of new knowledge within the application of business improvement methods within a supply chain context. The IIA builds from the literature discussed in section 2.6.2 and the barriers caused by the functional structure of supply chains, as well as building further on the core philosophy of Seddon (2003) and the notion of targets driving negative behaviour (see section 2.3.4).

In addition, this element of the model investigates information requirements between departments or supply chain steps, which influences supply chain integration (see section 2.2.3), specifically in the context of achieving more effective information flows for delivery of services and products.

The IIA has been designed with 4 main steps as highlighted in figure 3.3 below:

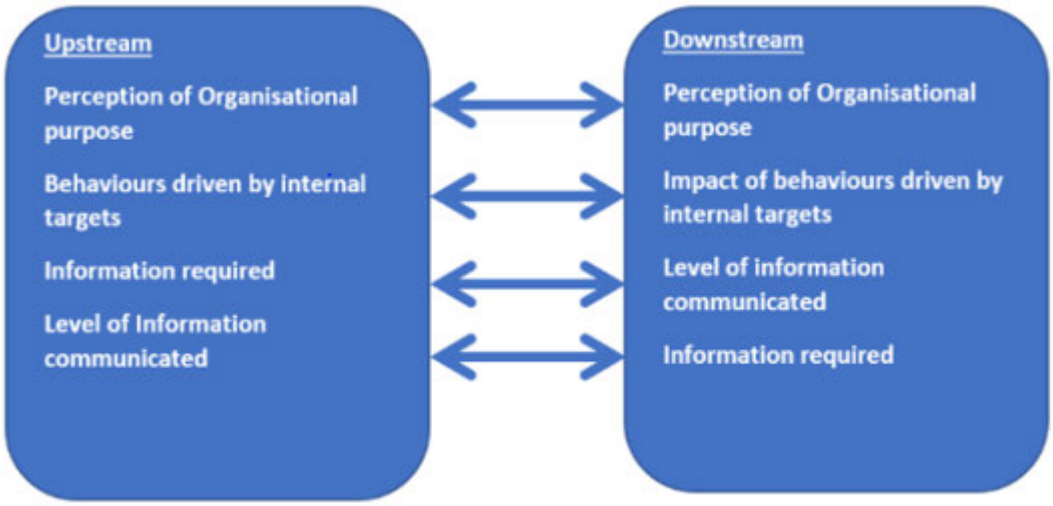


Figure 3.3 **-** *Interdepartmental Impact audit (IIA) model*

Perception of organisational purpose - This element is designed to gain knowledge as to how aligned the departments (or supply chain functions) are regarding the overriding measure of 'purpose' (discussed above). This builds further than the knowledge generation at stage 2.0. Gaining further knowledge in this area will inform as to levels of consensus and help identify different perceived priorities, this will contribute to informing stage 3 of the model regarding leadership strategies (see section 2.7.2 and 2.7.4) based on a holistic view of the organisation/supply chain.

Behaviours driven by internal targets – This aspect of the IIA drills down into the impact of performance targets (or KPI's – see section 2.2.4 for metrics examples) between departments. For example, if an upstream department has a high level of activity-based targets (see section 2.3.4 and table 2.5), how do these targets impact/influence the behaviours of teams/individuals within the departments, for example, do people focus on individual performance targets and not consider the needs of upstream/downstream departments/functions, how do these feed into departmental outcomes. In essence, how do targets within the departments influence potential creation of functional boundaries and silo working (see section 2.2.2) which inhibits a systems thinking approach with a focus on flow of product/goods (discussed in section 2.3.4).

Level of information required v level of information communicated – Building on the concepts of supply chain integration for improved flow (of goods/products through supply chain - discussed in section 2.2.3), this aspect is incorporated into the IIA to generate knowledge of how well departments/functions within the supply chain communicate information between each other (e.g., upstream/downstream or function to function), regarding timeliness and level of and detail (i.e. do depts/functions receive the right level of detail, do they have to continually chase for information) required to function efficiently and effectively. As discussed in section 2.2.3, information flows are important for integrating a supply chain and thus enable it to be managed as a system (holistic understanding of end-to-end flow rather than a group of individual departmental activities – see section 2.3.2, 2.3.4 and 2.3.6). Investigating the current perceived information requirements of a department/function, compared to what they actually receive will give a reference point as to the level of thinking at departmental/functional level v holistic thinking (or activity v flow).

Chapter 2 highlights literature that discusses the potential negative impact of using targets (see section 2.3.4) as a measure of performance, and how the integration and transparency of information across a supply chain is important for managing flow of product/service delivery (see section 2.2.3). A uniqueness to this conceptual model compared with the BI (Business Improvement) literature researched, is that the IIA element of the model presented seeks to find out the current status and impact of these areas in structured way. The knowledge generated from this element of the model is significant for informing stage 3 of the model, in particular aiding a mindset shift if required (to a systems mindset discussed in section 2.3.4) through leadership strategies (see sections 2.7.2, 2.7.4) for systems/holistic thinking towards BI and management and communication of information.

Stage 2.4 – Measurement

Understanding the impact of targets through application of stage 2.3 of the model will help inform as to rationale for some of the measurements being used. Stage 2.4 is the key stage for generating knowledge on how the current operations within the supply chain are performing and methods of measurement.

Stage 2.41 - Review current operational performance measurement methods

This element builds on the core theory of Seddon (2003) (discussed in section 2.3.4) through investigation of current performance measurement methods being used, in particular identification of activity-based targets as performance measures, against performance measures more associated with flow (for example, end to end process time). This element of the model will establish whether the true end-to-end performance of the supply chain is measured and understood and whether (in conjunction with stage 2.3) there is potential existence of functional barriers and silo working as discussed in section 2.2.2. In essence, to what degree is the supply chain measured and understood as a system.

During the implementation of this element of the model, new measures (such as end to end process time, (e.g., customer request product/goods to receipt of products /goods) may need implementing to understand the true performance of the current processes, including using measurement methods discussed in section 2.4.4.

The knowledge generated through this stage of the model will inform stage 3 of the model, in particular the design of new performance measures.

Stage 2.42 - Establish level and type of failure demand

This element builds on the concept of failure demand (see section 2.3.4), specifically in the context of activities that do not contribute towards achieving purpose (from the customers perspective) within the supply chain (e.g., having to chase information from other depts). Whilst the concept of failure demand for this model (in conjunction with the notion of ‘purpose’) derives from the theory of Seddon (2003) (presented in section 2.3.4), understanding failure demand within the system and processes for

this model also draws from other concepts and methodologies. For example, methods to understand failure demand (or waste) draws from techniques associated with Lean and Lean Six Sigma philosophies (presented in sections 2.4.2 and 2.4.3) such as:

- Value steam mapping
- Identifying the value stages of a lean intervention (i.e., identifying value activities within processes)
- Measure and Analyse stage of the DMIAC methodology as used within 6 Sigma methodologies
- The process study phase of the PDSA cycle

Understanding the actives and scenarios within the system and processes that do not contribute towards 'purpose' will build from stage 2.41 in understanding current levels of performance and identify improvement opportunities for incorporating into stage 3 of the model, in particular stage 3.2 - Re-design processes based on value demand (discussed in section 2.3.4), new measures and reduction of failure demand identified.

Stage 2.43 - Identify levels of external/internal influences on current processes/system

This element of the model identifies influencers of waste (failure demand) within the system and builds on the notion of 'System Conditions' which derives from the 'check' element of the check - plan - do model presented in figure 2.6 and table 2.4. In the context of supply chain and for this model, examples of system conditions could include:

- Inadequate I.T systems that are not fit for purpose and cause operational inefficiencies (e.g., having to repeatedly input the same data)
- Operational procedures that are not best aligned to the process
- Processes that are not fit for purpose
- Organisational structure, including job roles
- Contracts (with large companies or government type agencies)

The potential areas of system conditions can be drawn from the value chain model as presented by Porter (1998) and discussed in chapter 2.5, specifically areas included within the secondary activities such as infrastructure. In addition, this element of the model draws from general supply chain literature discussed in sections 2.2.2 and 2.2.3, where barriers to effective supply chain management can be identified as system conditions such as misalignment of processes, structure and poor compatibility of information and technical systems (for example, different I.T systems between functions or elements of the supply chain that would be very expensive to replace but cause duplication of work as not compatible with each other).

As highlighted in table 2.4, system conditions reflect double loop learning (Argyris,1977), in essence (for the context of this study), learning something about the organisation that requires a sizable change or change in thinking to improve, which although might be the best solution, might not be easy to do (e.g., for financial reasons), therefore assessment would need to be made as to what is feasible.

Identifying system conditions with a view to seeking active change will influence the re-design of processes in stage 3.2 of the model.

3.5 Stage 3 – New Design

Stage 3 of the model builds through an iterative process from the knowledge generation of stage 1 and 2. The new design stage represents the stages for building a new system and process design, in parallel with leadership and strategy for implementation and moving to a systems mindset (from the core concepts of Seddon's philosophy discussed in section 2.3.4).

Stage 3.0 - Use results from IIA to redesign (if required) performance measurement and leadership strategies/methods which reflect a holistic view (based on purpose) of the internal/external supply chain (for example, purpose driven delivered on time in full measures):

Through analysis of the knowledge gained in stage 2 of the model, in particular elements 2.1 (methods informing BI strategies) and 2.3 (Interdepartmental Impact Audit), this element is designed to evoke a systems mindset through strategic

leadership (see section 2.7.4). The implementation of the IIA in stage 2.3 will identify any current levels of systems thinking by establishing the level of consensus regarding ‘purpose’, and how holistic departmental performance measures are.

This step in the model is deemed important for driving both associated organisational change and the method for business improvement (the model) through the organisation (and potentially wider supply chain). It draws from the literature discussed for stage 2.3 of the model, and literature discussing the failure of change interventions related to other business improvement methodologies through lack of strategic leadership (discussed in section 2.6.2). It also builds from the notion that managers may need to change their thinking from traditional command and control (discussed in section 2.3.4), in particular viewing work from the perspective of flow rather than individual functional activities, with potential for the removal of functional boundaries (see section 2.2.2) and design of new performance measures which are more holistic and better reflect purpose (building on the concepts of Seddon (2003), section 2.3.4).

In addition, this element draws from the change management literature presented in section 2.73 and 2.7.4, in particular the attributes of frame-breaking change.

Stage 3.1 – Use results from IIA to redesign Information management and communication methods

This stage of the model is informed by the IIA in stage 2.3 of the model, especially the generation of knowledge associated with understanding the information (and associated communication) needs requirements, for a more integrated approach to cross departmental/supply chain working required for a systems thinking approach (discussed in section 2.3.3).

This element also links to stage 3.0 discussed above and the wider strategic leadership strategies for developing a systems thinking mindset within the organisation. It is developed from the notion of a systems thinking mindset enabling more holistic thinking and improved information flows across departments helping to reduce functional boundaries (as discussed in section 2.2.2).

Stage 3.2 - Redesign processes based on value demand, new measures and reduction of failure demand identified in stage 2.4.

This stage of the model is informed by the knowledge generated from undertaking the steps in the measurement stage (2.4) of the model. The stage builds on Seddon's (2003) philosophy discussed in section 2.2.4, in particular the notion of failure demand and the counter intuitive design aspects highlighted in table 2.3.

The stage also builds on the identification of value (discussed in sections 2.4.2 and 2.5.2) and the creation of value from how organisation functions interact (section 2.5.2). In addition (to Seddon's philosophy), the stage draws from elements of literature associated with the redesign stages of other improvement methodologies (discussed in sections 2.4), for example, the development of the flow stage (Womack and Jones ,2003), and the re-design stage of lean six sigma implementation (discussed in section 2.4.4).

This stage of the model is a key stage for implementing a change of thinking in supply chain process design, supported by the leadership strategies in stage 3.0 of the model.

Stage 3.3 – Prove process measurement systems through reliability and repeatability testing

This stage of the model is key prior to full implementation of measurement methods, with the aim of validating the measurement methods designed in stages 3.2 and 3.0. The stage draws from the six-sigma literature discussed in section 2.4.3, in particular the concept of MSA (measurement systems analysis) and the quantifying of variation levels within the measurement method.

This stage will identify influencers on the measurement methods that could cause unwanted variations leading to inaccurate actual measurements of process and system performance. Whilst MSA is more associated with manufacturing, including machinery and measurement equipment, an adaptation could be made for measurement of more service-related measures, which is the concept for this model.

Understanding the accuracy of the performance measurement methods does not form part of Seddon's method (discussed in section 2.4.3). The inclusion of this aspect within the model for this study is another example where Seddon's theory has been further developed, in this instance through inclusion of aspects from other BI theory.

3.6 Stage 4 – Pilot

Once the new process designs are completed and measurement systems validated during the new design stages, actual implementation of the changes can begin. This stage of the model presents a pilot testing phase, in essence, test the changes on a small scale (for example, for a proportion of goods, or specific dedicated processes) rather than a full roll out across the organisation (and potentially wider supply chain). Such testing will allow the changes to be reviewed and modifications made if required, as highlighted in stage 4.1. This might mean going back to stage 3.2 if the learning highlights that a re-think is required.

This element of the model has parallels with the BI literature in sections 2.3 and 2.4 and is seemingly a common feature in BI models/approaches.

3.7 Stage 5 – Roll Out

This final stage of the model reflects the roll out of concepts and new process designs across the organisation and (potentially wider supply chain). This stage will only be undertaken once the results are satisfactory from stage 4. The stage has parallels with the final elements of BI cycles discussed in section 2.3.4, with strategies developed that include the latter stages of Lean Six Sigma discussed in section 2.4.4, the detail of which would include areas such as mistake proofing, implement training and review to sustain solutions and create control plans and apply control strategies. Strategies for roll out across the wider supply chain (if different organisations) would be dependent on the involvement of the relevant organisations throughout the implementation of the prior stages of the model.

3.8 Overview and Conclusions

The development of the conceptual model has been deduced from the literature presented in chapter 2, which has enabled development of a method that presents an iterative sequence of events to be followed for application. The model potentially contributes to new knowledge, through the unique characteristics developed from the core systems theory of Seddon (2003) and applying to the context of an organisation(s) that form part(s) of a supply chain physically moving goods.

A particular uniqueness of the model is the incorporation of the IIA (interdepartmental impact audit), built from the behavioural theory associated with using performance targets (See section 2.3.4) and the supply chain integration theory (see section 2.2.3). Whilst aspects of the model have parallels with other approaches, elements such as the feasibility stage offers a uniqueness to the compilation of components and illustrations for the stages. The development of the model from the literature realised achievement of Research Objective 2:

- Through convergence and further development of concepts identified in the literature, develop a high-level conceptual model for analysing business performance, with a view to identifying and implementing improvement opportunities.

At this stage the model is a theoretical concept that requires testing, which will be undertaken through a 2-stage testing process, the methods for which are discussed in Chapter 4 and the results presented across Chapters 5 - 7. The 2 stages consist of:

Model verification – Has the conceptual model been constructed and considered in a robust manner and could it theoretically achieve the desired purpose if applied to an organisation.

Model validation – To identify whether the model can be applied in practice, in essence, moving from concept stage to actual application (does it work if applied to an organisation). This stage also gives opportunity to further adjust the model if/where necessary.

As discussed in section 2.8, the 2 stages of testing will also give a level of validation as to the literature used to inform the model, i.e., the subjects and subsequent derived elements.

Chapter 4 - Research Methodology

4.1 Introduction

The overall aim of this research is to develop a high-level conceptual model for analysing business performance within supply chains, with a view to identifying and implementing improvement opportunities.

Chapter 3 has presented a conceptual model developed through comprehension and conception (figure 3.1), which at this stage is a theoretical concept that requires testing. This chapter presents the research methodology for testing the model, theoretically through involvement of experts, and practically through application to an organisation.

Through first reviewing the authors ontology and epistemology in context of this research, this section discusses the general research philosophy and approach, followed by methodical choice and research strategies. This is followed by detailed discussion and justification of data collection and analysis methods, including methods for the verification and validation processes of the conceptual model presented in chapter 3.

- **Model verification** – in the context of this study, the term model verification is used to identify that the conceptual model is constructed in a considered and robust manner and could theoretically achieve the desired purpose if applied to an organisation.
- **Model validation** – Whilst the verification process provides a theoretical insight to the application of the model, the term model validation is used to identify whether the model can be applied in practice, in essence, moving from concept stage to actual application (does it work if applied to an organisation).

Easterby Smith et al (2013) present a model based on the inner rings of a tree trunk as a metaphor for highlighting an iterative process for the thinking behind the research process (figure 4.1).

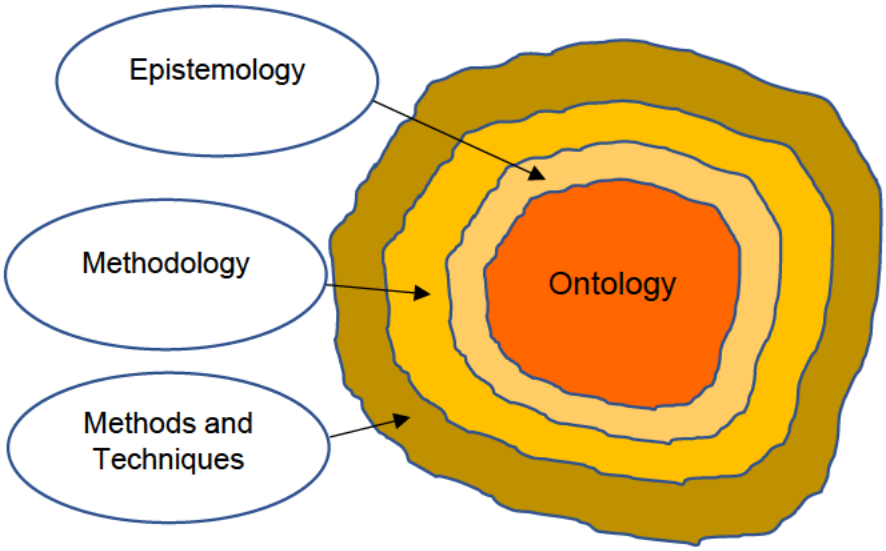


Figure 4.1 – Research thinking process, adapted from Easterby Smith et al (2013)

The process in figure 4.1 can be considered as iterative, as according to Saunders et al (2012), the research process causes assumptions to be made about the nature of reality, which impacts how the next stages of the research process are developed, for example, understanding how to shape research questions. The model presented in figure 4.1 illustrates how one thought process can lead to another, which is a less detailed model than the research onion model (figure 4.2) presented by Saunders et al (2012).

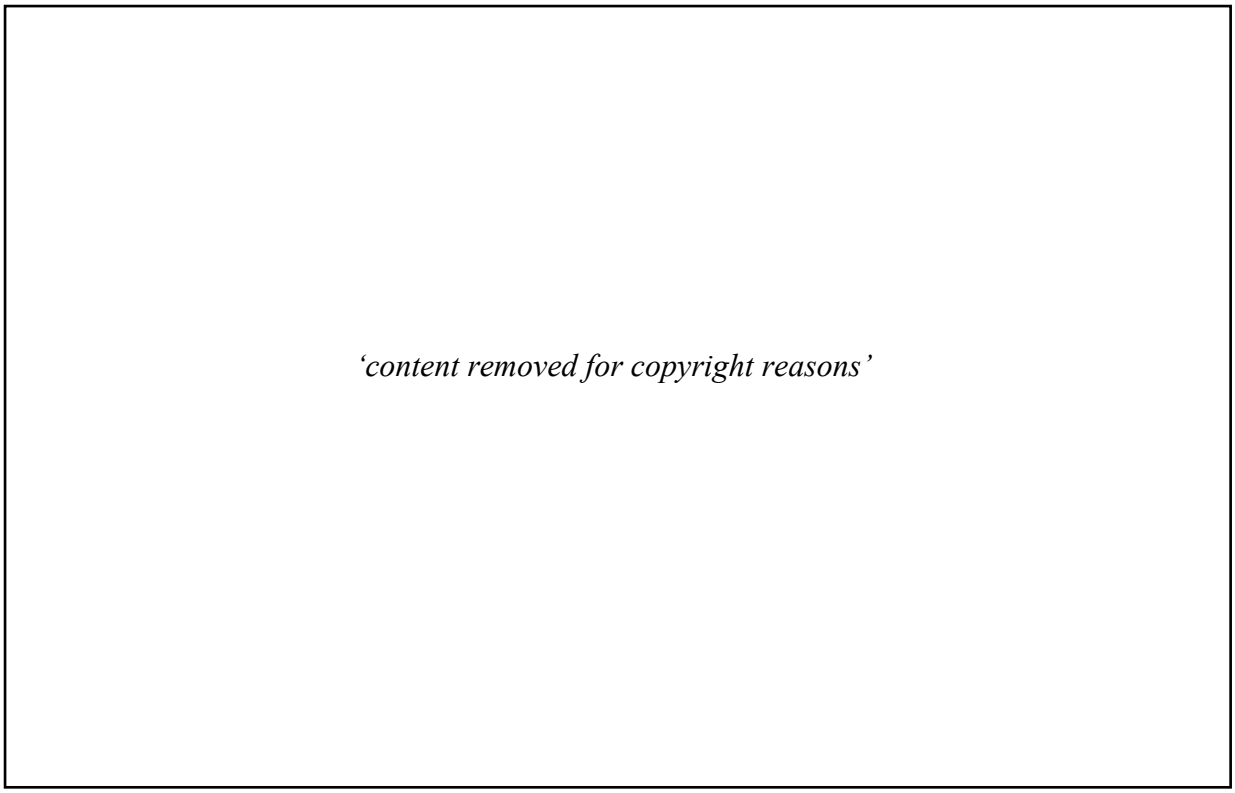


Figure 4.2– The Research Onion Saunders et al (2012, p128)

The model (figure 4.2) presented by Saunders et al (2012) offers more detail to the research process, whereas the model presented by Easterby Smith et al (2013) can be considered a high-level perspective on the process. The research concepts for this study are highlighted in red.

Initial enquiry into the subject of research methods highlighted that there is a different use of words or terminology between authors for the different stages of the research. For example, whilst some authors use the term strategy to define aspects of the process, others use the term method to incorporate similar topics. To give structure to this chapter, the main headings of the research process/areas adopted for this research are derived from the research onion (Saunders et al,2012) illustrated in figure 4.2.

4.2 Research Philosophy

4.2.1 Ontology

According to Saunders et al (2012), research philosophy has an influence on how a researcher will think about the research process and highlight ontology and epistemology as two ways of thinking about research philosophy. Easterby Smith et al (2013,p17) argues that ontology and epistemology are areas of central debate for philosophers, highlighting that ontology "is about the nature of reality and existence", and epistemology "is about the best ways of enquiring into the nature of the world". Ontology is the starting point, highlighted by Easterby Smith et al (2013) in figure 4.1 as the central core in their analogy to a tree trunk, with the other factors built around the core, and argue that there are several different ontologies, including realism and relativism. Easterby Smith et al (2013) highlight that there are many forms of realism, including the notion that there is a single truth. For example, in the context of this study, this could be the answer to a question such as do targets drive negative behaviour? A single truth would be reflected in a definitive yes or no. However, arguably it is difficult to give such a definitive answer, as it will most likely depend on a range of different things associated with the social actors (Saunders et al, 2012), for example, experience of working with targets within an organisation or social entity (Saunders et al, 2012).

By contrast, according to Easterby Smith et al (2013) an ontological position of relativism holds the notion that there could be many truths, there are potentially different views amongst people (social actors) and that a common truth can be reached through agreement between the social actors (Saunders et al, 2012). Using the same example as above for the context of this study, the answer to the question 'do targets drive negative behaviour' would not necessarily be a definitive yes or no, due to the potential of multiple truths depending on perceptions. This reflects a more qualitative position highted by Collis and Hussey (2003), where the participants present a reality that is multiple and subjective.

A summary of the different ontologies discussed are presented table 4.1 below:

Table 4.1– Comparison of ontologies, adapted from Easterby Smith et al (2013)

	Ontology	
	Realism	Relativism
Truth	Single truth	There are many truths
Facts	Facts exist and can be reviled	Facts are dependent on the view of the observer

Reviewing the literature for this element highlighted that there are blurred lines and much debate between philosophers in this area of study (research philosophy). This is also highlighted by Blumberg et al (2014), who argue that in practice (particularly in management studies) it is rare to have subscription to the same philosophy consistently and often there is the prevailing of a pragmatic view. Saunders et al (2012,p129) argue that it is more appropriate "to think of the philosophy adopted as a multi-dimensional set of continua rather than separate positions". This study aligns to the notion of Blumberg et al (2014), where the study can be related to both realism (single truth) and relativism (multiple truth) and will be highlighted in later sections.

4.2.2 Epistemology

According to Collis and Hussey (2003, p48), epistemology "is concerned with the study of knowledge and what we accept as being valid knowledge", or as stated by Easterby Smith et al (2013,p21), it "is about inquiring into the nature of physical and social worlds". Bryman and Bell (2015,p29) discuss that once the ontological position is understood, it will "imply a particular epistemological position – understanding of how we can gain knowledge of that reality". This aligns to the process of events illustrated by the Easterby Smith et al (2013) tree trunk analogy, where ontology is the central core of the trunk and epistemology is the next ring of the trunk - discussed in section 4.2.1 and highlighted in figure 4.3 below.

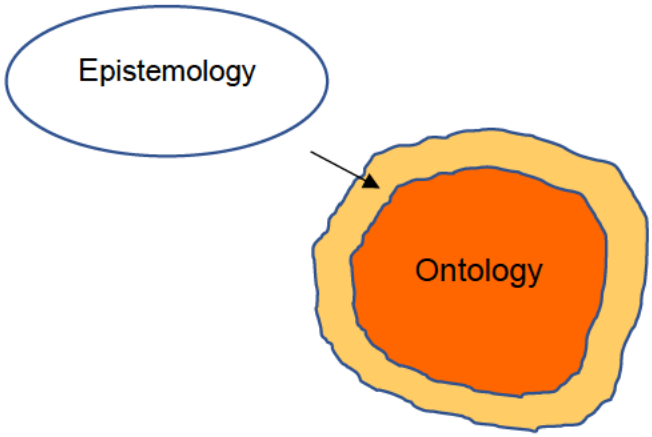


Figure 4.3 – Research thinking process extract, adapted from Easterby Smith et al (2013)

To further understand gaining knowledge of reality, Saunders et al (2012) and Bell et al (2015) discuss two research philosophies which are in some ways diametrically opposed, Positivism and Interpretivism. To establish which research philosophy best reflects what is considered acceptable knowledge, and taking into consideration the ontological positions discussed in section 4.2.1, table 4.2 has been compiled to contrast Positivism and Interpretivism, based on the differences espoused by Saunders et al (2012) and Bryman and Bell (2015). In addition, the third column reflects the view of a pragmatist as presented by Saunders et al (2012), who argue that a pragmatist recognises that the world and the conducting of research can be viewed and undertaken in different ways – in essence, can be viewed through multiple lenses.

Table 4.2 – Comparison of research philosophies, adapted from Saunders et al (2012) and Bell et al (2015)

Positivism	**Interpretivism**	**Pragmatism**
Reflects the stance of natural scientist	Believes reality is impacted by human action	Concepts only relevant when supporting an action
Only phenomena that can be observed can provide credible data	Concerned with understanding human behaviour	Can work with different philosophical positions
Phenomena reduced to simplest elements	Understanding the process of why things happen	Importance of practicality of research findings
Testing of Hypothesis	Conducting people rather than objects	More than one way to interpret the world
A deductive logic	Understanding the difference in the role social actors (people) play	Potential to integrate different perspectives for interpreting data
Measure using surveys or other instruments	Focus on details of a situation	

Reviewing the philosophies in the literature and the summative comparisons made in table 4.2, this research has attributes linking to both philosophies of interpretivism (relates to Ontology of multiple truths) and Positivism (relates to Ontology of a single truth), including the views of single and multiple truths aligned to each philosophy. This is an example of the theory of Blumberg et al (2014), who as discussed in section 4.2.1, argue that for management studies it is rare to align totally to one philosophy and therefore reflects Pragmatism (Blumberg et al,2014; Saunders et al ,2012). In this context, this study aligns to Pragmatism, in particular (as highlighted in

table 4.2) because the approach works between different philosophical positions and the importance of practicality of the findings, with the standpoint that there is more than one way to view the world.

4.3 Research Approach

In addition to understanding the research philosophy, Saunders et al (2012) consider 3 different research approaches, Deduction, Induction and Abduction. The key attributes associated with the approaches discussed by Saunders et al (2012) are:

Deduction (which can be linked to Positivism):

- Links to scientific research, including theory development which is then tested. This could include the development and testing of a hypothesis - Testing of a premise through data collection, followed by analysis of variables or concepts
- Measurement of facts usually through quantitative means
- Verifies or falsifies theory
- A research approach dominant in natural sciences, explanation based on laws presented

Induction (Which can be linked to Interpretivism):

- Theory developed from the analysis of data
- Typically, the research is concerned within the context of it taking place
- Associated more with qualitative data to evaluate potentially different views of phenomena
- Identification of themes from the data
- Creation of a conceptual framework
- Generation and building of theory

Abduction (Which can be linked to Pragmatism):

- Combines deduction and induction
- Development of plausible theory
- Identify themes and patterns in data, build into a framework and test
- Create a conclusion from through testing a known premise
- Exploration of phenomenon through data collection, patterns and themes identified, locate in conceptual framework, test framework through subsequent data collection
- Generates and builds new theory or modifies existing theory

As discussed in section 4.2.1, analysis of the literature suggests there can be blurred lines between the differing research philosophies, which can also be considered true for the research approach. This study can be considered an abductive approach to the research, with a key characteristic (as highlighted by Saunders et al, 2012) that it combines induction and deduction, linking to the identified philosophy (for this study) of pragmatism, which has the potential to integrate different perspectives for interpreting data and can work with different philosophical positions. In addition, the attributes of an abductive approach in relation to this study reflect the generation and modification of theory, and subsequent testing through additional data collection. Bell et al (2015) argue that abduction has grown in popularity, notably with business research as a mode of reasoning, highlighting that inductive and deductive approaches applied on their own have weaknesses.

4.4 Methodological choice

Methodological choice according to the model (figure 4.2) presented by Saunders et al (2012) is reflective of whether the data collection techniques employed within the study are of a quantitative or qualitative nature. Saunders et al (2012) highlight that whilst each method is associated to a particular research philosophy, (i.e., quantitative with positivism, qualitative with interpretivism), for quantitative data collection there should be distinctions made between the type of data collected. For example, is the data based on specific attributes of organisations/people (or other things), or is it based on opinions, which according to Saunders et al (2012, p162) can be referred to as “qualitative numbers”, this could suggest that the methods are not necessarily fully aligned to a philosophy. Bell et al (2015, p35) makes comparable commentary, as they imply that whilst interconnections and contrasts between the features of each method can be made “it is necessary to be careful about hammering a wedge between them too deeply”.

This study combines quantitative and qualitative data collection and analysis through the model verification and validation stages (to be discussed later in the section), which can be identified as a mixed method approach (Saunders et al, 2012), and links well with the pragmatism and abduction attributes of this study. According to Saunders et al (2012), a fully mixed method approach would find both methods (quantitative and qualitative) integrated at each stage of the research, including the presenting of the interpreted data. This research uses a combination of methods in the model verification stage but adopts a qualitative approach in the model validation stage (to be discussed in following sections), in this context the research can be considered a mixed method approach which is partially integrated (Saunders et al, 2012).

4.5 Time Horizon

Whilst the PhD study has taken place over several years, the actual primary data collection was undertaken over a constrained amount of time. According to Saunders et al (2012), research conducted within a constrained amount of time is termed cross-sectional, highlighting the study of a particular phenomenon over this time period, often using a survey strategy. This contrasts with a longitudinal study, which according to Saunders et al (2012) has a strength of being able to study change over time and measuring associated variables.

In this study, both elements of primary research (model verification and model validation) were undertaken over a limited time period, in essence researching views and perceptions valid to the respondent at that moment in time, based on current and past scenarios and experiences that the respondent has had to form perceptions, hence a cross-sectional study.

The primary research was undertaken during the Covid 19 pandemic, where supply chains had been thrown into focus and were having to flex and adapt, whilst the pandemic initially delayed the data collection due to the stresses upon supply chains at this time, once undertaken the timing was good as businesses were reflecting on their approaches.

If this study was involved in fully testing an existing model for business improvement, a longitudinal time horizon could have been adopted to apply the model in the early stages and measure the impact upon the organisation over several years.

4.6 Research Strategy, Primary Data collection and Analysis

4.6.1 Introduction

Saunders et al (2012, p173) use the term strategy for definition of the research plan as how to approach answering the research question (research objectives in this study), highlighting that strategy is the “methodological link” between the research philosophy and methods used for collecting and analysing data. Bell et al (2015, p44) use the term “research deign” to incorporate similar themes, including case study and survey approaches. This research adopted two primary data collection strategies in the form of Delphi Study (incorporating surveys) and case study (as

discussed below). However, prior to the primary research the conceptual model was developed through review of the literature and the author's experience (presented in Chapter 3). The strategies are introduced below:

Literature Review

The literature review consisted of secondary research (Saunders et al, 2012,) which enabled exploration of topics through an organic and iterative process (discussed in chapter 2.1) to explore and review concepts and theories to inform the conceptual model. This enabled the achievement of the first objective of this study:

Research Objective 1: To research and give critical review to the literature for informing the design and construct of a high-level conceptual model.

Delphi Study

The verification (see section 4.6.2) of the conceptual model enabled review and critical assessment by experts (academic and practitioners, discussed in section 4.6.2) that enabled enhancements to be made from the initial development, which was derived from the literature and the author's own experience (discussed in section 3.1). The verification was achieved through application of a Delphi study which is discussed in more detail in section 4.6. Using a survey to collect data for the Delphi study enabled the collection of both quantitative and qualitative data and subsequent analysis, an example of quantitative data is measuring the level of consensus (to be discussed in section 4.6) for areas of the model. Whilst surveys are associated with quantitative data collection and analysis (Saunders et al, 2012), the survey also enables the collection of qualitative data for analysis, examples include the collection and analysis of additional comments, or descriptions of situations in a specific context – from participants from a range of organisations with different experiences (discussed further in section 4.6.2).

Case Study

According to Easterby Smith et al (2013), a case study focuses on one or a small number of organisations and can be used in different ways. Bell et al (2015) highlight that the term case study is commonly applied to organisations in particular geographic locations, with the setting being the focus of the examination. This study applied a case study strategy for validating the conceptual model, this stage of the research is presented in chapter 7 and was undertaken in one elected organisation, (a global supply chain company).

An advantage of using a case study strategy for this research is that it gives opportunity to ask questions such as ‘what’, ‘how’ or ‘why’ for detailed investigation of the phenomenon (Ghauri et al, 2020), in this case, the conceptual model construct and application. The case organisation was used to apply aspects of the model for validation, in essence, answering the question - will application of the model be informative in relation to the different stages (of the model) and provide opportunity for performance improvement?

4.6.2 Delphi Study – Model Verification

Primary data collection and analysis for verification (model constructed in a considered and robust manner and could theoretically achieve the desired purpose if applied to an organisation) and modification of the conceptual model was undertaken using the Delphi method, which according to Njuangang et al (2017) has become more popular following work undertaken in the 1960’s, and is now used across many disciplines in different sectors, which, according to Förster et al (2014) includes sporadic use in the context of supply chain management.

According to Avella (2016,p305), the Delphi method “takes its name from the ancient Greek city that housed the “oracle.” There, a priestess (called the “Pythia”) purportedly communicated directly with the gods and would answer questions”. In more recent times development of Delphi was undertaken in the U.S as a method of forecasting potential outcomes from the use of nuclear weapons in war. Avella (2016) highlights that Delphi is unique in its application where prior research is minimal (not relevant in this case regarding general business improvement methods), or where the collective judgement of experts could realise an advantage.

In the context of this study, the unique composition of the conceptual model in its entirety needed to be researched regarding testing of concept, utilising the knowledge of experts to undertake the testing (verification) was deemed as essential for adding significant value to this stage of the research process.

According to Förster et al (2014) the Delph technique is a survey procedure which incorporates multiple levels (or rounds), with an assumption that using experts to provide opinion provides more exacting results than that of non-experts - For example, a level (or round) can incorporate the use of a survey, presented to experts to seek, review and gauge of opinions to a range of questions or idea. After each level (or round), the panel receive feedback of the group response to the questions (Linstone & Turoff, 2002), with the goal of reaching a level of consensus for the answer to the question, for example, in this study consensus of whether an element of the conceptual model has relevant content. Avella (2016) point out that consensus does not mean 100% (for example, 100% of the panel believe red to be a stronger colour than blue), with 55% - 100% being typical ranges, but 70% agreement considered as the standard. This level of consensus is supported by Diamond et al (2014), who conducted research to investigate how consensus has been determined, highlighting that from 75 studies undertaken (Delphi Studies), the median threshold to define consensus was 75 % agreement. This study will use a consensus threshold of 80% agreement – discussed further in Chapter 5.

Njuangang et al (2017) highlight that over the years different types of Delphi have emerged:

- **Classical** - Being expert based, anonymous, iterative process (e.g., one stage informs the next, with controlled feedback from the researcher to the panel
- **Policy** – To generate alternative policies through structured public dialogue
- **Decision** – Aimed at decision making for social development (development related to people)

This research is mostly aligned to the classic approach, with some deviation from the approach espoused by Linstone & Turoff (2002), most notably that the study was designed to run over 2 rounds only, with the first-round questions being devised from

the literature (rather than through consultation with the Delphi participants), this deviation can be considered as a modified Delphi design (Avella, 2016), an approach successfully undertaken by Nadeem (2019) for testing a conceptual framework as per this study. Njuangang et al (2017) provide further rational for this decision, by highlighting that having an inductive approach with the panel in the primary stages (e.g., for potential generation of survey questions) can actually be very time consuming, especially the analysis, highlighting that an alternative method sees the researcher generating ideas through qualitative research such as a literature review, which reflects the approach taken for this study - a benefit of which enables access to a wide range of available theories and concepts to frame the initial thinking.

Additional rationale for the approach of undertaking the study in a realistic time frame was due to the Covid lockdown period. During this period supply chain companies were working at breaking point, with other sectors dealing with high levels of uncertainty, for ethical reasons it was decided to push back the initial primary research and reduce the levels of contact if possible. However, whilst the time frame had to be realistic, it was nevertheless a good time to undertake the study as the Covid period sharpened the focus of many businesses, with process changes likely to have been made very quickly to adjust to the situation. The timing of the survey allowed the participants (especially the practitioners) to potentially re-think their approach to future process changes, and reflect on the current processes that might have been adjusted in an ad hoc way to meet the unusual circumstances presented by a pandemic.

4.6.2.1 Why Used Delphi

Application of the Delphi study reflects the Pragmatist nature of this research (discussed in section 4.2), in particular the moving between philosophies aspect of pragmatism. For example, open type questions (discussed in section 4.6.2.4) in the Delphi surveys that seek opinion/views can be considered as inductive, as the qualitative nature of the answers allows identification of themes from potentially different viewpoints, giving opportunity to enhance the conceptual model – linking to traits associated with Interpretivism and the ontology of relativism, where different viewpoints can reflect multiple truths (see table 4.1). In contrast, quantitative

questions that are seeking a consensus answer across the panel have traits of Positivism, where a question can be considered a hypothesis which is seeking verification through a consensus agreement, in essence, an agreed view which can be considered a single truth, thus reflecting the ontology of realism.

In addition to alignment of philosophy, literature reviewed for this study highlights that numerous scholars have applied Delph studies to the context of supply chain, with rationales that align to this study. For example, Bastas (2018) argue it is a method which is highly utilised in the verification of novel concept (in this case the conceptual model), including systems topics, and Agrawal (2022), who highlights the use of Delphi studies in areas of supply chain management. To further support the rationale for this study, Gebhardt et al (2022) argues the Delphi method as suitable for studying a supply chain topic, due its suitability for the investigation of future scenarios and how it enables the work to build on expert opinions.

From the researcher's perspective, in addition to the above, using the Delphi method for the model verification stage was deemed a logical, efficient and coherent method for seeking opinion from subject experts from both academic and practitioner groups. Initial research into using the method highlighted that the approach could be adapted to suit this PhD study, which can be considered as a modified Delphi (Avella, 2016), or a further adapted version of the hybrid approach discussed by Njuangang et al (2017). Table 4.4 highlights further advantages, and therefore further rationale of using the Delphi method for this study, as adapted from Avella (2016) and Fink-Hafner et al (2019).

Table 4.4 - Advantages and rationale for using Delphi method, adapted from Avella (2016) and Fink-Hafner et al (2019)

Advantages and Rationale Factors for Using Delphi Method Within This Study
Avoids confrontation between experts (there would be no face-to-face contact between panel members or the researcher, with Delphi surveys being conducted online)
No limits to geographic areas of experts
Well suited when knowledge is incomplete about phenomena; (i.e., testing of the model), especially when seeking to improve the level of understanding
More than one interaction with the respondent, thus giving more opportunity to think about the concept – iterative process
A flexible methodology with many variations accommodated; flexibility allows researchers to adapt the technique to the context of the research
Can provide a more complete picture due to incorporating qualitative and quantitative methods
Contribution by experts for understanding and resolution of any significant issues
Verification through transparency and openness for production of knowledge which is practice orientated
Reduces the likelihood of noise that can be created through other forms of group communications (for example, diversion from the focus that can occur in face-to-face communication)
Anonymity of panel results in freedom of expression
Design is relatively straightforward and flexible in construction
Number of panel members can vary for each round, meaning if panel members drop out between rounds is not a major issue

In addition to the advantages presented above, other advantages were associated with the Delphi surveys being conducted online. The main reason for conducting online was the ability to enable panel members (or respondents, to be discussed later in the section) to engage irrespective of geographical location whilst also adhering to Covid restrictions. But in addition, conducting online also gave flexibility as to when the panel members could complete the Delphi surveys, resulting in a high participation rate.

4.6.2.2 Limitations of Delphi Method

Whilst there are many positive reasons for adopting the Delphi method for this study, there can be limitations if consideration is not built into the design and management of the surveys. Two significant areas highlighted within the literature and relevant to this study are:

Potential for low response rates – due to the iterative nature of the technique, there is risk of panel members discontinuing with the study after the first round, highlighting that the key to success is subject motivation Hsu and Sandford (2007).

In this study the panel was formed from experts in the field from both academic and practitioner environments; this most likely helped maintain a level of interest and commitment due to having genuine interest in the subject field being studied. For example, academics broadening knowledge, practitioners reflecting on current and future process design as discussed in section 4.6.2. In addition, it could have also reflected a model design and survey questions that were easy to comprehend, through interaction with a well-known online platform which was user friendly.

Researcher Bias or Opinion Moulding – As the researcher is influential in the process, there is potential for unintended bias to creep in. This could occur through the way the questions are formulated, for example, steering the respondent towards a certain answer (Avella, 2016). In addition, the presentation of results and questions in the 2nd round of the study could unintentionally mould opinion (Hsu and Sandford, 2007), notably if there is a distorted truth presented in panel feedback.

To reduce the potential of unintended bias, the survey questions were pilot tested (see section 4.6.2.5), with modifications made where appropriate. The survey

questions were unbiased and thematically derived from the literature in Chapter 2 rather than personal opinion – Chapter 3 highlights how the literature informed the model, and therefore the related subject areas of the survey questions.

To avoid potential moulding of opinion, results from the first round of questions were clearly integrated into the questions of survey round 2 (i.e., stating outcomes from survey 1 highlighting rationale for modifications) and any changes to the model highlighted. The survey was pilot tested again for ambiguity to avoid unintended distortion of results. There was no distortion of results from survey 1 incorporated into the questions for round 2 of the survey.

Bias of Panel – The information informing the study is expert based rather than factually based. Therefore, different experts may offer different opinions or provide different information to one another (Nadeem, 2019).

As the model is conceptual at the stage of undertaking the Delphi surveys, information that is factually based about the application of the model would be non-existent at his stage, with informed opinion(s) being the key information sought. Informed information in the context of this study was the desired type of information to inform the concept further in an inductive way (Saunders, 2012).

As the panel members were constituted from academia and supply chain related organisations/professions, including global companies and academics form overseas institutions, the diversity of the panel significantly reduced the risk of panel bias.

The panel selection criteria are presented in section 4.6.2.7.

4.6.2.3 The Delphi Process for this Study

As highlighted in section 4.6.2, the Delphi method is an iterative process, incorporating a series of rounds (Förster et al ,2014; Avella, 2016). The conceptual model, derived from the literature was tested for verification firstly through Survey 1, the analysis of survey 1 enabled enhancements to the model which were presented in survey 2, analysis of which enabled further verification of the model. The full

process for the Delphi study to verify the conceptual model is illustrated in figure 4.4 below:

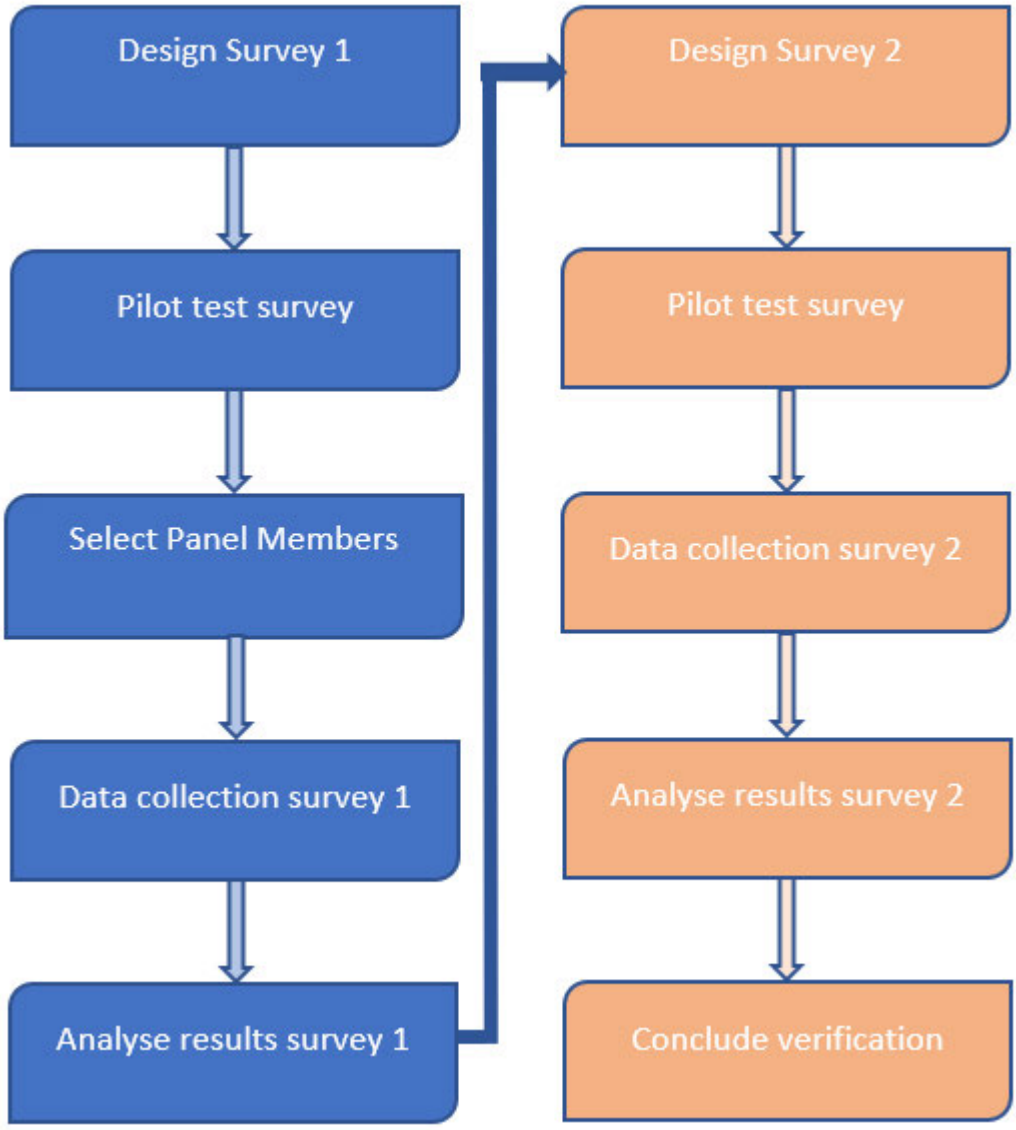


Figure 4.4 - Process steps for application of the Delphi method for model verification

4.6.2.4 Delphi Survey Questionnaire Design

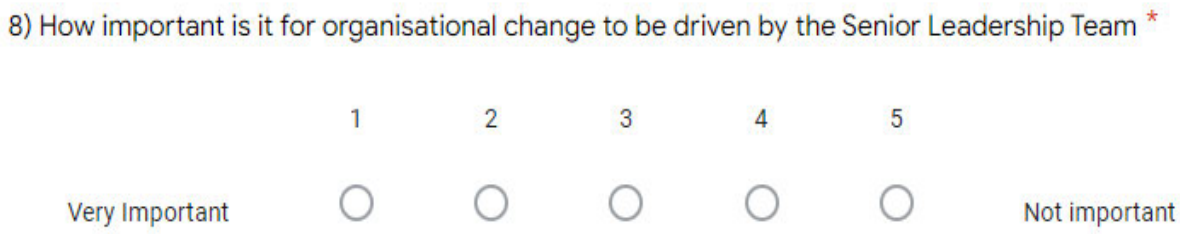
Mullen (2003) argues that most Delphi studies use questionnaires that are self-completing, sometimes using an electronic format. Both rounds of this Delphi study were conducted using an online electronic form (google forms), which enabled a mixed method approach (Saunders et al, 2012) for collection of quantitative and

qualitative data. Google forms was chosen as a platform due to ease of use, accessibility and general familiarity.

Both stages of the survey design were a structured questionnaire, designed to seek opinion and level of consensus as to the construct and concept of the model. The questionnaire was designed to follow the stages of the model in a systematic way to offer a logical sequence of events and themes to be presented at the analysis stage. Different question designs were used to seek opinion and levels of consensus for each stage of the model. For example:

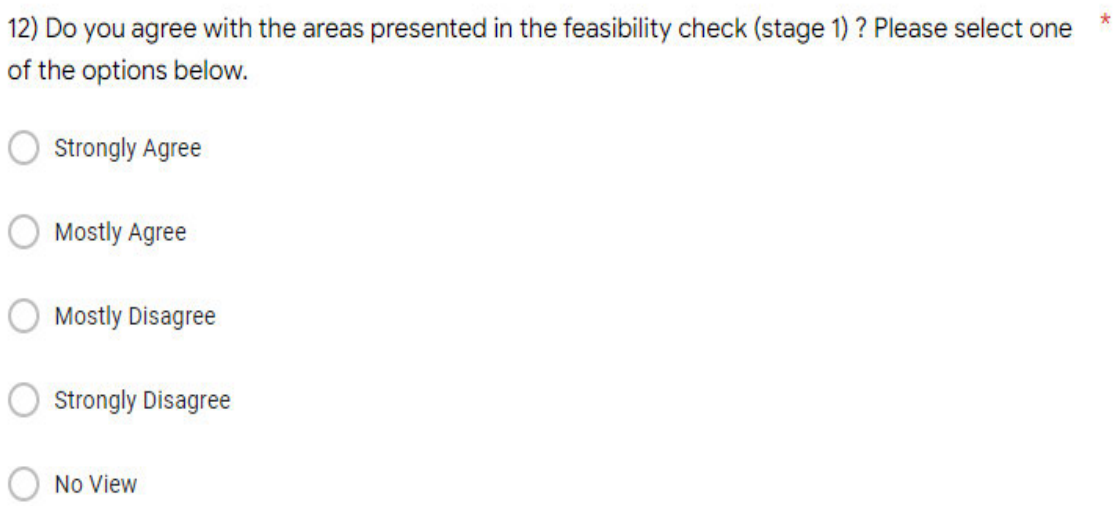
Likert scale questions were used to understand the level of agreement with statements (Bryman and Bell, 2015), each statement was designed to seek opinion which related to specific attributes of the model. A 5-point scale was used to offer a mid-point neutral position, with 2 additional moderate or extreme response options (Easterby - Smith, 2013).

Example:



Closed questions were used to seek levels agreement with stages of the model, including rating type questions (Ghauri et al,2020), using this method enabled the level of consensus to be gauged quickly at the analysis stage.

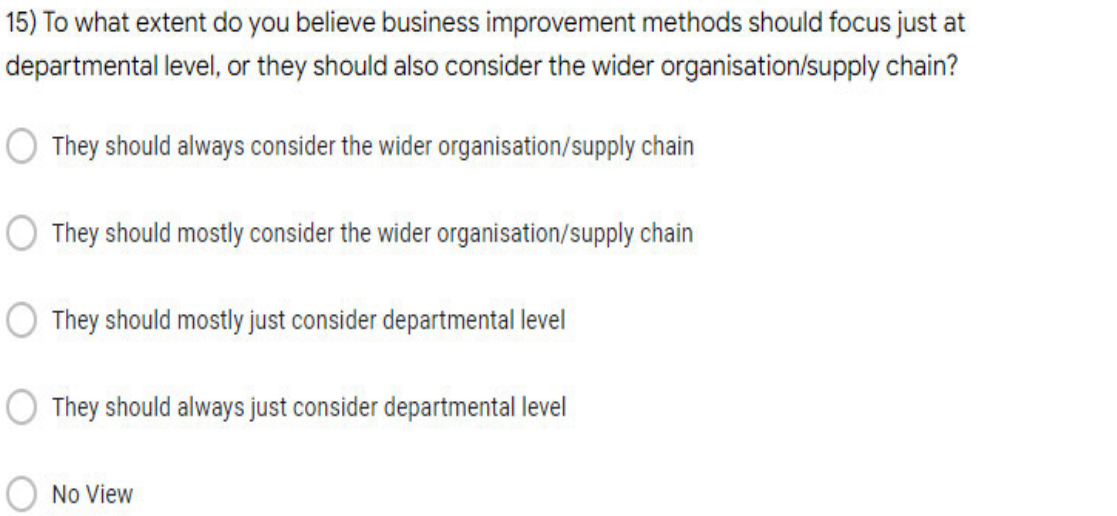
Example:


12) Do you agree with the areas presented in the feasibility check (stage 1) ? Please select one of the options below. *

- Strongly Agree
- Mostly Agree
- Mostly Disagree
- Strongly Disagree
- No View

In addition, closed questions were also used in a multiple-choice format to seek opinion on preference.

Example:

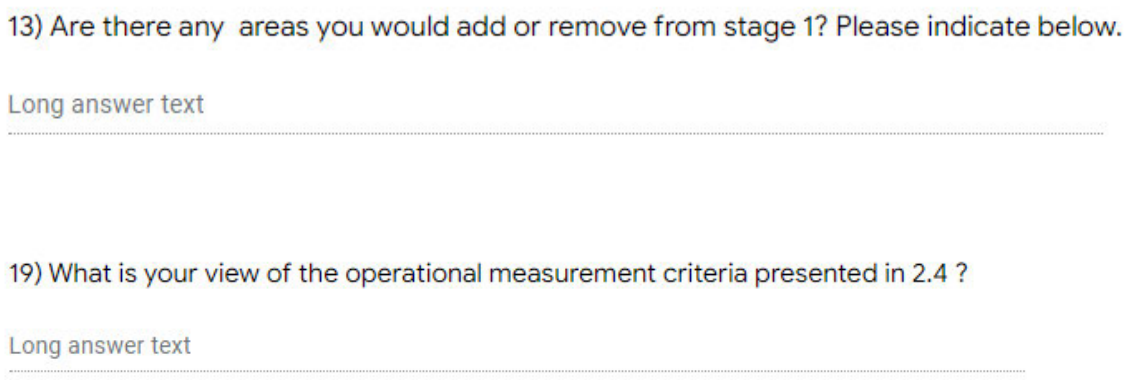

15) To what extent do you believe business improvement methods should focus just at departmental level, or they should also consider the wider organisation/supply chain?

- They should always consider the wider organisation/supply chain
- They should mostly consider the wider organisation/supply chain
- They should mostly just consider departmental level
- They should always just consider departmental level
- No View

The closed question format style questions enabled the seeking of opinion in a structured way and enabled quantitative analysis to be undertaken regarding levels of consensus. To enable the iterative process of a Delphi study (Njuangang et al, 2017), it was important for the questionnaires to include the collection of qualitative data. To enable qualitative data collection, open ended questions were used, which according to Bryman and Bell (2015) have advantages which include:

- Tapping into respondents' knowledge and experience
- Allows responses to be derived that in areas not considered by the researcher
- Useful for exploring limited areas of knowledge to the researcher

In the context of this study, the main advantage is tapping into the respondents' (panel members) knowledge and experience, specifically to inform improvements to the model for testing in the 2nd survey round. Open questions therefore were designed to primarily seek further view and opinion of aspects or stages of the model, for example:



Whilst the decision was made to limit the Delphi study to 2 rounds, open ended questions were also used in survey 2 to consider further thoughts on the model. If the feedback from survey 2 indicated a low level of consensus and/or offered significant opportunities for improvement to the model, the need for further survey rounds would have been necessary.

4.6.2.5 Delphi Survey Pilot Testing

As the Delphi survey questionnaires are self-completed, it was deemed appropriate (for survey 1 in particular) to run a pilot test of the questions with a selected group of people. The pilot testing enabled testing of areas such as:

- Whether questions are understood (Bryman and Bell, 2015) and no mis-interpretations - to avoid potential question skipping or random answer selection.
- Whether there are adequate instructions (Bryman and Bell, 2015) – this could also include information, for example, how well understood are any descriptive sections that explain areas of the model.
- To highlight any unintended researcher bias (Avella, 2016) – for example, unintended steering towards answering a question in a certain way

Testing for survey 1 was conducted with a diverse group of people, including:

- 3 x Academics in the area of Business management
- 1 x Academic in the area of education
- 1 x Supply chain practitioner
- 1 x Business Improvement practitioner
- 1 x Senior project manager

The learning from survey 1 design was fundamental into the design of survey 2, which included similar questions in terms of style and design. With this in mind, the pilot study for survey 2 was undertaken with fewer people from the same group.

The main factor types that were identified for attention are presented in table 4.5.

The full surveys can be found in Appendix C (survey 1) and Appendix D (survey 2).

Table 4.5 - Survey Pilot testing main factor types and remedial actions

Factor Type	Remedial Actions
Double barrel questions - questions that seek 1 answer, but include 2 factors within the question	Questions reconfigured by means of questioning singular factors, or reconsidering method of giving answer
Ambiguity in terms of what the question is asking	Question rewritten and terminology changed if required
Question Repeated	Deletion of repeat
Not enough context at beginning of question sections	The questionnaire has multiple stages which reflect the sequence of the model. Level of context reviewed and re-written

Upon completion of the pilot questionnaires, the feedback from the respondents was analysed and discussed with each respondent to ensure clarity of terms and ensure no ambiguity (the main factors highlighted in table 4.5). Modifications were made to the remedial areas identified and agreed individually with each respondent (this took multiple iterations for a few of the questions), on completion of this process the fully updated questionaries were viewed and agreed by the pilot study respondents. The full surveys can be found in Appendix C (survey 1) and Appendix D (survey 2).

4.6.2.6 Reliability and Validity

The pilot testing also acted as a test of reliability, which according to (Saunders et al, 2012) refers to consistency of findings under different conditions – in the context of this study it would refer to the diverse Delphi panel members. As presented above, the pilot study participants were a diverse group, which enabled a level of consistency to be measured regarding the interpretation of the questions. The discussions with each participant post survey completion ensured confidence that the surveys were reliable, in that the questions were interpreted as designed. The

design of the questionnaire also incorporated the opportunity to add comments in the sections, this enabled a test of reliability in 2 ways:

1- If comments made by a panel member did not align to the way they had answered the previous questions, this might suggest a misunderstanding of answer scales (i.e., Likert scale style questions)

2- The comments enabled panel members to highlight any ambiguity in question sets

In addition, the analysis of results enabled cross referencing of responses from each panel member, this enabled analysis of consistency of responses, for example, if 3 responses out of 4 made it clear that the respondent likes the colour red, but the 4th response is diametrically opposed, this might suggest a misinterpretation of the question, which would have led to further analysis of other responses. If the results highlighted areas of unreliability in round 1 of the Delphi, this could be rectified for round 2, and if necessary, an additional round could have been added to the study.

Another consideration to ensure reliability was to minimise the risk of researcher or panel member bias, this is discussed in section 4.6.2.2.

In addition to reliability, Sanders et al (2012) discuss the notion of construct validity, which in the context of this study means whether the surveys (in the Delphi study) are asking the right questions to inform the study, this can also be extended to whether the questions are being presented to the right people. To ensure validity, the questions were derived from the extensive literature reviewed in Chapter 2, which informed the conceptual model (discussed in Chapter 3), with questions designed to test the subject content and structure. In terms of asking the right people, a concise and strict selection criterion was designed to ensure the panel consisted of true experts in the relevant fields, the following section (see section 4.6.2.7) presents the selection criteria and the backgrounds of the panel members.

As discussed in section 4.6.2.1, Delphi studies have been used by multiple scholars in supply chain research and is a method highly utilised for verifying novel concepts (Bastas, 2018), such as the conceptual model for this study. Using a method that has been successful in comparable studies further adds to the validity of using as a data collection method for this study, giving a high confidence that the method would

accurately measures what was intended (Sanders et al (2012). An additional strength of using the Delphi method can be the internal validity evidenced by the level of consensus in relation to the survey questions. In a basic sense, if the model is applied to a supply chain organisation (cause), would it work (effect), with the strength and depth of the panel creating a trustworthy outcome when consensus is achieved (Cunic,2022).

4.6.2.7 Selection of Delphi Survey Panel Members

The literature highlights that there is different thinking towards the size of a Delphi panel, table 4.6 presents differing views as discussed in the work of Mullen (2003).

Table 4.6 - Suggested Delphi panel sizes, adapted from Mullen (2003)

Suggested Panel Size	**Authors cited by Mullen (2003)**
Typically, about 8 – 12 members	Cavalli-Sforza and Ortolano (1984)
Approximately 12 members	Phillips (2000)
Minimum of 7 members, highlighting deterioration of accuracy if numbers deplete and more accuracy if numbers increase.	Linstone (1978)
From 10 to 50 people recommended	Turoff (1970)
4 to 3000, specifically in health studies. The purpose of the investigation should govern the size.	Cantrill et al. (1996)
A suggestion that panel sizes of 300-500 can be considered sufficient	Wild and Torgersen (2000)

The differing views on panel size indicates that there is no specific formula for deciding on the exacting numbers of a panel. As this study is focused on a specific

area of context (Supply chain related organisations) a large panel (e.g. 50+) was not deemed necessary, however, a panel size of under 10 had potential risk to accuracy if any panel members decided to drop out between rounds (Mullen, 2003; Hsu and Sandford, 2007). To mitigate the risk and therefore the impact of drop out, and to ensure the group had diversity to avoid the risk of panel bias (Nadeem,2019), it was decided to aim for 12 to 20 active panel members (i.e., return of responses). To achieve this, a higher number of potential panel members were contacted, on the assumption that not all would complete both rounds. After initial informal communications with potential panel members, a total of 32 were selected and formally invited to participate – see section 4.6.2.8. Whilst this was not a high number, the initial informal communications gave a high confidence level regarding completion rate, reducing the potential likelihood and impact of panel member drop out.

4.6.2.8 Selection Criteria

The conceptual model developed in this study was designed for application within a supply chain environment, with the aim of giving opportunity for making improvements to the performance of the business. To verify the concept, it was decided to have two main criteria for the panel members:

- Academic
- Practitioner

The rationale for the chosen criteria is:

Academic – As the model was a concept initially derived from the academic literature, it was deemed important to seek the view of professionals with appropriate levels of academic experience and subject knowledge, it was therefore decided that opinion and consensus would be sought from very experienced academics in relevant fields of study with a minimum of Doctoral status, with a track record of research in relevant business areas, e.g., supply chain, operations, business improvement methods. The rationale for doctoral status is because to reach this level in academia requires significant and detailed research to be undertaken, the examination of which is through a rigorous and largely standardised process -.i.e.

completion of a sizable thesis, which is scrutinized and reviewed by at least 2 examiners, followed by additional verbal scrutinization in the form of a viva. Knowing the academic panel members had been through a similar process and reached a universally understood level gave a confidence level in the potential responses (i.e., they have the knowledge to respond accurately), which contributes to the validity of the study - see section 4.6.2.6

Practitioner – As the model is designed for implementation within an organisation (or set of organisations), it was deemed important to seek opinion and consensus from experienced managers working in a supply chain related organisation, and/or business improvement practitioners. The main inclusion criteria included, numerous years' experience working at a managerial level, either working within, or having experience of medium to large organisations within a supply chain. The rationale for experienced practitioners is such that it was more probable they have experienced supply chain related challenges and have a good understanding of supply chain management and/or functional operations. Such experience/knowledge contributes to the validity of the study – see section 4.6.2.6.

As the selection criteria for the study was quite specific, this reflects non – probability sampling, in particular purposive sampling which uses judgement (in this case the selection criteria) in the selection processes (Saunders et al, 2012). Saunders et al (2012) further highlight that purposive sampling is often used with small sample sizes and when the selection criteria include the cases being particularly informative, which aligns to the Delphi method of data collection and analysis being adopted for this study.

Using the selection criteria, academic and practitioner experts were invited to participate in the study as highlighted in table 4.7 and table 4.8.

Table 4.7 - List of invited Delphi panel members from Industry

Industry Experts	Geographic Location
Head of Logistics in a retail company with 11500million £ turnover	UK Based
Former CEO of a major European Rail company	European
COO of large retail logistic provider	UK Based
Senior Logistics Manager in one of UK's largest DIY and Garden retailer	UK Based
Supply Chain specialist in Power tool retail	UK Based
Supply Chain continuous improvement specialist	UK Based
Former operations director of train manufacturer	European
Director of UK logistics company	UK Based
Business Improvement specialist in 1st tier supplier to Rolls Royce	Global
General Manager of International aviation supply chain company	Global
Supply Chain continuous improvement specialist	UK Based
Director of transport and distribution company	UK Based
Project Manager in 1st tier supplier to Rolls Royce	Global
Director of Supply chain consultancy company	UK Based
Manager of a Business Improvement consultancy	UK Based

Table 4.8 - List of invited Delphi panel members from Academia

Academic Experts	Geographic Location
Professor in Logistics Management	Sweden
3 Professors in Supply Chain and/or Logistics	UK Universities
Emeritus Professor	UK Universities
Professor in Supply chain and Logistics Management	Norway
Professor of Operations and Supply Chain	UK University
3 x Dr in area of Supply Chain/Logistics	UK Universities
Professor of Logistics	UK University
Professor of Engineering Logistics	Sweden
Professor in Management	USA University
Professor in Supply Chain Management	USA University
Professor in Operations Management	India
Professor in Logistics Management	Turkey
Professor of Operations and Supply Chain Management	Brazil

The tables highlight that the panel members form a diverse cohort, with 2 distinctive groups, which as discussed in section 4.6.2.2 reduces the risk of panel bias. The tables also highlight the international and global nature of the panel, which in today's environment of global supply chains offered the potential for a wide perspective and high levels of experience to draw from, giving significant opportunity to review and enhance the model. The inclusion of academic doctorates and high number of professors on the panel adds to the significant practitioner experience of the panel, where combined can be considered a panel of very high calibre, significantly adding to the robustness of the model verification.

4.6.2.9 Analysis of Delphi Survey results

The Delphi survey analysis is presented in Chapters 5 & 6, which includes both the qualitative and quantitative analysis discussed below. Throughout the analysis commentary is made as to how the results influence any changes to the model, particularly after survey round 1.

Quantitative data:

The closed questions within the Delphi survey questionnaire generated quantitative data based on the number of response types, for example:

1. 30% of respondents selected answer A
2. 25% of respondents selected answer B
3. 45% of respondents selected answer C

As the Delphi survey panel members were a relatively small, selected group, statistical analysis such as testing statistical significance would not be relevant as the sample size would need to be higher to conduct such testing (Saunders et al, 2012).

One of the main attributes of using the Delphi method for this study was to seek opinion and consensus on what is being presented (i.e., the conceptual model). As highlighted in section 4.6.2, consensus does not have to mean 100% (agreement of panel members) and that 70% is considered as standard (Avella, 2016). For this study, it was decided that 80% consensus would be aimed for in relation to quantitative questions, based on the rationale that 100% agreement between a diverse group of people for every question is an unlikely occurrence, and that 70% potentially leaves several question marks around each element of the concept being tested. The work of Nadeem (2019) faced a similar decision for verification of a conceptual framework, choosing an 80% consensus worked well for the study; if consensus is 80% or above, it offers a higher level of confidence in the concepts of the model (than 70%), and it was deemed that further testing of the model through the validation stage would identify any potential weaknesses (not recognised at the verification stage) within the concepts being presented. Further explanation of what

is deemed consensus for the responses to the survey questions are presented in the Delphi survey analysis sections (chapters 5 and 6).

The analysis of the data was undertaken using Microsoft Excel software, as there was no need for statistical testing of results, the use of more complex statistical testing software such as SPSS was not valid. Initial data sorting was undertaken within the electronic data collections forms (google forms), data then being downloaded from the forms in Excel spreadsheet format. Further analysis was undertaken using Excel for cross referencing (if required) between the panel members responses to the ranges of questions presented, with themes identified and presented in the discussion of results. Presentation of results was done using pie charts, which are useful for the presentation of proportional data (Collis and Hussey, 2003), for this study the data was presented in percentages.

Qualitative data:

Qualitative data analysis included the open questions within the Delphi survey questionnaire. The data was analysed in a systematic way, i.e., reviewing and analysing responses for each question and then identifying themes and any linkages or commonalities between responses, this reflects an open and inductive approach aligning with Grounded analysis (Easterby Smith et al et al,2013).

During the design of the Delphi survey and the case study data collection, the data analysis method was considered, allowing the use of tables to be incorporated into the presentation of results and analysis, thus making the identification of themes more straightforward. With this in mind, and the fact that the study was undertaken with a limited number of respondents, it was not deemed necessary to use a more complex method of analysis.

The analysis from survey No 1 (Delphi round 1) provided opportunity for further enhancing the model, which was updated and further analysed through the results of survey round 2. The changes to the model from the analysis of survey 1 are presented in chapter 5.

4.6.2.10 Concluding level of verification

The level of verification, or whether the model can be deemed verified was based on the level of consensus from the qualitative and quantitative data produced by the Delphi study. This consisted of:

- Analysing the percentage values on closed questions for consensus levels
- Thematic analysis of open questions for positive themes, linkages and attributes towards the model

The concluding levels of verification for various stages of the model are presented in chapters 5 & 6.

4.6.3 Case Study - Model Validation

The criterion for the case organisation is fully presented in Chapter 7, this section gives overview of the methods undertaken.

Whilst the verification process identified in section 4.6.2 provides a theoretical insight to the application of the model, the model validation stage was undertaken to identify whether the model can be applied in practice, in essence, moving from concept stage to actual application. Using an organisation as a case study to gain a better understanding of the conceptual model has elements of a ‘critical case type’ (Bell et al, 2015), whereby in this scenario the testing of the model can be likened to the testing of hypothesis, which according to Bell et al (2015) create the grounds for the choice of organisation. As the context of the conceptual model is supply chain, using a critical case study type strategy applied to an organisation working within a supply chain, gives potential for explanations made from the study to be relevant for similar type organisations working within a supply chain (Ghauri et al,2020). As highlighted in section 4.6.1, an advantage of using a case study strategy for this research is that it gives opportunity to ask questions such as ‘what’, ‘how’ or ‘why’ for detailed investigation of the phenomenon (Ghauri et al, 2020), in this case, the conceptual model construct and application.

Through application to a case organisation, a qualitative data collection technique was undertaken through semi – structured interview(s) to practically test aspects of the model, the full criteria for the validation process are presented in Chapter 7,

including how the case organisation was selected and how the questions were derived. The research was conducted with staff from each main department (as illustrated in Chapter 7) of the organisation, to avoid bias of the participants, the model was only presented at the time of the interviews, therefore reducing the possibility of preformed perceptions. In addition, interviews were conducted with respondents on a departmental basis, negating risk of any unintentional bias through noise or influence of other participants. To avoid risk of unintentional bias related to the researcher, all participants were asked the same questions, with no intended influencing of answers, ensuring answers were either factually based, or the opinion of the participant. In addition, it is worth noting that the participants were not known to the researcher, so there was no unintentional bias either way derived from historical scenarios.

As with the Delphi study, the qualitative data was analysed in a systematic way, i.e., reviewing and analysing responses for each question/discussion and then identifying themes and any linkages or commonalities between responses, this reflects an open and inductive approach aligning with Grounded analysis (Easterby Smith et al et al,2013). The use of tables was incorporated into the presentation of results and analysis, and as with the Delphi study (combined with the purposive sampling and limited number of respondents), it was not deemed necessary to use a more complex method of analysis, including the use of computer aided analysis (CAQDAS).

Reliability and Validity

According to Saunders (2012) reliability refers to consistency, and for a data collection method to be valid it must be consistent. As the model had already been tested for verification (see chapters 5 & 6), the questions for validation were developed in line with the model stages/elements and themes, it was not therefore necessary to pre-test the questions from a subject perspective. However, the chosen areas of focus were presented for evaluation and commentary to the case organisation senior management prior to application to the case organisation, this enabled testing for ambiguity or other concerns that might impact the reliability of the method. To build further reliability to the data collection, all 4 groups (departments of

the organisation) of participants were asked the same questions in relation to each stage of the model (being tested), and as highlighted in section 4.6.3, the research was conducted on a departmental basis negating risk of any unintentional bias through noise or influence of other participants (from other departments).

A strength of using semi structured interviews to test the model is highlighted by the high level of construct validity (Sanders et al, 2012). The semi structured interview questions were designed in line with the model sections being tested, in essence asking direct questions about the subject, whilst giving opportunity to explore the subject through ‘what’, ‘how’ or ‘why’, a strength of using the case study method (Ghauri et al, 2020). It is this opportunity within the semi structured interview method that enables clarification of questions and further opportunity to probe that enables a high level of validity to be achieved (Sanders et al, 2012). As highlighted in section 4.6.2.6, construct validity can also be extended as to whether the questions are being presented to the right people, in this study the participants were managers within each department/function, with each area of the model being tested being fully relevant to their position, therefore adding strength to the validity of the method.

Regarding the validity of subjects within the semi structured interviews, the validation of the model builds from the Delphi study verification, which enabled testing of the model concepts and therefore supporting theory that underpins the model. As discussed above, the interview questions were directly related to each subject area of the model being tested, therefore highly relevant and a high level of subject validity.

Another strength of using a carefully selected case organisation (see section 7.2) is that it offers a minimum level external validity (Sanders et al, 2012), in this case a highly vertically integrated supply chain organisation with different supply chain functions established across distinct areas. Considering this type of supply chain structure, the model can be considered valid for use in relation to the outcomes of the study. In addition to organisational context, the results of the verification will have areas that could be considered in a wider context, for example, findings with the impact of targets that prove to be common in other sectors (e.g. Seddon (2008) public sector findings). In summary, the results are likely to be generalised if applied

to a similar context (structure, supply chain), however, some factors will likely have generalisation across multiple contexts of study.

More detail as to the data collection and analysis process are presented in Chapter 7 (model validation), which includes stages:

- Stage 1 - Identify most suitable aspects of the model to test
- Stage 2 - Generate a semi structured set of questions/criteria for model application
- Stage 3 - Visit organisation, obtain overview and structure of the business, apply model
- Stage 4 - Analyse data from model application and identify validation aspects
- Stage 5 - Conclude level of validation
- Stage 6 - Identify future validation options and or opportunities

4.7 Ethics

According to Zikmund et al (2010) ethical dilemmas face people involved with business research, Ghauri et al (2020) highlight that ethics has an influence on the way research is conducted, which is influenced by moral values and principles. Key ethical areas applied for this research are highlighted by Zikmund et al (2010) and Ghauri et al (2020), and include:

1. The participants right to anonymity
2. Not to involve any participants without their consent (In addition for this study is approval of the business concerned)
3. Allowing Participants to withdraw during the data collection process
4. No use of coercion to get information
5. Confidentiality of data collected
6. Respondents have the opportunity to ask further questions about the research

Bryman and Bell (2015) highlight the importance of data management and how it could be stored and shared in the digital world. This study followed the GDPR requirements as espoused by the University of Derby.

This research was undertaken and managed through the University of Derby and had to seek ethical approval from the research committee before the primary research could commence. The areas of consideration consist of:

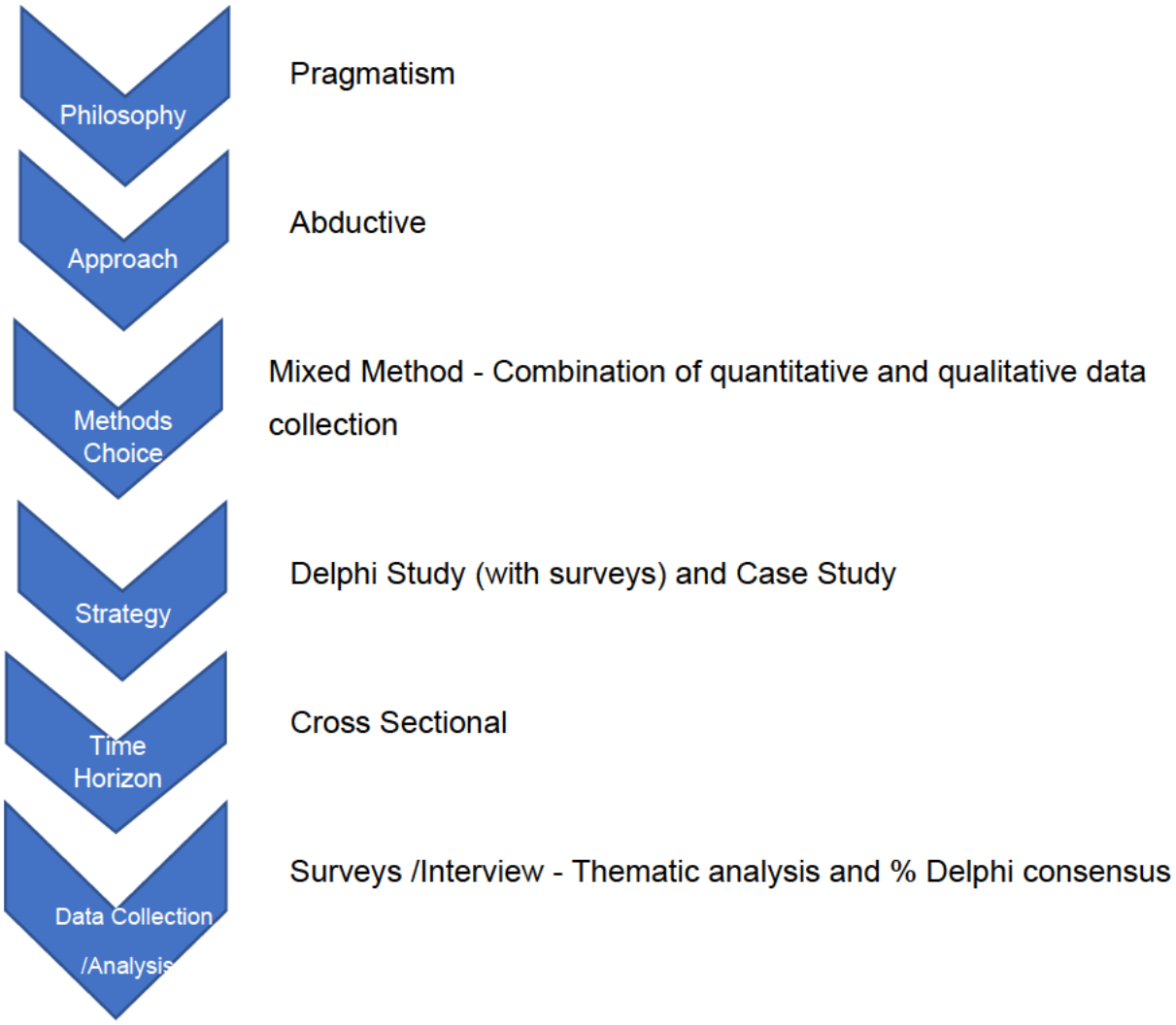
a. Consent
b. Deception
c. Debriefing
d. Withdrawal from the investigation
e. Confidentiality
f. Protection of participants
g. Observation research
h. Giving advice
i. Research undertaken in public places
j. Data protection
k. Animal Rights Environmental protection

The process espoused by the university was followed in full throughout the research process.

The approval form and template consent letters can be found in Appendix E.

4.8 Overview and Conclusions

This section presented the research methodology for development, verification and validation of the conceptual model. Reviewing the literature presented, the nature of the research highlighted that this research moves between philosophies (which is common in business study related research), and therefore reflects pragmatism. A summary of the methodology in relation to the research process identified by Saunders et al (2012) is presented below.



The following chapters (5,6 and 7) present the analysis of results from the implementation of the research methodology presented in this section.

Chapter 5 - Analysis of Delphi Round 1

5.1 Introduction

This chapter presents the results of Delphi round No 1 (survey No1), which is the first stage of the model verification process (see section 4.6.2.3). The survey questions were designed using a range of questions (see section 4.6.2.4) to seek perceptions from panel members on the stages and concepts of the model. The questions were developed in relation to the stages and themes within the conceptual model as presented in chapter 3, and throughout the survey, context and instructions were made clear to the respondents (panel members) in relation to each section of the survey and question type (see Appendix C for full survey No1). As highlighted in chapter 4, the survey was designed to seek a level of consensus agreement with the model concepts and themes, whilst also giving opportunity for inductive research derived from comments related to open questions (within the survey) for enhancing the model. For ease of navigation and reference, panel members were sent a PDF version of the model to use whilst answering the survey questions – please see Appendix A for the conceptual model (version 1) and Appendix C for survey 1 as presented to the panel members in round 1 of the Delphi study.

This chapter presents the elements highlighted in figure 5.1 (with red circles) below from the Delphi study process steps (presented in section 4.6.2). The previous steps of the process were discussed in Chapter 4, including question design within the survey. The questions were designed to seek opinion and level of consensus as to the construct and concepts of the model, and therefore the subject themes of the questions relate to the subject themes within the model, which are linked to the literature as highlighted in chapter 3.

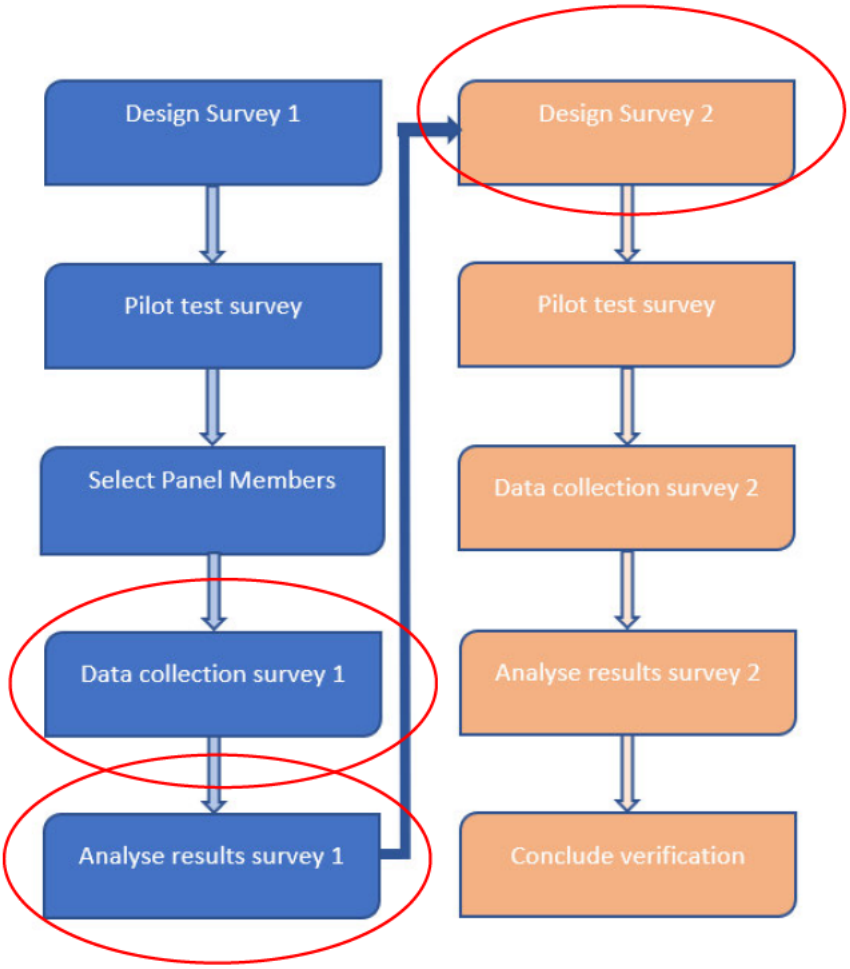


Figure 5.1 – Chapter 5 highlighted Delphi Process steps

The rationale and design of the survey is discussed in chapter 4 (Methodology), including the decision to use the value of 80% (see section 4.6.2) or above as panel consensus for relevant quantitative questions. The inclusion criteria for consensus considers:

- For Likert type question design the combination of the top 2 answers on the scale were counted, for example, if 1 = fully agree and 5 = fully disagree, the percentage answers for 1 and 2 on the scale were considered as positive for agreement and combined.
- The same approach was adopted for rating type questions, for example:
    - Strongly Agree
    - Mostly Agree
    - Mostly Disagree
    - Strongly Disagree
    - No View

In this case the combined percentage answers for Strongly Agree and Mostly Agree were counted. If a panel member returned a No View answer, this was disregarded.

Combining the 2 top answers on the scales was a successful method undertaken by Nadeem (2019), in a study which a used similar methodology, and was therefore deemed appropriate for this study. The results for all questions are presented after each question.

As discussed in section 4.6.2, the open questions within the Delphi survey questionnaire generated qualitative data, which was analysed in a systematic way, i.e., reviewing and analysing responses for each question and then identifying themes and any linkages or commonalities between responses, reflecting an open and inductive approach aligning with Grounded analysis (Easterby - Smith et al, 2013). The analysis is presented in tables with additional commentary when deemed appropriate; with answers mapped to themes related to the conceptual model (as presented in chapter 3), i.e., Strategy, Leadership, Change Management, Performance Measurement, Measurement Methods, Operational Processes and Wider Supply Chain (this can be internal).

Findings from the quantitative questions were used to:

- Seek opinion and evaluate the level of consensus on the question, which links to stages of the model

Findings from the qualitative questions were used to:

- Highlight areas of supporting model verification
- Identify opportunities to fine tune the model
- Inform the content of survey 2 (Delphi round 2)

The combined results of the qualitative and quantitative analysis for contribution to model verification are presented as an overview in table 5.13 (section 5.3), which includes links to the associated survey question numbers. The analysis enabled opportunities to enhance aspects of the model, these are presented in each relevant area of the analysis, together with new questions for survey 2 (Delphi round 2) to seek the Delphi panel members view of the enhancements. The complete updated

model (Model Version 2) is presented in section 5.2.8 and in Appendix B for reference.

The survey yielded 21 (from 28 potential) respondents, which is a suitable number when using the Delphi method, this study was aiming for 12-20 panel members to respond - as discussed in section 4.2.6.7.

5.2 Analysis

5.2.1 Organisational Targets

The first set of questions (3-7) were designed to collect data on the perceptions of organisational targets and potential impact(s) they may have on organisations and the wider supply chain. These questions are not seeking consensus but investigating general mindset and opinion on the use of targets. They link to stage 2.3 of the model (Appendix A), the investigation of the impact of targets within an organisation and wider supply chain through application of the interdepartmental impact audit.

The number preceding each question is the question number as presented in the survey.

Note: questions 1&2 were related to the survey administration (see Appendix C).

3) Do organisations need to use targets to help measure performance

The model investigates the impact of targets as a performance measure (see section 3.4) this question is the first in a series of questions to investigate the mindsets towards targets and use as a measure of performance.

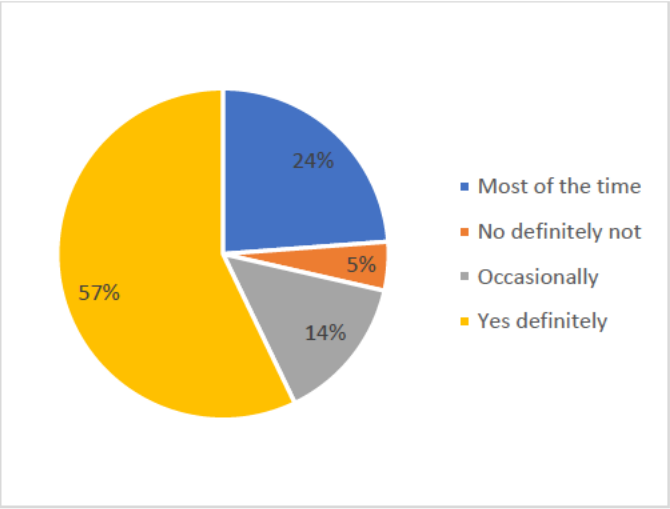


Figure 5.2 – Survey 1 Q1 results

Most respondents perceive that organisations need to use targets to help measure performance, this reflects the approach to measuring supply chain performance discussed in section 2.2.4 regarding metrics, particularly those that can be associated with activity type measures. This result also has parallels with the notion that command-and-control management uses target type measures discussed in section 2.3.4. The need for targets contradicts the theory of Seddon (discussed in section 2.3.4), highlighting that there is potential to drive negative behaviours (investigated through stage 2.3 of the model). The result supports the verification of investigating the impact of targets, and further highlights how a change of thinking could be required for changing methods for measuring performance (i.e., shifting from using a target driven culture/mindset for measuring performance) which is one of the characteristics of the model that makes it unique in its application, contributing to the development of new knowledge. For the minority that selected 'definitely not', this could be reflective of someone who has experienced negative impacts of targets and/or is a systems thinker (as per the approach discussed in section 2.3.4) in the approach to measurement.

4) Do departmental performance targets ensure the customer is the No1 focus of the operations?

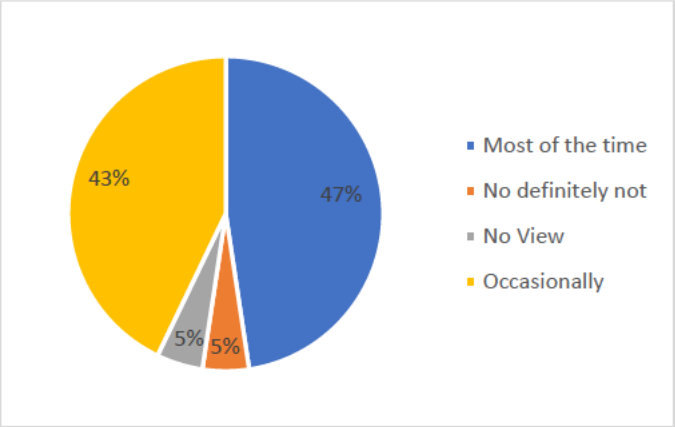


Figure 5.3 – Survey 1 Q4 results

Whilst 47% of respondents believe that departmental targets ensure the customer is the No1 focus of the operations, a large percentage believe that the customer is only occasionally the No1 focus. This suggests that in the participants experience, the targets are focused in other areas, potentially reflective of the areas highlighted in section 2.2.4 and the discussion of metrics – more enquiry is to be made in survey 2 (Delphi round 2).

The change of thinking regarding performance measurement within the model (towards a commonly understood purpose measure – see section 3.5) would ensure constancy of measures related to the customer.

5) What type of impact do departmental performance targets have on the downstream supply chain (internal or external) ?

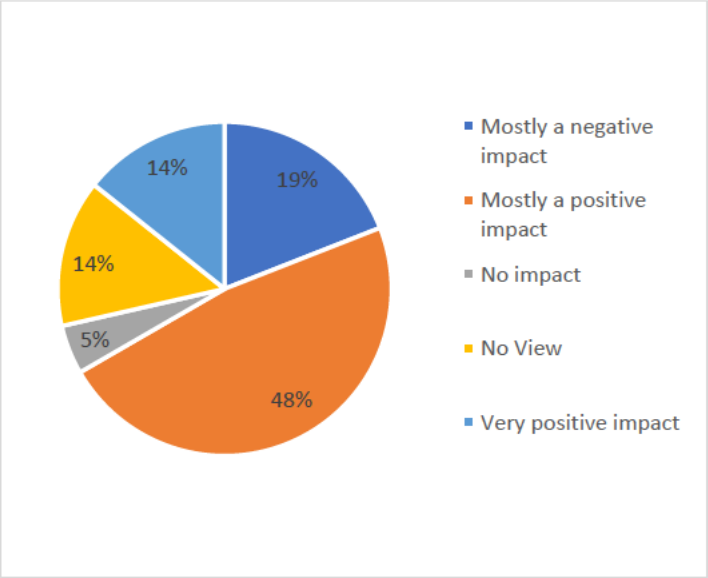


Figure 5.4 – Survey 1 Q5 results

Over half the respondents perceive departmental performance targets to have a very positive or mostly positive impact on the downstream supply chain. However, the remainder of responses are mixed, with respondents having either no view or perceive such targets to have a mostly negative impact on the downstream supply chain. Responses to Q3 above highlighted perceptions for the need of targets, however some participants clearly perceive they can have a negative impact outside of the measured function (or area of the supply chain), this highlights the opportunity to further explore the area of target use and gives supporting rationale for it being a key component in the model.

Whilst a consensus is not sought on this range of questions, the mixed responses give rationale to ask further questions in survey No2 and consider specific areas of the model for adjustment, in particular the IIA (Interdepartmental Impact Audit).

5A) What type of impact do departmental performance targets have on the upstream supply chain (internal or external) ?

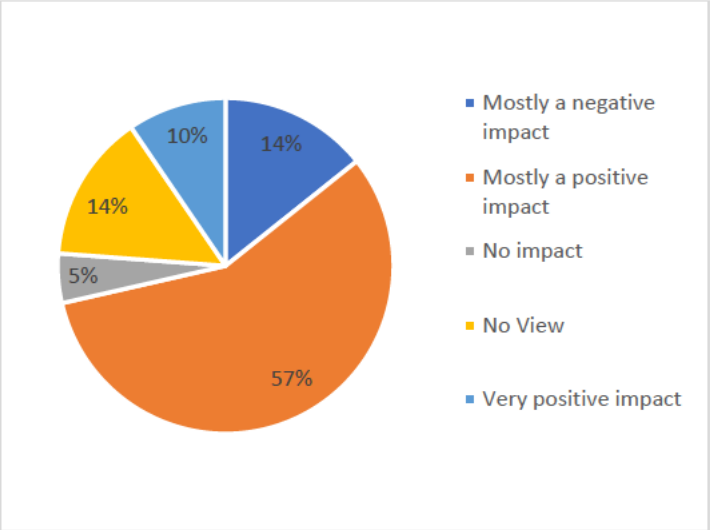


Figure 5.5 – Survey 1 Q5A results

As question 5A was similar to question 5, the results were similar; again, over half the respondents perceive departmental performance targets to have a very positive or mostly positive impact on the downstream supply chain. As with question 5 the remainder of responses are mixed, this time with an equal number of respondents having either no view or perceive such targets to have a mostly negative impact on the downstream supply chain. As the results to question 5 and 5A are so similar, any further questions in later surveys directly relating to this subject matter and context were grouped (See survey 2 in Appendix D).

6) Do you think that Individual performance targets based on output volume (e.g. items packed per hour) are mostly positive or negative for team working?

This question investigates the perceptions of what can be considered activity-based targets, the line of questioning continues to draw from the core concepts discussed in chapter 2.3.4 and the notion of such targets potentially driving negative behaviour.

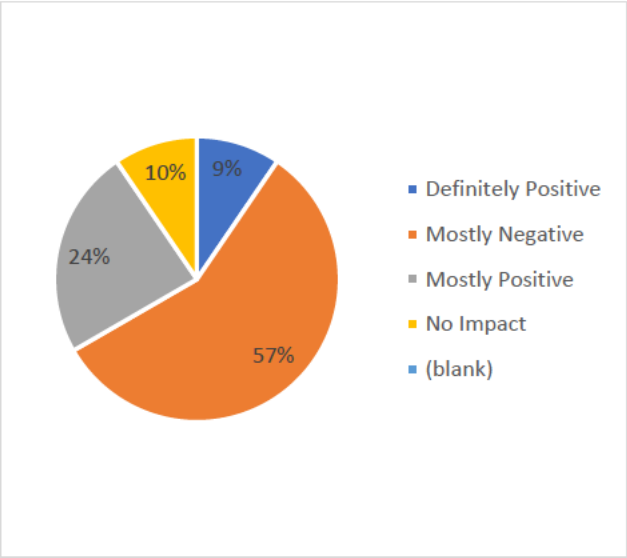


Figure 5.6 – Survey 1 Q6 results

Question 6 is more specific than the previous questions regarding the type of target and the context of the impact. In this instance the majority of respondents perceive such targets (individual performance targets based on output volume) have a mostly negative impact when relating to team working, which aligns with the literature presented in section 2.3.4. This can be considered in contrast to question 3, where the majority of respondents believe organisations need to use targets for measuring performance. However, if such targets are to have a negative impact (such as staff not considering the wider process, trying to achieve personal targets but at the detriment other areas of process or functions) at a micro level (as in the context of this question) further exploration in survey 2 and the updated model is beneficial.

7) Please add any comments you may like to add regarding the questions you have just answered. For example, views on use of targets related to individual, team or departmental performance.

The following pages illustrate and analyse the qualitative data from question 7. Analysis of each comment highlights support of verification of the model and opportunities for enhancing the model. In addition, each comment has been mapped (in the sense that it has relevance in some way to that area) to main themes associated with the model, these are illustrated below, with the associated links to the sections of related literature reviewed and model development sections.

Strategy – Respondent comment can relate to informing the development of strategy, and/or the actual development and implementation of strategy for improving business performance (see sections 2.7.2, 2.7.3 and 3.4, 3.5)

Leadership – Respondent comment can relate to leadership of strategy development and/or leadership of model implementation (see sections 2.7.4 and 3.5, 3.6, 3.7)

Change – Respondent comment relates to an aspect of strategic change, including changing to a systems thinking mindset (see sections 2.3.2, 2.3.4, 2.7.3 and 3.5 – 3.7)

Performance Measurement – Respondent comment can have a link to current performance measurement or future performance measurement of an organisation, i.e., what is being measured currently, what is to be measured in the future (see sections 2.2.4, 2.3.4, and 3.5, 3.5)

Measurement Methods – Respondent comment links to methods for undertaking measurement, for example, use of targets, activity type measures v holistic type measures (flow), also linkages to understanding accuracy of methods (see sections 2.2.4, 2.3.4, 2.4.3 and 3.4, 3.5)

Operational Processes – Respondent comment links to impacts on current operations and processes and/or future operations and processes (see sections 2.3.4, 2.2.3 and 3.4 – 3.7)

Wider Supply Chain (this can be internal) – Respondent comment can be related to the wider supply chain (i.e., outside of one functional area), this can be internal or external (see sections 2.2.2, 2.2.3 and can be related to all sections 3.3 – 3.7)

Table 5.1 - Analysis of Question 7 - Delphi Survey No1

Comment Number	Respondent Comment	Comments/analysis	Strategy	Leadership	Change	Performance Measurement	Measurement Methods	Operations Processes	Wider Supply Chain
1	Evaluating positive or negative impact of performance targets greatly depends on how the targets have been identified. The more customer (both internal and external) oriented targets, the more positive impact there will be anywhere in the organization, both individual, team and/or organization. I believe having processes generating the "right" (i.e. customer and process	This comment supports the notion that that the customer should be the focus when measuring performance, which supports verification of the concept of 'purpose' within the model.	x	x	x	x	x	x	x

	oriented) targets forms a crucial challenge for every organization.								
2	Individual targets in my opinion and experience often lead to stronger performers being able to "relax" once they are aware they have hit targets, and the naturally slower colleagues to struggle. there is a clear difference between an individual not working and being not capable of performing as well. the output targets need to be joined with other targets in my experience. Additionally, unless department targets are aligned with other parts of a business, one departments target can negatively impact another. e.g.: customer services need to record X% of customer complaint notes, but logistics need to keep this number	These comments highlight how targets can drive negative behaviours (see section 2.3.4) individually and departmentally. The secondary comments recognise that non-aligned targets across departments can have a negative impact on each department, and possible functional boundaries (see sections 2.3.4 and 2.2.3). In this regard further consideration can be given to making the IIA (Internal Impact Audit) element of the model a little more explicit in relation to the departments, enabling a better understanding of the impact of targets cross functionally – see fig 5.20.		x		x	x	x	x

	down. Leads to complaints being recorded when there is no complaint!								
3	My organisation does not use KPIs, however I feel if we were to implement for instants, pallets picked per hour, I feel this would have a negative effect, from my experience managing people, in particular warehouse operatives all exceed in different areas. For example, 1 employee may excel on driving a forklift but may be slower on a Very Narrow Aisle (VNA) truck. However, this being said, I feel that business performance metrics are important and my business would benefit from their implementation.	Interesting that KPI's are not used and that there is recognition that employees have strengths in different areas. It would be interesting in this instance to understand more about how work is allocated and staff development methods. The secondary comments suggest that the organisation has no KPI's or metrics at a macro level or micro level and that the business would benefit from some. This suggests that perhaps the organisation has a limited understanding of current performance and the use of some type of metrics would be beneficial, whether these should be actual	x	x		x	x	x	x

		targets adds to the debate of how/if targets are used.							
4	Rightly set, departmental targets may promote downstream performance, but that is seldom considered in such targets. On the team/individual levels: what you measure gets done - measure individual performance will create competition within the team. Nevertheless, team performance measuring may also allow for some a wide variation in individual performance that need to be managed.	It would be interesting as to understand what type of targets this respondent thinks could promote downstream performance; this is an area that the IIA could identify when applying the model. It is not clear whether the respondent perceives individual/team performance targets to be positive, or would they actually limit 'what gets done' – the IIA would help understand behaviours that could limit performance once targets are achieved. The respondents comment about team performance measurement 'allowing for some variation in individual performance' link to the comments from respondent 3, who				x	x	x	x

		recognises that staff have strengths in different areas of the operation so therefore individual can have a negative impact - assuming KPI's are activity based in this context (as highlighted in Q6). As with the analysis of respondent 2, further consideration can be given to making the IIA (Internal Impact Audit) element of the model a little more explicit in relation to the departments – see fig 5.20							
5	Sometimes individual performance targets can create a wrong perception of the reality - cases that do not consider quality elements, for instance.	This response suggests that some performance targets are not always a true measure of performance as they need to be more holistic.				x	x	x	x
6	Targets are generally used as internal KPIs for operations and staff and in many cases may not bear any relation	This response suggests a perception of internal targets lacking a holistic overview or linkage and could be reflective of an				x	x	x	x

	to customer or supplier KPIs, targets or expectations.	organisation working with functional boundaries (Christopher, 2016). Gives further validation of the holistic approach of the model by means of ‘purpose’,							
7	To ensure the customer is No1 focus of the operations then the departmental performance targets needs to be geared towards the voice of the customer. Measurements must be made against what's important to the customer otherwise the focus is wrong and so the customer is not the No1 focus.	This response reflects the notion of ‘purpose’ and the need for ‘consistency of purpose’ as integrated in the model. This response supports the verification of the use of ‘purpose’ within the model.				x	x	x	x
8	When you apply targets to individuals they can have adverse effects in terms of if people are not hitting targets in can impact their quality due to rushing etc.	Reflects targets driving negative behaviour (discussed in section 2.3.4) and supports the verification of the IIA element of the model.				x	x	x	x
9	Whether departmental targets have a positive or negative impact is closely	This response suggests targets need to be set with consideration,				x	x	x	x

	connected to how these targets are set. Well-chosen target factors will probably give a positive impact, while poorly chosen ones probably will give a negative (or no) impact. So, I would say that it is impossible to answer some of the questions. Still, you will most probably get answers, but you cannot be sure that the different respondents have interpreted the questions in the same way.	potentially links to other respondents who identify that individual targets have the potential to have negative impacts. Further expansion of the IIA to make more explicit regarding target areas (as discussed in responses 3 &4 above) would give further insight to target impact – see fig 5.20.							

Whilst the majority of respondents perceive that organisations need to use targets for measuring performance (as highlighted in responses to questions 1-5), perceptions are more broad ranging when considering the impact and focus of targets.

The qualitative comments suggest that there can be a disconnect between individual targets and the wider organisation, including other teams and not having the customer as the target focus. These comments in particular build on the target theory and the notion of functional boundaries (see section 2.3.4), both theories highlighting the negative impact targets can have on the wider organisation/supply chain and the customer.

Using the thematic table mapping illustrates that targets can impact or be influenced by all of the areas presented, linking to the literature of traditional managers/leaders with a command-and-control style making the rules (see section 2.3.4), which would include deciding on the performance measurement methods and associated targets. Every person in a team and department can impact productivity and the customer experience in some way, including within operations and the wider supply chain, and hence inclusion in the mapping (in table 5.1).

The initial survey questions sought perceptions on the use of targets and highlighted mixed views which support the verification of the model regarding understanding ‘purpose’ and the IIA (interdepartmental impact audit). Further development of this area gives further opportunity to develop new knowledge through the content and structure of the conceptual model for this study. The responses have enabled tuning of the model as highlighted in fig 5.20 to further study the perception of targets. The 2nd survey round of the Delphi study includes the questions presented below, survey 2 will seek further levels of consensus for the model stages.

Table 5.2 – Modified target related questions for survey 2 (Delphi round No 2)

Survey V2 Question Number	**Question**
Question 3	What is the purpose of using targets when measuring performance in organisations?
Question 4	What should be the focus for departmental performance related targets?
Question 5	Please give the reason (and any other comments) for your answer to Q4
Question 6	Whilst responses were broad ranging, the majority of responses in the previous survey indicated that departmental performance targets have a very positive or mostly positive impact on the upstream or downstream supply chain - how do you think targets at departmental level can have a positive impact on the upstream or downstream supply chain?
Question 7	Analysis of the comments from the previous survey highlighted that the 'type' of target and 'how' a target is set can impact performance within teams\departments and the wider supply chain. What type of target(s) do you believe can generate positive impacts within an organisation and the wider supply chain?

5.2.2 Factors for Change Interventions

These questions build from the literature presented in sections 2.7.2 – 2.7.4 that incorporates themes for enabling and influencing change to happen for implementing business improvement. The questions also build from the literature analysed regarding barriers to making change happen in the context of implementing the model (for business improvement) to an organisation (see section 2.6.2 and 2.6.3).

8) How important is it for organisational change to be driven by the Senior Leadership Team

1-Very Important ---------- 5 - Not Important

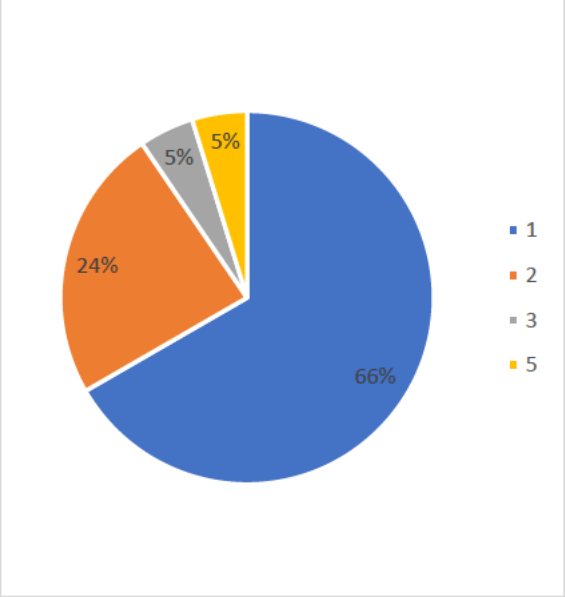


Figure 5.7 – Survey 1 Q8 results

This question evolved from the literature discussed in section 2.6.2 for consideration of barriers to making changes within an organisation. The question used a Likert scale to capture the participants view, 1 = very important, 5 = not important. 90% of respondents believe senior leadership is an important factor for driving organisational change (and therefore consensus), which aligns to the literature presented in section 2.6.2 and the importance of senior management vision, commitment and support (see section 2.6.2, table 2.11). In addition, these results align to the literature of change leadership (presented in section 2.7.4), in particular the notion of how motivated leaders make it easier for followers to adapt to change.

Consensus to Q8 supports the verification of stage 1 of the model, in particular stages 1.1 and 1.2 (see section 3.3), for evaluating appetite for change and resource, and the leadership element in stage 3.0 (see section 3.5).

Only 1 participant viewed senior leadership as not important for driving organisational change (perhaps reflecting a specific experience, or incorrect use of the scale), the second survey gives an opportunity to explore further which could be informative for any further model updates. To explore further, the following question was added to the 2nd survey (see Appendix B).

Table 5.3 - Survey 2 question 8 derived from analysis of survey 1

Survey V2 Question Number	**Question**
Question 8	A high majority of responses from the previous survey indicated the importance for organisational change to be driven by the senior leadership team. Are there any circumstances where you think it is less important for the senior leadership team to drive organisational change?

9) How important is it to have the commitment of Local/Departmental Leadership when implementing organisational change?

1-Very Important ---------- 5- Not Important

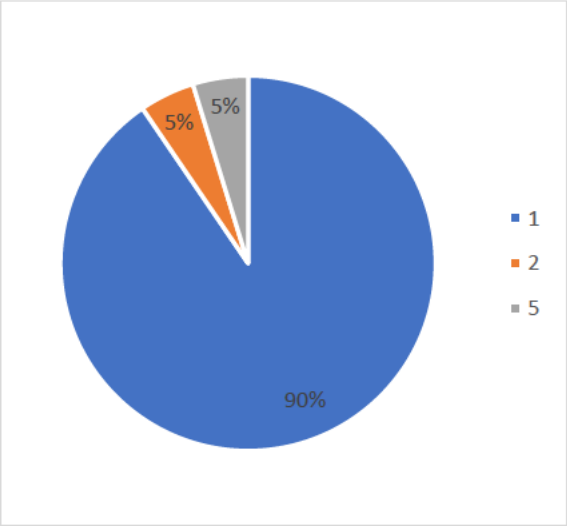


Figure 5.8 – Survey 1 Q9 results

This question further builds from question 8 and builds from the literature presented in section 2.6.2 through using the term commitment; the question also has a more local focus within the organisation.

Whilst analysing the results to this point, it became clear that one respondent had selected answer 5 of the Likert scale for both leadership questions, on investigation of other questions, the same respondent selected number 5 on other questions using the same scale. On closer inspection of the results, the respondent's answers to the following questions did not suggest that 5 was the logical selection of answer. It is most likely that the respondent mixed up the scale and meant to select 1 rather than 5, which would be more consistent with answers to the following questions. With this taken into consideration, all remaining respondents perceive a high level of importance for the commitment of local/departmental leadership when implementing change, which is consensus.

The results from this question support the verification of the leadership elements of stages 1&3 of the model as presented in sections 3.3 and 3.5.

10) How important is it for change projects to be incorporated in organisational strategy

1-Very Important ---------- 5- Not Important

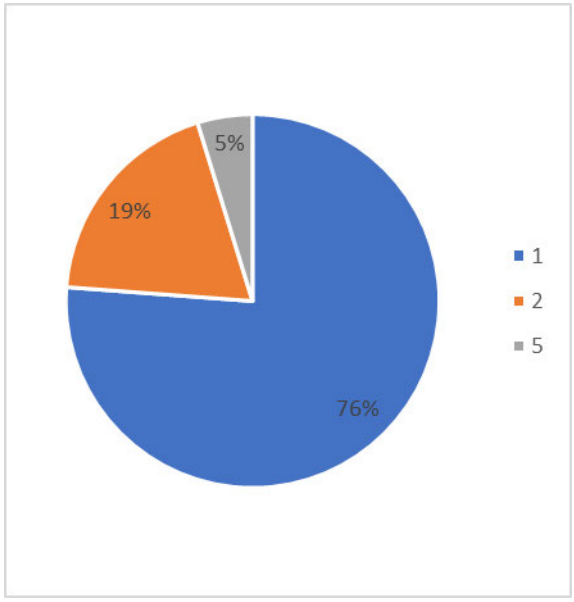


Figure 5.9 – Survey 1 Q10 results

This question extends the leadership theme to strategy and strategic leadership (discussed in section 2.7.2), in the context of organisational change through implementation of the model (including a change of thinking – see section 3.5).

Considering the potential input error of one respondent, the results from the remaining respondents indicate a perception of high importance for change projects to be incorporated into organisational strategy. This is a consensus result and verifies the inclusion of elements 2.1 (informing business improvement strategies) and 3.0 (use of results to inform strategies) of the model (see sections 3.4 and 3.5).

11) How important is it to have agile processes in supply chains (i.e Processes that can be changed at pace if required to meet new demands or situations)

1-Very Important ---------- 5- Not Important

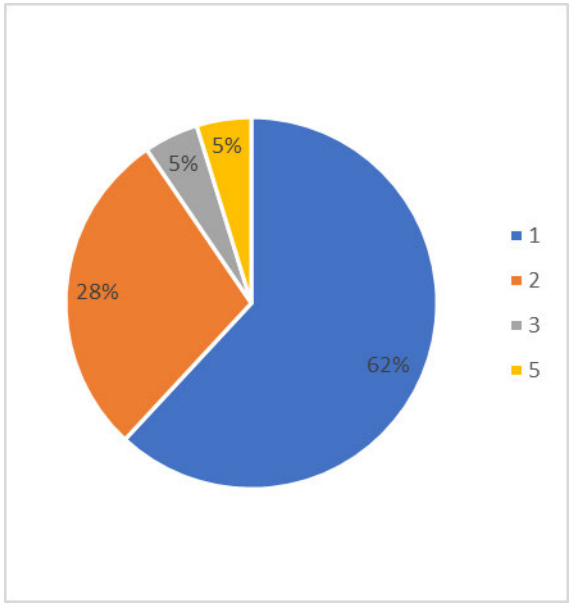


Figure 5.10 – Survey 1 Q11 results

This question draws from the business improvement literature presented in section 2.3.4 and 2.4.2 – 2.4.4 and the models and approaches presented for making process improvements, for example Lean six sigma and PDSA cycle, with the notion that application of the model will lead to process changes.

Considering the potential input error of one respondent, the high majority of results from the remaining respondents (over 80%) indicate a perception of high importance for processes to be agile (e.g., the ability to be changed at pace if needed), which is consensus. This supports the verification of stage 3 of the model and the design of processes based on demand - stage 3.2 (see section 3.5), established during the knowledge generation in stage 2 of the model (see sections 3.3 and 3.4).

5.2.3 Model Stage 1 Overview

The responses to questions 3-11 have highlighted supporting verification of specific elements of the model and opportunities for fine tuning the model, together with additional questions for survey 2. Questions 12 and 13 are seeking perceptions

based specifically on the whole of stage 1 of the model – feasibility check. This includes the areas not tested individually such as 1.3 - stakeholder groups.

12) Do you agree with the areas presented in the feasibility check (stage 1)?

The question seeks to understand the consensus for the elements presented in stage 1 of the model (Appendix A)

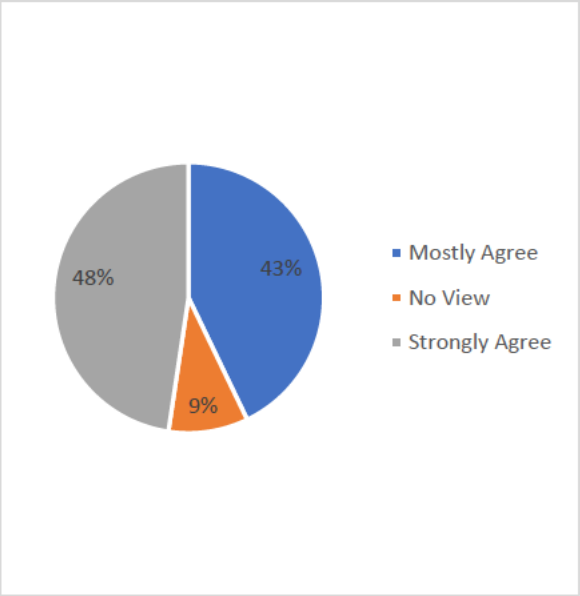


Figure 5.11 – Survey 1 Q11 results

Most respondents (92%) either strongly agree or mostly agree with stage 1 (feasibility check) of the model, which is consensus. No respondents selected disagree or strongly disagree. This can be considered as verification of stage 1 (see Delphi consensus in section 4.6.2). A very small number of respondents (2) have no view; however, the following question (Q13) gave respondents the opportunity to comment further on the stage.

13) Are there any areas you would add or remove from stage 1? Please indicate below.

The following table is qualitative analysis of the respondents' comments for question 13. It is notable that there were no recommendations for removal of any areas to stage 1, which aligns to the analysis of question 12 with 92% of respondents agreeing with the stage.

Table 5.3 maps the comments to the themes identified in the introduction (and further explained in Q7 results), whilst there is consensus for stage 1 (as highlighted by results from question 12), analysis of results from question 13 gave opportunity for enhancing the model. Following the analysis of comments, related enhancements to the model are presented in fig 5.13.

Table 5.4 - Analysis of Question 13

Comment Number	Respondent Comment	Comments/analysis	Strategy	Leadership	Change Management	Performance Measurement	Measurement Methods	Operations Processes	Wider Supply Chain
1	Analysis of market position and changes on the market	Not relevant – model not designed for strategic decision making related to the market.	x						
2	Can't think of any for removal. One important item missing is the need for a change, i.e., the strategic imperative for considering a change.	A common understanding of change would be a useful measure against organisational 'purpose' (section 2.3.4). Enhancement of the model in stage 1 makes this element more explicit – see fig 5.13.	x	x	x	x	x	x	x
3	I would wonder if there is something additional around assessing "if" there	This comment links to the previous comment regarding understanding	x	x		x			

	is even need to change in the first place? often we say yes we need to but don't asses current "status"	organisational purpose. The initial knowledge generation stages of the model will give explicit indicators for change via the measurement stages of the current situation. As highlighted above, enhancement of the model in stage 1 would make this more explicit the perceived need for change(s) – see fig 5.13.							
4	It needs to relate to the organisation strategy - Strategical/operational alignment. But I agree with the elements.	Whilst stage 3 of the model does include strategy, more explicit links to strategy could enhance this section – see fig 5.29	x					x	x
5	Perhaps identify any key risks	Whilst indirectly associated with barriers to implementation, more emphasis of risk could be made – see fig 5.13.	x					x	x
6	Potentially something around the perceived benefits vs cost / time of implementation?	Whilst this is perhaps a measure used in organisations, particularly in capital expenditure type projects, this type of measure is arguably		x		x			

		reflective of an activity cost type mindset. Increased emphasis on evidence-based justification for change (through measuring the current situation) is more reflective of the approach adopted by this, reflected in the primary measurement stages that build from the check model (see section 2.3.4).							
7	This might be included in legacy (?), otherwise: the employees' perceptions and their willingness to change, which can be the result of the present culture, the educational level among the employees, and past experiences. If these agents of change are not participating, it will not matter if the strategies are fins and sound.	This is included in legacy (1.4), however further elaboration would make more explicit – see fig 5.13.	x	x	x				

8	Where is the customer/-s? Are they included in 1.3? They should be top priority!	Whilst the model is driven by ‘customer purpose’ (see section 2.3.4), emphasising the customer more in stage 1 could help embed within the mindset– see fig 5.13.	x	x	x				
9	Yes. I would add the "Culture" perspective. Is the Organization Culture prepared and aligned to the Change?. Also, The "Leadership Commitment" How engaged the higher leadership is with the change project?	The culture aspect is included in Legacy (1.4), and the leadership commitment evidenced through 1.1 & 1.2. Enhancement of stage 1 could make these aspects more explicit **–** see fig 5.13.	x	x	x				

Figure 5.13 below illustrates the updates to stage 1 of the model from the analysis presented in table 5.4 and outcomes from questions 1 -11. The incorporation of the additional areas informed from survey 1 and the literature sections linked to each response, enhance stage 1 of the model, making the combination of areas unique in construction for this conceptual model and therefore contributing to the body of knowledge for improving business performance in the context of supply chain related organisations.

Figure 5.12 - Stage 1 Model Version 1 (for reference)

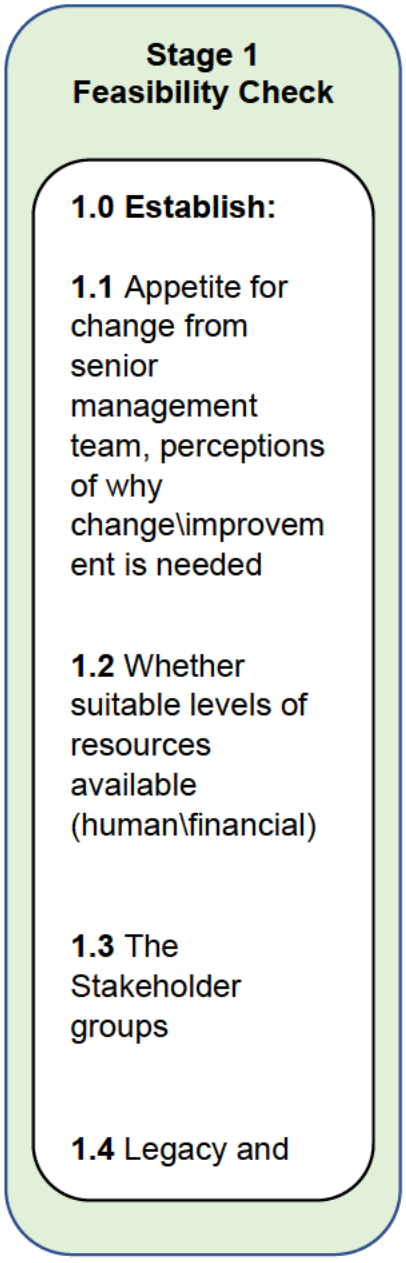
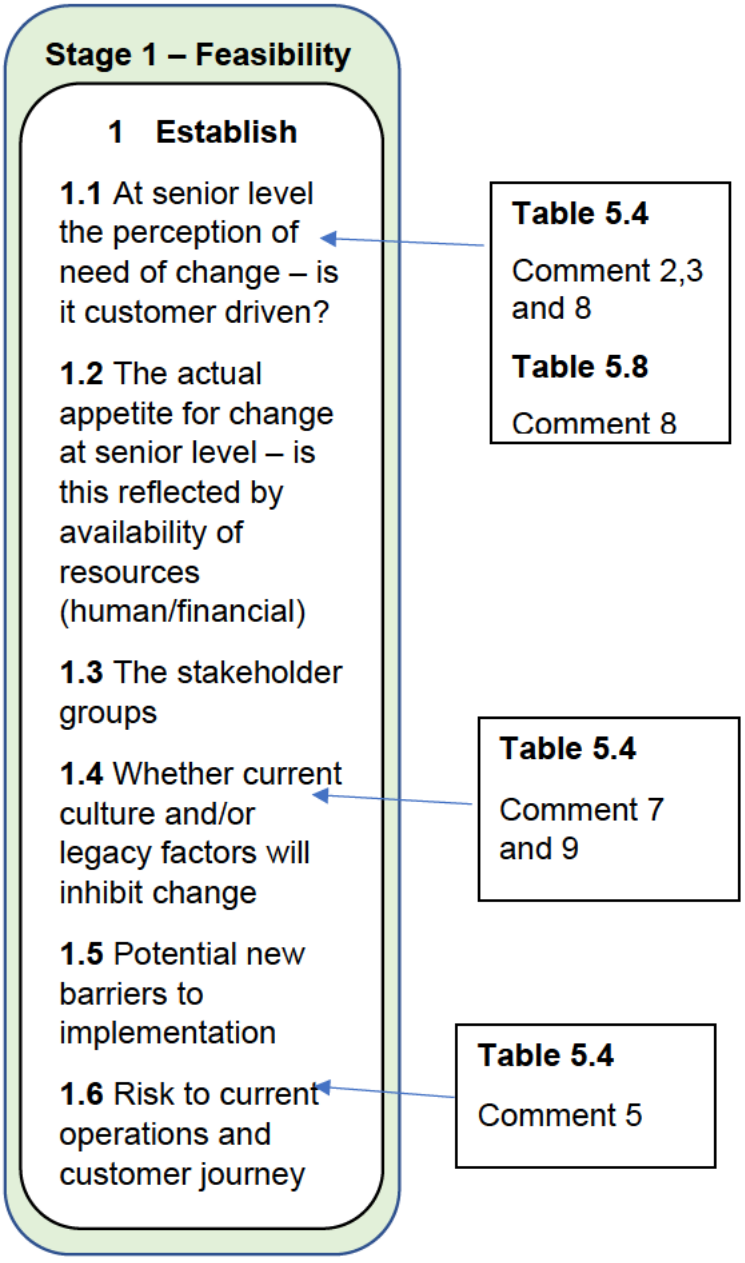


Figure 5.13 - Stage 1 Model Version 2



5.2.4 Knowledge Generation

This section of the survey asked questions relating to stage 2 of the model – knowledge generation (see section 3.4), which builds further from the literature presented in section 2.3.4). The questions seek consensus and comments for verification of the stage, and opportunities for fine tuning the model, with associated questions for inclusion in survey 2 (Delph round No2).

14) How important do you think it is for employees to understand the purpose (from the customers perspective) of the business operations?

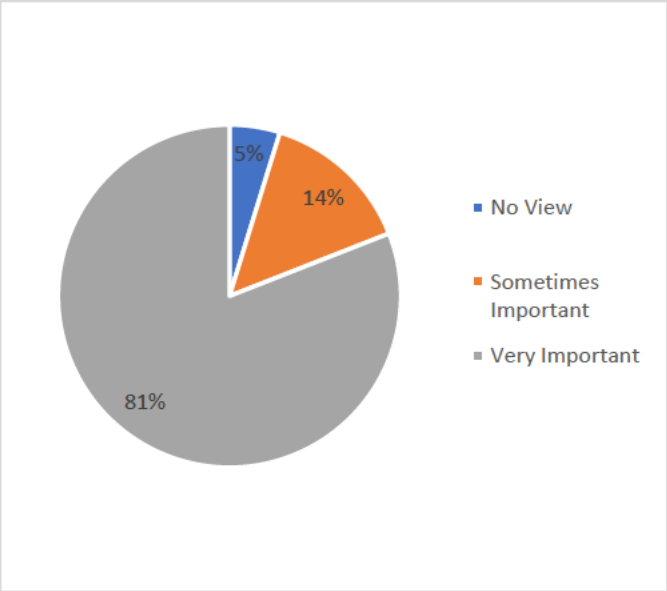


Figure 5.14 – Survey 1 Q14 results

This question seeks perceptions to verify the inclusion of stage 2.0 of the model (see section 3.4) – establishing perceived organisational purpose across stakeholder groups. It builds on the theory of understanding the purpose of the operations from the customers perspective (see section 2.3.4 and 3.4). The majority (over 80%) of respondents perceive it is important for employees to understand the purpose (from the customers perspective) of the business operations, which is consensus. This is aligned to the core concepts of the literature in section 2.3.4, and the notion of having a common goal presented in section 2.7.2). No respondents selected not very important or not important. The results provide part of the evidence of verification for inclusion of the following elements of the model:

- Stage 2.0 (Establish perceived organisational purpose across stakeholder groups)
- Stage 2.3 (Purpose element of the IIA)
- Stage 3.0 (leadership strategies/methods which reflect a holistic view (based on purpose) of the internal/external supply chain)

15) To what extent do you believe business improvement methods should focus just at departmental level, or they should also consider the wider organisation/supply chain?

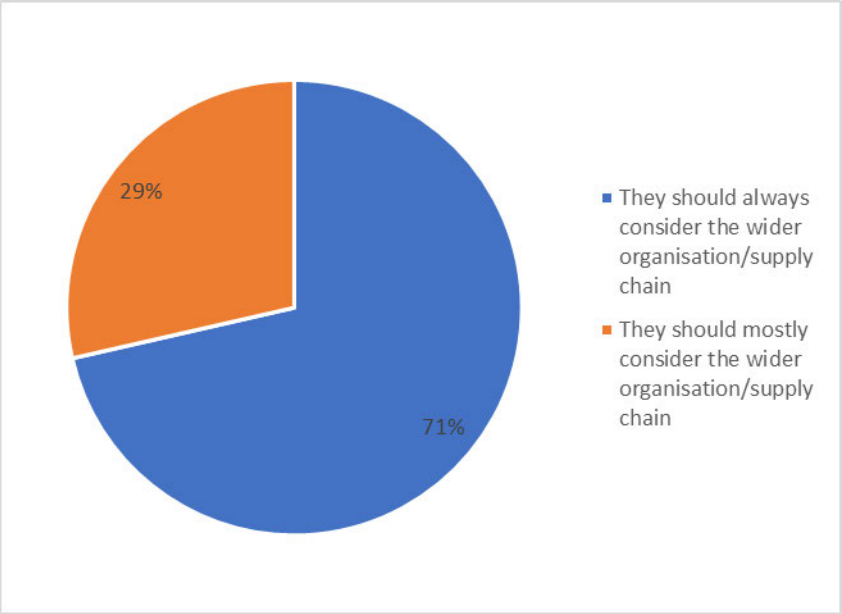


Figure 5.15 – Survey 1 Q15 results

This question sought consensus for thinking outside of departmental/functional level, in essence, contributing to the systems thinking philosophy as a core concept of the model (see sections 2.3.3, 2.3.4).

All respondents believe that business improvement methods should always or mostly consider the wider supply chain (internal or external), and therefore achieves consensus. The results support the notion of viewing the supply chain holistically, having alignment with the literature discussed in sections 2.3.3, 2.3.4, 2.2.2 and 2.2.4. This result supports the verification of the systems thinking concepts of the model and the inclusion of the interdepartmental impact audit in stage 2.3 of the

model (IIA – see section 3.4), which investigates the upstream and downstream supply chain. In addition, in the context of the conceptual model, the holistic approach is inclusive of performance measures as illustrated in stage 3 of the model (see section 3.5).

16) Do you think it is important to understand any impact departmental targets may have on the overall performance of the organisation?

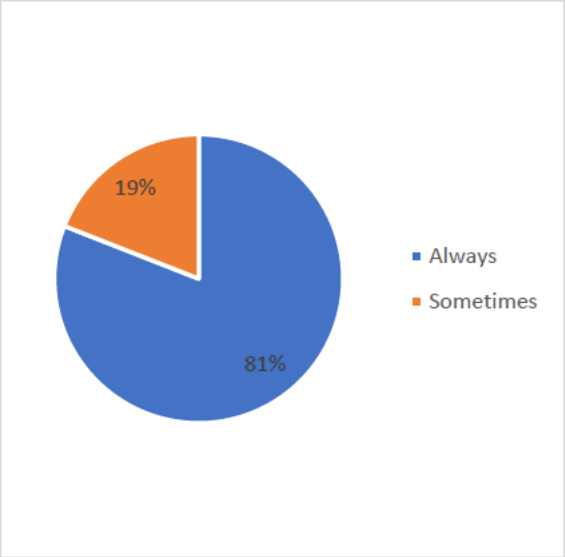


Figure 5.16 – Survey 1 Q16 results

This question builds from question 15, specifically regarding the potential impact of targets as discussed in section 2.2.4.

Most respondents (over 80%) believe it is always important to understand the impact departmental targets have on the overall performance of the organisation, which is consensus. Whilst there is consensus, the literature argues that organisations are often inhibited through functional barriers and work in silo's, focusing too much on targets at functional/departmental level (see sections 2.3.4, 2.3.6, 2.2.3), which suggests that in practice there can often be a lack of understanding between departments/functions.

The results of Q16 and the literature discussed above, support the verification of the IIA within the model (see section 3.4), which presents a method for investigating the impact of targets, such as the existence functional barriers and silos. The

development of the IIA is unique to this model and contributes to the body of knowledge in the area of business improvement within supply chain organisations.

5.2.5 Information and Communication

17) In your experience do departments communicate information across the organisation in an effective manner?

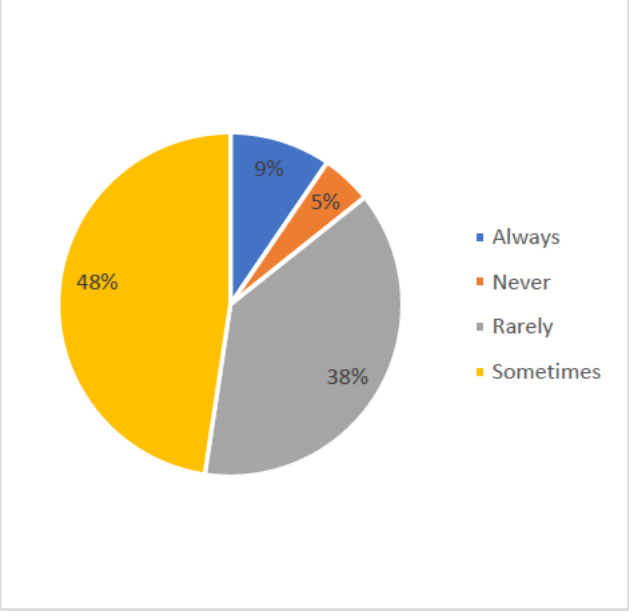


Figure 5.17 – Survey 1 Q17 results

This question further investigates perceptions related to the interdepartmental impact audit (IIA) aspect of the model, in particular information between functions/departments.

Quite a mixed result, but perhaps alarmingly for organisations only a small number of respondents (2) perceive that organisation always communicate information across departments in an effective manner, which the literature highlights is key for integration of a supply chain (as discussed in section 2.2.3.)

As this question is just based on the participants experience, the results are not looking for a consensus (in order to agree aspects of the model). The question builds from the theory discussed in chapter 2.2.3 and the concept of supply chain integration, with communication of information between entities (departments)

important for improved flow of product/service, however, as the results indicate, there is often reluctance to share such information across organisations.

The results further support the verification of the IIA within the model (see section 3.4), which presents a method for investigating the impact of targets discussed in the analysis of Q16, in combination with understanding levels of information required against the actual needs. The combination of the two elements of targets and information within the IIA is another unique feature to the conceptual model of this study, further contributing to the to the body of knowledge in the area of business improvement within supply chain organisations

18) In your experience do departments receive the required level of information from other areas of the organisation to ensure efficient delivery of service\product?

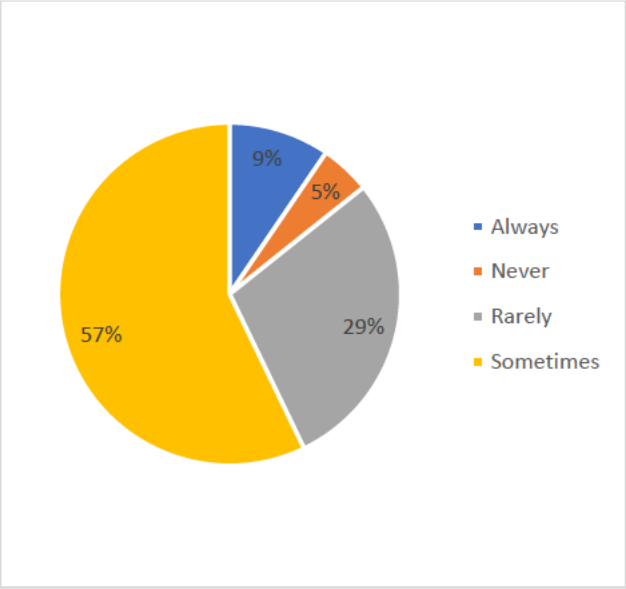


Figure 5.18 – Survey 1 Q18 results

This question builds from question 17 and further investigates perceptions related to the interdepartmental impact audit aspect (IIA) of the model, in particular information between functions/departments. The application of the IIA would confirm the type/frequency of information required between departments and establish how well this is being done.

Building from communication of information in question 17, this question investigates levels of actual information being communicated between functions/depts. Perhaps unsurprisingly, a similar pattern of results, with only 2 respondents perceiving that departments always receive the required level of information from other areas of the organisation to ensure efficient delivery of service\product. As with question 17, this question is just based on the participants experience (and therefore not seeking consensus); the mixed results suggest that information flows in organisations are inconsistent which gives further verification for the inclusion of this area in the IIA and continues to build on the theory discussed in Q17.

5.2.5.1 Overview – Interdepartmental Impact Audit

Whilst responses to questions 14 -1 8 have verified the content of the IIA, the responses to questions 3- 7 relating to targets evoked thought towards expanding this element to give opportunity to further understand the use of targets and associated impact on behaviour. The IIA was updated (for model version 2) to consider targets at different levels within the organisation and associated process, Figure 5.20 below illustrates the changes in response to survey 1 (Figure 5.19 is included for reference).

Figure 5.19 - Interdepartmental Impact Audit Model Version 1 (for reference)

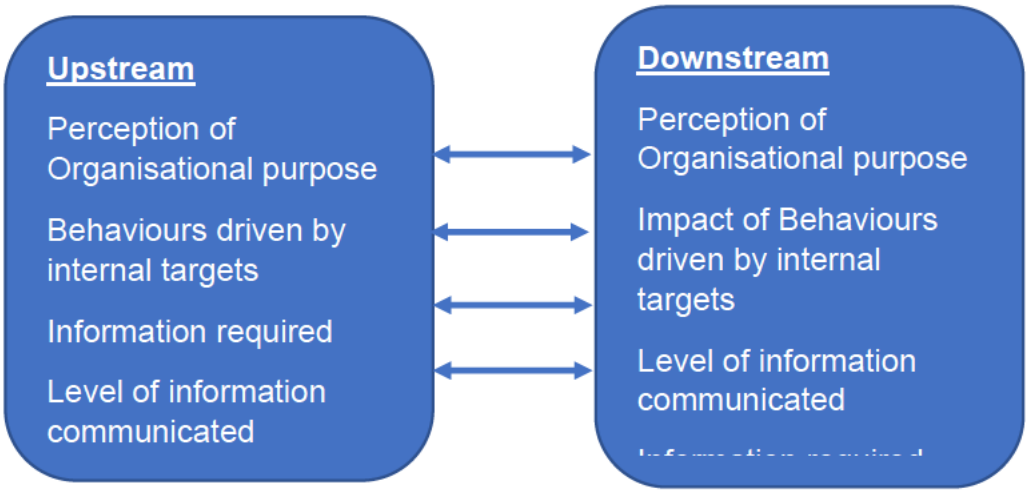
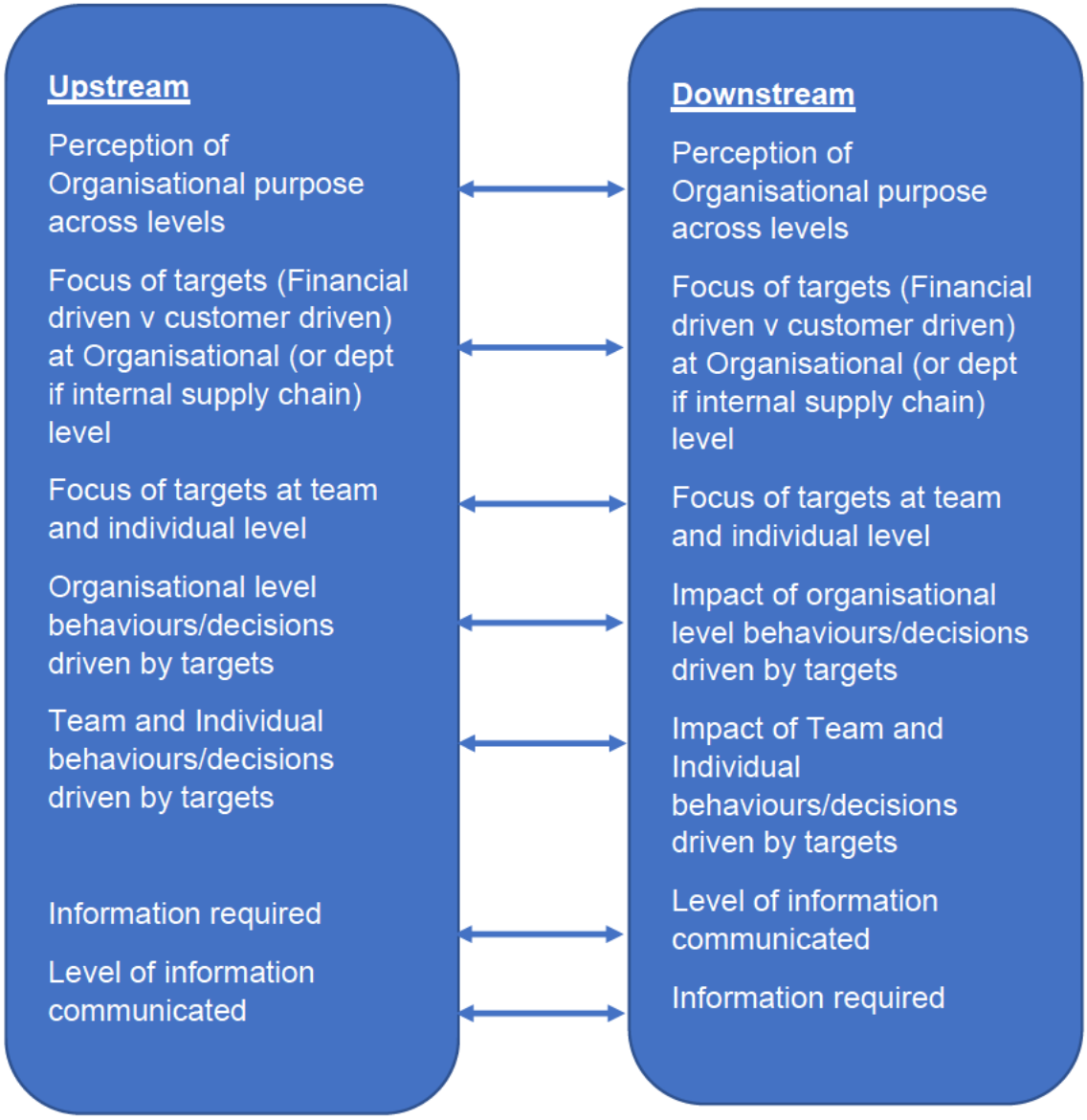


Figure 5.20 - Interdepartmental Impact Audit Model Version 2



The updated IIA draws further from the literature (section 2.3.4), particularly identifying if targets are financial oriented (do more with less, buy cheaper materials etc), or whether they are customer driven (or focused), together with any associated negative behaviours (This will help establish whether there are potential functional boundaries created through the organisations budgeting system (as discussed in section 2.3.4). In addition, the expanded lines of enquiry in the updated IIA differentiate in more detail between the different levels of target setting. Table 5.5 highlights questions for survey 2 (in Delphi round No 2) to seek views on the

enhanced IIA (Interdepartmental Impact Audit) in version 2 of the model (see Appendix B).

Table 5.5 – Survey 2 questions 11,12,13 derived from analysis of the IIA in survey 1

Survey V2 Question Number	**Question**
Question 11	Do you think the updated model will help departments/elements of supply chains to understand the wider impact of targets?
Question 12	Do you think the updated model will help departments/elements of supply chains develop a greater understanding of the information needs between departments/elements of the supply chain?
Question 13	Please add any further comments you may have on the IIA

5.2.5.2 Measurement

19) What is your view of the operational measurement criteria presented in 2.4? *(of the model)*

This question seeks views on the content of stage 2.4 of the model, generating knowledge on current process/system performance and measurement methods used.

Table 5.6 below is qualitative analysis of the respondent's comments for question 19 and maps the comments to the themes identified in section 5.2.1 (Q7 results). Following the analysis of comments, related enhancements to the model are presented.

Table 5.6 - Analysis of Question 19

Comment Number	Respondent Comment	Comments/analysis	Strategy	Leadership	Change Management	Performance Measurement	Measurement Methods	Operations Processes	Wider Supply Chain
1	(*Stages*) 2.41 and 2.43 are easy to understand, but how can you identify "levels of influence"? that one is a bit vague. 2.42 I don't get. Establish level and type of failure demand - what is failure demand?	'Levels of influence' is an area that would be explained further during implementation and reflects influences such as 'system conditions' (see section 2.3.4, table 2.4). In a basic sense, anything internal or external of the organisation that can influence process/system design and				x	x	x	x

		operations. E.g., external legislation or rules. Failure demand was defined in the survey which in this case was perhaps missed. This element can be re-highlighted in the next survey round.							
2	Accuracy of measurement methods / data?	This is covered in stage 3, however if it was introduced earlier in the model a consistent method of testing reliability/repeatability could be established earlier – see fig 5.22.				x	x		
3	Clear and concise, lacking with linking to the customer's requirements, although organisations may not be prioritising that in their measurements	Whilst the failure demand measurements link directly with the customer, this element could be made more explicit in this element of the model – see fig 5.22.			x	x	x	x	x
4	Evaluate the effectiveness of these criteria against target/KPI and their relationships with other departments' measurements	The IIA in stage 2.2 identifies targets and impacts on other departments. Stage 3.3 of the model proves new measurement methods, as above, a				x	x		

		consistent method of testing reliability/repeatability could be established earlier – see fig 5.22.							
5	Excellent	This comment supports verification of this stage.	x		x	x	x	x	x
6	I like the inclusion of "failure demand". Why not also include current "value demand"-level (and type) as a measurement factor?	This comment partially verifies the content of element 2.4. Identifying ‘value demand’ would be a natural part of the process of identifying ‘failure demand’ (section 2.3.4), there is scope to make the type of demand a little more explicit in this element of the model - see fig 5.22				x	x		
7	I think an important area that is good to see covered here is the external and internal influences. E g: a performance measurement in my current operation is SDP (same day put away for product). However, I have no control on the arrival times of	Positive comments, especially with the practical context given. Also, interesting to note that ‘internal and external influences’ were understood in this case, unlike in comment 1. This comment supports verification of stage 2.4.				x	x	x	x

	the trucks. So this external factor impacts us.								
8	I think it could be broader, cover holistically if this could be the purpose. Perhaps, try to link with some Performance Measurement System (e.g. Balanced Scorecard and Performance Prism)	A balanced scorecard could be a helpful method/technique when aligning the internal 'value chain' (see section 2.5.2) to the strategy. The intent for measures to be more holistic could be made more explicit at this stage- see fig 5.22.				x	x	x	x
9	I'm happy with this	This comment supports verification of element 2.4							
10	Internal influences are easier to distinguish and modify	Quite possibly, however, the IIA (stage 2.2) will help establish some of the external influences related to performance measurement.				x	x	x	x
11	Its good	This comment supports verification of element 2.4	x		x	x	x	x	x
13	Looks fine to me	This comment supports verification of element 2.4	x		x	x	x	x	x
14	Missing goals for the change - what to achieve	The purpose of the change is established in stage 1, stage 2.4 is	x	x					

		about applying measurement methods and other models for analysis of the current situation – not about goal setting so n/a.							
15	Very boiler plate and consultancy-like. There is no sensitivity analysis or suggestions for corrections in this phase.	The model is designed for a sequential consultancy like approach, so in this regard the comment is positive. This stage is about knowledge generation, recommendations for corrective process design etc are in stage 3. However, stronger linkages from stage 2 - 3 could be more explicit in the model - see Fig 5.22.	x		x	x	x	x	x
16	What about best practices? Is it included in item 2.41?	It depends in what context 'best practice' is being phrased. Section 2.41 will identify if any 'best practice' currently exists in areas such as 'measurement systems analysis' (see section 2.4.3). However, 'best practice' such as benchmarking may				x	x	x	x

		not be appropriate as customers could be quite different from other measured organisations.							

The analysis of question 19 (16 from 21 respondents gave comments) highlighted many factors that support the verification of the stage, however, some comments highlighted areas that could enhance the model. Five people did not comment, which suggests they do not have comment for enhancements.

To further tune the model an annex was created to expand on specific areas identified in the analysis that were associated with element 2.41. The updated version to enhance the model is illustrated in fig 5.22 below. Following on from figure 5.22, an updated illustration of stage 2 is presented for the enhanced model (figure 5.24), which highlights linkages to the annexes and additional arrows linking aspects of stage 2 to stage 3, the addition of the arrows were derived from the analysis of Q23 presented in table 5.8, and are further illustrated in figure 5.29.

Figure 5.21 - Element 2.4 Model Version 1

(for reference)

2.4 Measurement

2.41 Review current operational performance measurement methods

2.42 Establish level and type of failure demand

2.43 Identify levels of external/internal influences on current

Figure 5.22 - Element 2 with annex 2.41, model

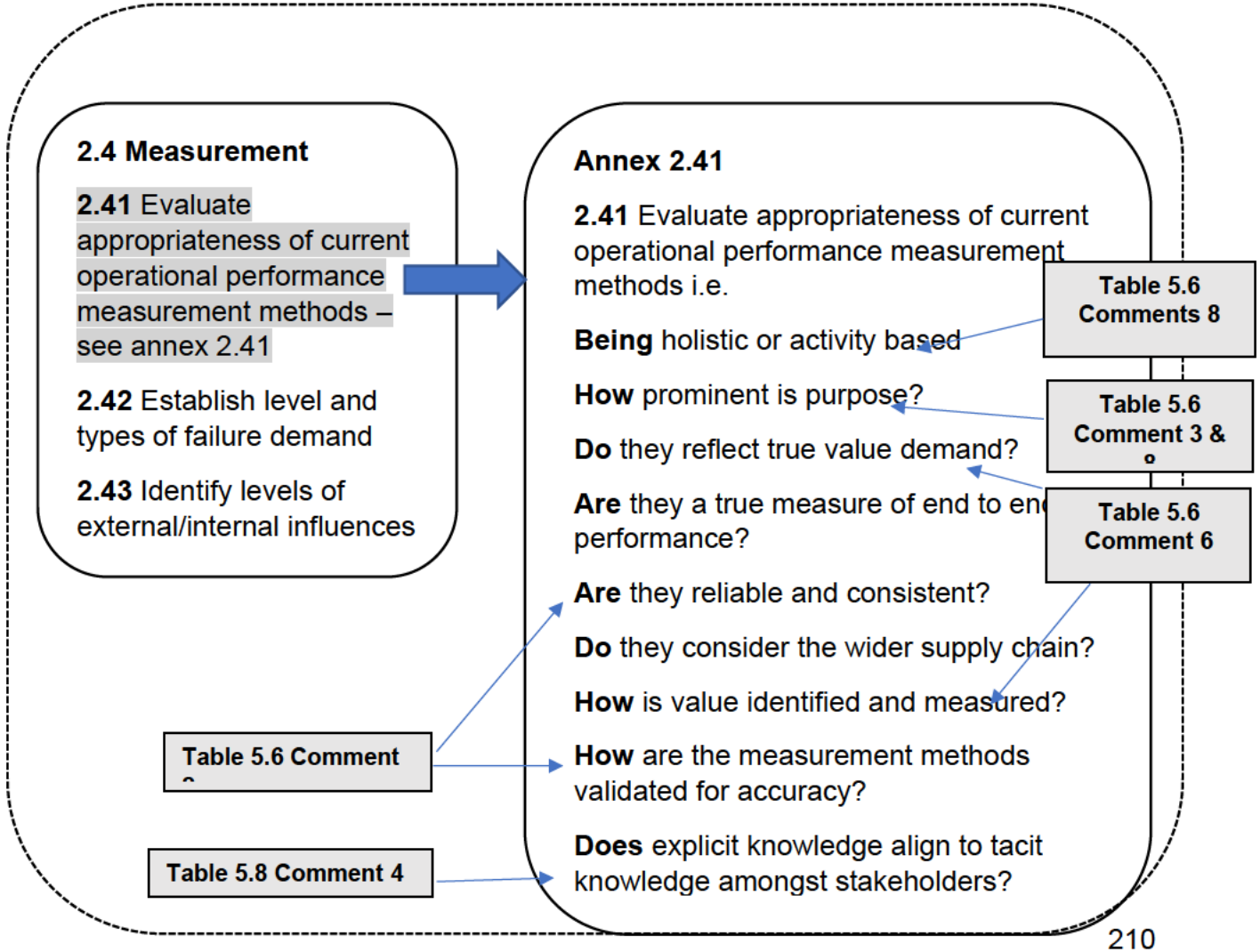


Figure 5.23 - Stage 2 model

Version 1 (for reference)

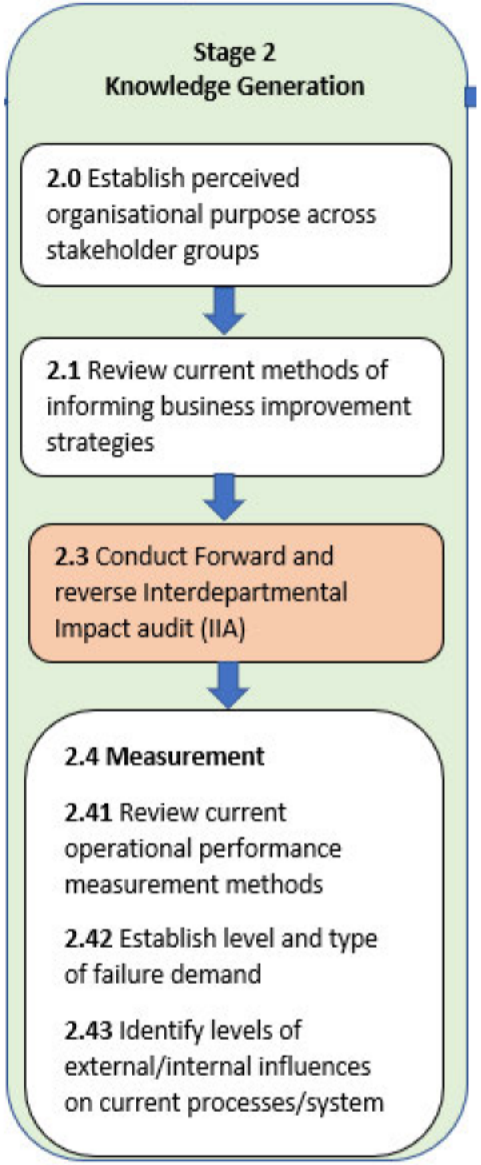
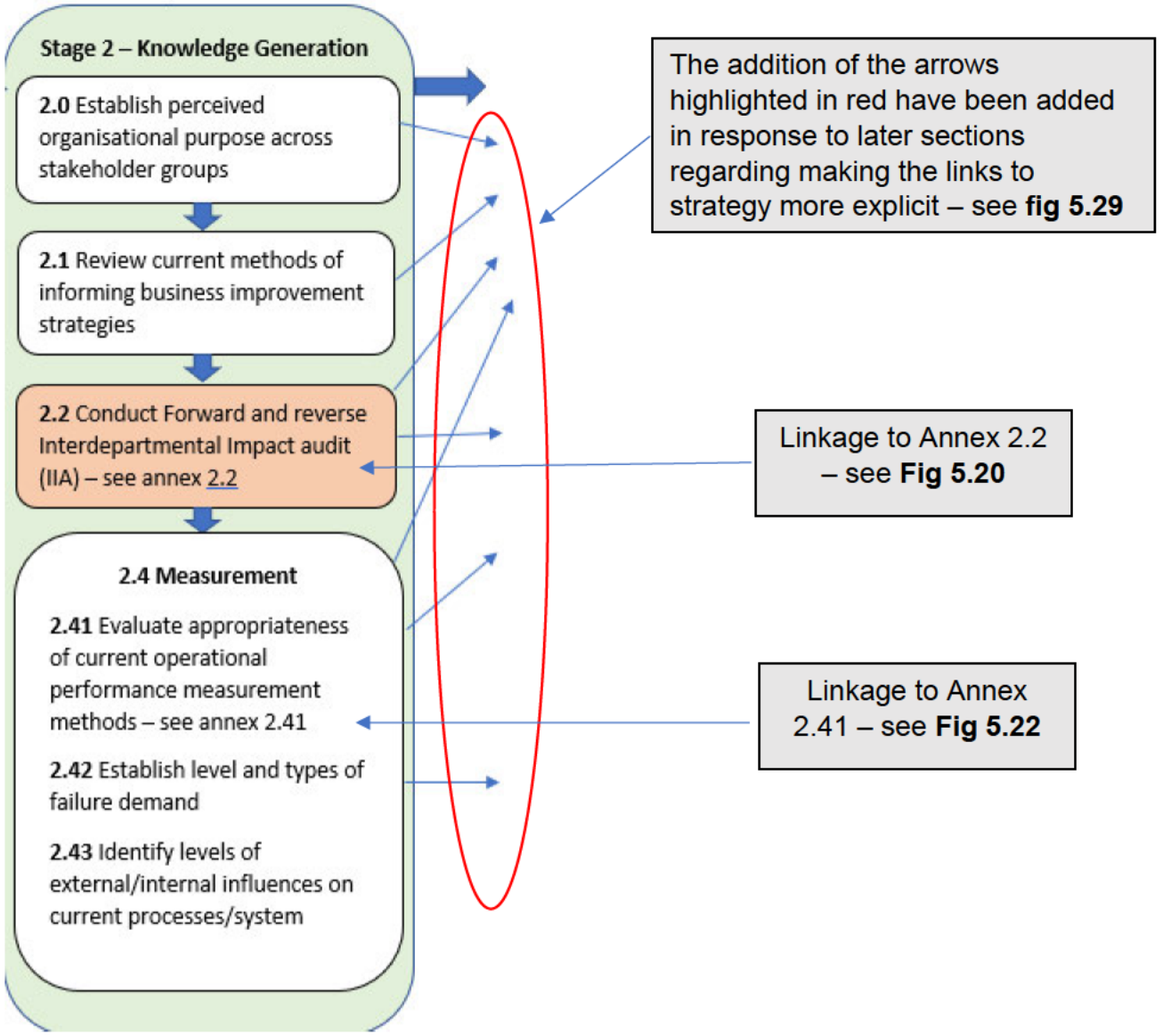


Figure 5.24 - Stage 2 model version 2



The following question in table 5.7 was included within survey No 2 (for Delphi round No2) to review the enhancements to element 2.41 of the model.

Table 5.7 – Question for survey 2 to seek views on element 2.41 of model version 2

Survey V2 Question Number	**Question**
Question 14	What is your view of the expanded operational measurement criteria presented in 2.41?

5.2.6 New Design Stage

This section of the survey asked questions relating to stage 3 of the model – New Design stage. This stage of the model uses the information from the knowledge generated in stage 2, highlighting the iterative nature of the model. The questions seek consensus and comments for verification of the stage, together with any points for fine tuning the model.

20) Do you think the re-design elements in stage 3.0 build logically from the knowledge generation in stage 2?

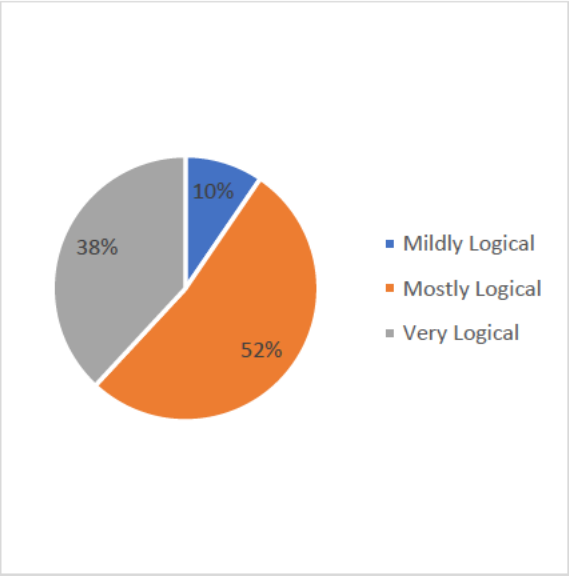


Figure 5.25 – Survey 1 Q20 results

This question seeks views as to the logic for the re-design elements included within stage 3 of the model.

The results for question 20 (See Appendix C) indicate that the re-design elements within stage 3.0 of the model build logically from the previous stage of the model stage 2 (i.e., using the information from the IIA to inform aspects of the redesign), with the majority (over 80%) of respondents perceiving it to be very logical or mostly logical, no respondents selected the not logical option. This is consensus and the result supports verification of the re-design content of element 3.0.

21) How important do you think it is to prove the accuracy of the measurement methods of processes?

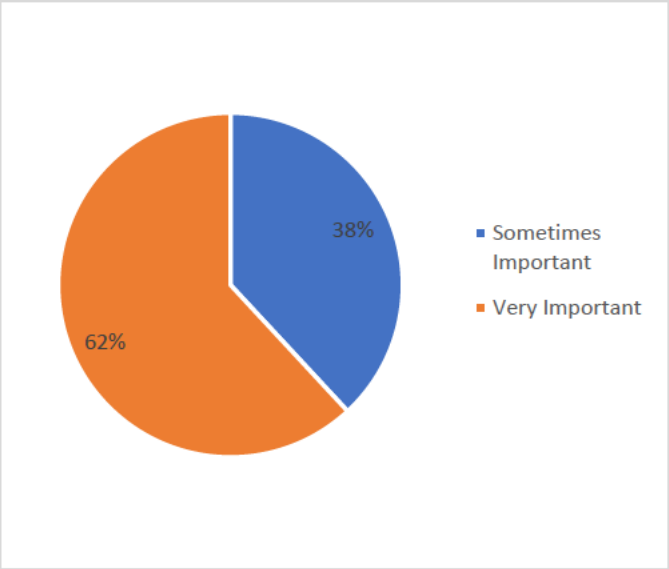


Figure 5.26 – Survey 1 Q21 results

This question seeks to verify the inclusion of stage 3.3 of the model (Prove process measurement systems through reliability and repeatability testing) by seeking consensus as to the importance of proving the accuracy of the measurement method being used.

All respondents consider it either very important or sometimes important to prove the accuracy of the measurement methods of processes, and therefore consensus. No respondents selected the ‘not important’ or ‘not very important’ option.

This element of the model draws from the literature discussed in section 2.4.3, with the importance of inclusion discussed in section 3.5. As highlighted in section 2.4.3, proving the measurement system (measuring the accuracy of the method used to measure performance) is lacking in Seddon's (2003) method, the integration of proving measurement systems combined with core concepts of Seddon's method (presented in section 2.3.4) add another element of uniqueness to the model

This result can be considered verification for element 3.3 of the model.

22) If an organisation is trying to change the way it thinks, how important is it to incorporate new thinking into the development of organisational strategy?

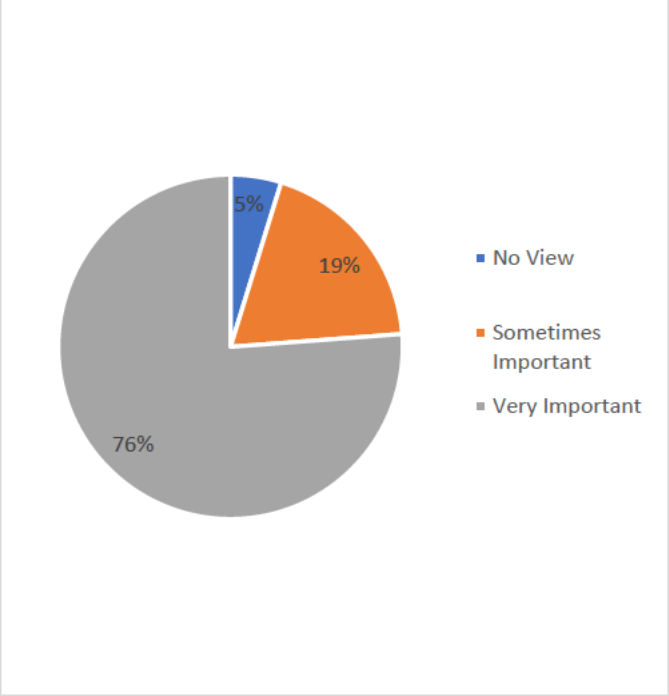


Figure 5.27 – Survey 1 Q22 results

This question seeks consensus as to the inclusion of strategy within the model for leadership of the organisation adopting a new way of thinking - in this case, more holistically, as a system (see sections 2.7.4 and 3.5).

The results of question 22 is consensus of the respondent's belief of the importance of incorporating a new way of thinking into organisational strategy, which parallels with the literature discussed regarding the importance of strategic leadership (as highlighted in the literature sections 2.6.2 and 2.7.4) and managers needing to

change their thinking (for implementation od a new concept). All except 1 respondent selected ‘very important’ (the majority) or ‘sometimes important’. Whilst 1 respondent had no view, there were no selections of ‘not very important’ or ‘not important’. This response supports the verification of element 3.0, specifically the leadership of strategies that reflect a holistic view based on purpose.

23) Do you have any further comments on stage 3?

Whilst the responses to previous questions support verification of the themes within stage 3 of the model, question 23 gave opportunity for qualitative analysis for further verification of the stage and opportunities for further tuning of the model. Table 5.8 presents the analysis, with the same thematical mapping as for the previous tables in this section.

Table 5.8 - Analysis of Question 23

Comment Number	Respondent Comment	Comments	Strategy	Leadership	Change Management	Performance Measurement	Measurement Methods	Operations Processes	Wider Supply Chain
1	#22: Hard to really grasp what is embedded in "incorporate new thinking into the development of organisational strategy"...	This answer does not review stage 3. However, question 22 does investigate areas of element 3.0. In this regard the model could be more explicit in stage 3 and the need to promote thinking as a system and how performance measurement methods are informed - See fig 5.29	X	X	X	X	X	X	X
2	From personal experience whilst new thinking is important, I often find issue	This response highlights the potential need for strategies to be well communicated. As stated	X	X	X	X	X	X	X

	arise from when existing strategy is not understood.	above, the model could be more explicit in this area, particularly element 3.1. - See fig 5.29.							
3	I am now (wishfully?) seeing elements of the classic PDSA/PDCA methodology in the model.	The model is underpinned by numerous theories, including the Check, Plan, Do cycle of Seddon (2003) (see section 2.2.4) and also draws from the PDSA cycle as discussed in chapter 2.3.4.		X		X	X	X	
4	I would have for the Knowledge Generation. I would suggest to consider better "knowledge". Try to bring something from Knowledge Management (e.g., Nonaka and Takeuchi) discussing about Knowledge creation and dissemination. Also, for your research try to split what is "tacit" knowledge and "explicit" knowledge. Mainly the first one might be highly important for	Whilst this research is not intended to investigate the subject of knowledge management in any depth, the point raised about splitting ‘tacit’ knowledge and ‘explicit knowledge’ in the model potentially adds value to the model, as it would help establish whether true performance is being measured. For example, whether process maps or procedural				X	X	X	X

	the Change Process and to Identify accurate Performance Measures. -	documents (explicit knowledge) are aligned to what is actually being done by people using their experience, but not necessarily documented (tacit knowledge). - See fig 5.22.							
5	It follows on very logically from the earlier stages.	The comment supports verification of stage 3.							
6	It looks great	The comment supports verification of stage 3.							
7	Measuring the right KPI is of utmost importance. However, some organisations fall into the pitfall of collecting too many KPI that do not add value to their process and this can have and adverse impact on individuals, their departments and teams.	This view is aligned the literature on section 2.3.4. The model draws from the core concepts of Seddon (see Chapter 1) and hence the integration of the IIA which includes the measure of ‘purpose’. Therefore, this comment further verifies stage 3 of the model.		X		X	X	X	X

8	This phase and its steps assume that change is necessary. What about when operations, KPIs and service levels are fine and thus do not require change, i.e. a status quo scenario? The problem with this entire model in my view is that it is predicated on the assumption that change must happen	Whilst a ‘status quo’ situation in the said scenario is perhaps a desirable position, it should not stop the desire for continuous improvement. However, the ‘assumption that change must happen’ is a valid point, and the front end of the model can make the need for change more explicit. It should also be pointed out that completion of the knowledge generation stage will verify the scale and scope of any problem and need for change. – see fig 5.13.	X	X	X	X			

Analysis of question 23 highlights that only 8 from 21 respondents chose to make comment. Three of the comments gave further verification for the stage (over and above the verification highlighted in analysis of previous questions). Fig 5.29 illustrates modifications to the model derived from the analysis, including making links to strategies more explicit. In addition, there are more directional arrows to make the links between stage 2 & 3 more explicit.

Figure 5.28 - Stage 3 Model Version 1

(For reference)

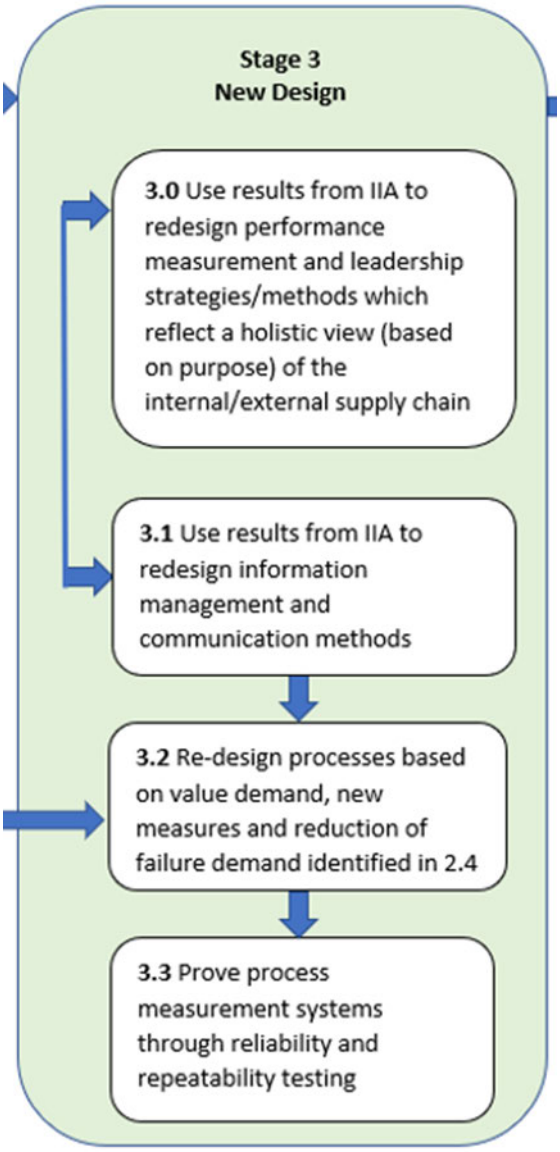
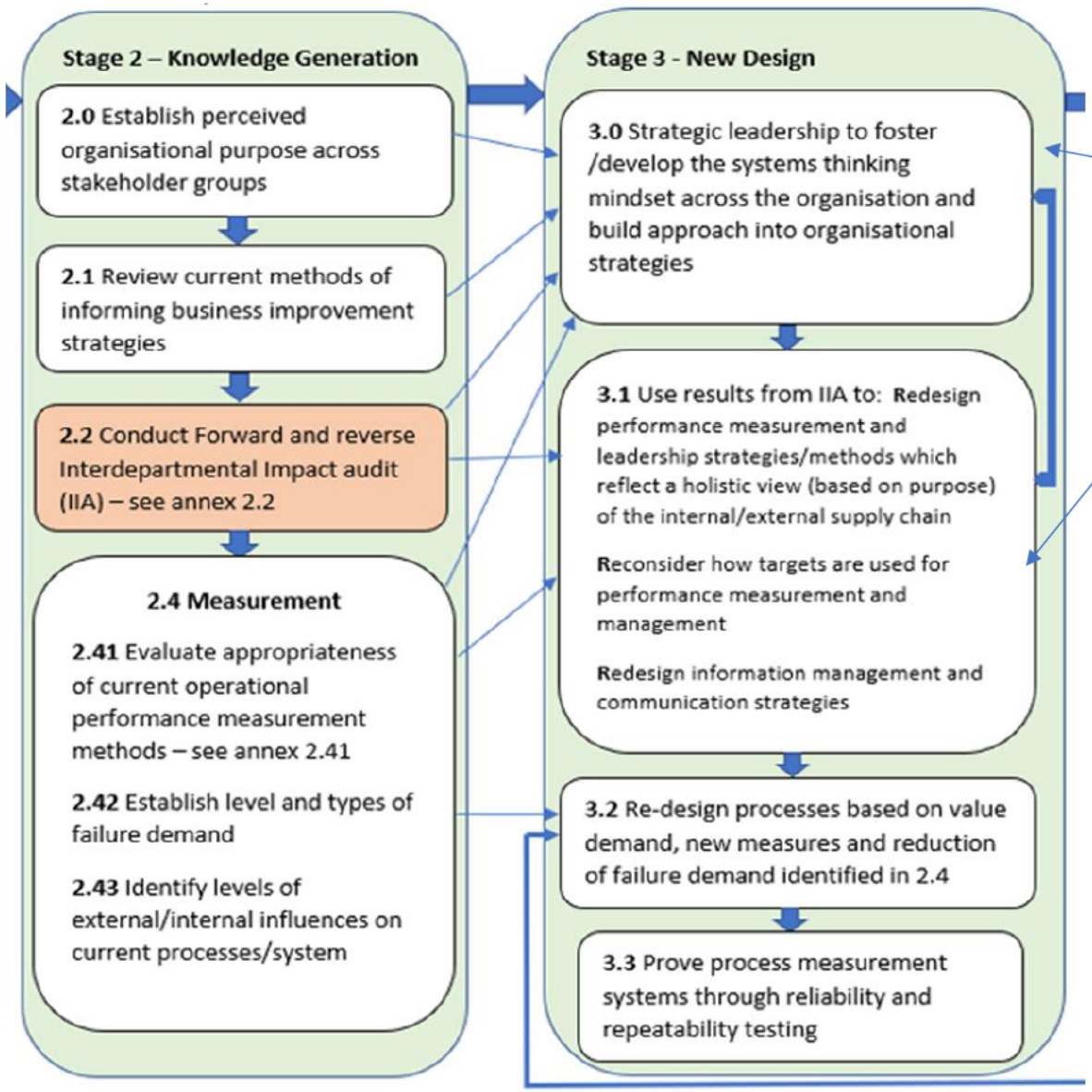


Figure 5.29 – Stage 3 model Version 2 including Model stage 2 to highlight linkage arrows between stages from analysis in table 5.8)



As the updated stage 3 of the model was influenced from the respondents' comments, the following questions in table 5.9 were included within survey No 2 (Delphi round No 2), to test the clarity of the enhanced stage and give opportunity for further comments.

Table 5.9 – Question for survey 2 to seek views on stage 3 of the enhanced model

Survey V2 Question Number	**Question**
Question 15	Do you think the stages in stage 3 are clearly presented in the updated model?
Question 16	Please add any further comments you want to make on stage 3.

5.2.7 Pilot and Roll Out

Questions 20-26 sought perceptions to verify the content of stages 4 and 5 of the model - Pilot and Roll out stages. Stage 4 of the model builds form the re-design undertaken in stage 3 of the model.

24) How important is it to run pilots before rolling out a change intervention across the whole organisation?

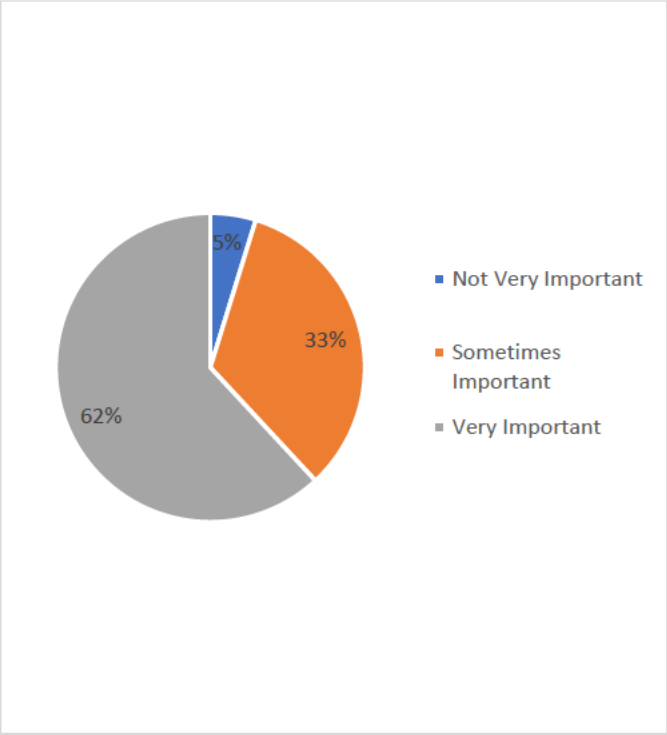


Figure 5.30 – Survey 1 Q24 results

This question seeks to verify the pilot testing phase of the model as discussed in section 3.6.

Most respondents (over 80%) believe it is 'very important' or 'sometimes important' to run pilots before rolling out a change intervention across the whole organisation, which is consensus. Only 1 respondent answered differently by selecting 'not very important' (which may reflect someone who has experience of improvement projects working first time, without any updates required), no respondents selected 'not important.' The results concur with the literature, in that many of the business improvement methods have an integral pilot stage.

This supports verification of element 4.0 (pilot systems approach and new process designs) of the model, which is an integral stage in many of the business improvement methods discussed in the literature, for example, the PSDA cycle and the 10 step Six Sigma methodology (see sections 2.3.4 and 2.4.3.).

25) Do you have any further thoughts on this stage?

Whilst the need for a pilot stage can be considered verified by the responses to previous questions, question 25 gave the opportunity for comments on how the pilot stage was presented within the model. The analysis of comments are presented in Table 5.10, with the same thematical mapping as for the previous tables in this section.

Table 5.10 - Analysis of Question 25 (Model Stage 4)

Comment Number	Respondent Comment	Comments/analysis	Strategy	Leadership	Change Management	Performance Measurement	Measurement Methods	Operations Processes	Wider Supply Chain
1	Depending on the complexity of change being implemented, piloting and reviewing may not be required if the change is well understood and simple in nature.	Whilst this comment is acknowledged, the application of this model is intended to evoke potential new approaches to process and systems design, no piloting of such changes would be high risk.			X	X	X	X	X
2	I think that the learning process is essential in this and I totally agree that it goes back to the item 3.2	This comment is referring to the link from 4.1 back to 3.2, such comments support verification of stage 4 of the model.			X	X	X	X	X

3	No								
4	Pilot is fundamental to any successful role out and a step between pilot findings and implementation is required to incorporate any further development or requirements identified at Pilot in order for a full successful role out	This comment supports verification of stage 4 of the model and highlights the purpose of elements 4.0 and 4.1, particularly the loop between Review adjust and Pilot new Process designs.			X	X	X	X	X
5	Pilots and up-scaling of test projects must be de rigueur in organizational improvement programs	This comment supports verification of stage 4 of the model and highlights the purpose of elements 4.0 and 4.1.			X	X	X	X	X
6	Possibly the most important part of the overall process.	This comment supports verification of stage 4 of the model and highlights the purpose of elements 4.0 and 4.1.		X	X	X	X	X	X
7	This is exactly what should happen in my opinion for this type of process. Should always pilot to then review. Without review you won't be able to successfully engage or launch.	This comment supports verification of stage 4 of the model and highlights the purpose of elements 4.0 and 4.1.		X	X	X	X	X	X

	Well, this notion of piloting is OK, but cybernetic technology within the systems domain provides such testing as well as corrective actions. The author has not provided any background on the systems theory used to develop this study and model, and for the general types of respondents that is likely OK. However, the authors has asked me to respond and as a logistics and supply chain management academic whose interests are in performance measurement and customer service, and who has worked within a logistics and systems group at a UK university, I find that some of this study's development and discussion is insufficiently novel. That might be because this survey is a "Reader's Digest" version for non-academics,	The author appreciates the constructive criticism and guidance given within the comments. The respondent has only had access to the survey, so therefore has not seen the rationale presented for the data collection methods used. Piloting (or testing) or testing of processes/systems is indeed integral of other business improvement methods and is not been presented as unique feature in comparison with other models/approaches. It is appreciated that other Delphi studies may have more rounds and potentially more of a qualitative nature, the rational for the mixed method approach within the study and the limitation of 2 rounds is discussed in chapter 4.		X	X	X	X	X	X

	but I trust the author has a good theoretical and methodological grounding behind it. For example, Delphi approaches are usually more qualitative i.e. less Likert scales so that content or thematic analysis can be carried out to refine the thoughts and hence the model over three or more Delphi rounds. I appreciate that PhD study is time and resource constrained and thus two rounds may be all that is achievable. However, that drives a need to ensure the theory and methodology are as robust as possible.								

Analysis of comments in Table 5.10 gives further verification (in addition to question 24) of the pilot and review stages of the model (stage 4), with some respondents making explicit their view on the importance of a pilot stage. Stages 4 & 5 in version 2 of the model is presented following the review and analysis of question 26.

26) What are your thoughts on the final stage

Table 5.11 presents review and analysis of respondents' comments regarding the final stage of the model, Stage 5 - Roll Out.

Table 5.11 - Analysis of Question 26 (model final stage)

Comment Number	Respondent Comment	Comments/Analysis	Strategy	Leadership	Change Management	Performance Measurement	Measurement Methods	Operations Processes	Wider Supply Chain
1	A roll-out or implementation stage needs some scope for fine-tuning during the roll-out until the process or operations is functioning as expected. I do not mean usual process variance that would be captured by usual control limits or fail-safe methods, rather teething or embedding issues that may need adjustments at the outset.	Whilst there is the opportunity to fine tune during the pilot phase of the model, this comment suggests that further opportunity for review could be integrated into the final elements of the model and make stages more explicit in stage 5 **–** see Fig 5.32.				x	X	x	x

2	agree	This comment supports verification of stage 5.							
3	At this stage, it might be best to specifically add few steps to sustain the process after rolling it out OR direct the user to follow steps of models such as DMAIC (Control stage).	As with comment 1, this comment presents an opportunity to adjust stage 5 to include more review of roll out, additional review would offer further opportunity to refine process controls – see Fig 5.32.				x	x	x	X
4	I am not totally sure, but per my first view from your research I would consider another step which is something like "reviewing the method". This is something approached for maturity of performance measurement systems. Organizations changes along the time. It might be that in one, two years, your performance measurement system/method does not make sense anymore (i.e. you need to readapt, change again in	An interesting point raised, additional steps for review as above, and accurate process measurement methods established during stages 2&3 will highlight any change in performance, and thus need for investigation and potential change. Reapplication of stages 1&2 will offer a ‘temperature test’ of future scenarios.	x	x					

	order to keep the method aligned with the changes caused from the environment).								
5	I see no issues with the last stage, pretty standard! I would suggest the only addition is a further review. often a few weeks/months post roll out things have slipped and need a little alignment.	As with previous comments, further review within the model would be beneficial – see Fig 5.32.				x	x	x	x
6	I think you need to connect this element with the first one, identifying possibilities for future improvements - a continuous improvement characteristic.	As with previous comments, further review within the model would be beneficial, together with opportunities to learn and operationalise new learning – see Fig 5.32.	x			x	x	x	x
7	I'm guessing there must be some kind of "follow-up"/"evaluation"/"validation" step as well. What about evaluating short term and operational output versus long term and higher level outcome?	As with previous comments, further review within the model would be beneficial – see Fig 5.32				x	x	x	x

8	it is sound	This comment supports verification of stage 5.							
9	It looks very straight forward, but in reality this might be where the problems begin. Can this be somehow detailed? An iterative process would also mirror a real application, as users may need to go back and forth between these steps and the prior ones.	Stage 4.0 and 4.1 highlight the linkages which reflect an iterative process, including a link back to stage 3. More explicit steps in these elements could make this clearer **–** see Fig 5.32				x	x	x	x
10	Logic	This comment supports verification of stage 5.							
11	Need to think about impact of the journals you send finding to.	This is a useful comment for future publication(s) related to the work, however it does not offer an opinion/answer of the question asked.							
12	Perhaps a feedback loop to demonstrate the new way of thinking and measuring performance	Whilst such a feedback loop exists in stage 4, this could be enhanced to be made more explicit – see Fig 5.32.				x	x	x	x

13	Perhaps there should be a further step to assess whether the objectives have been achieved.	The review in stage 4 offers the opportunity to measure level of success of new process design and a new way of thinking. The contents of this element could be made more explicit in the model, together with an additional review step as per previous comments – see Fig 5.32				x	x	x	x
14	Sounds good	This comment supports verification of stage 5.							
15	Strategize for roll out is key here - it requires buy in from management at all levels and adjustments to standard operating procedures if required.	The ‘buy in’ from staff is part of the ‘Mind-Set Shift’ phase of the model; with operational re-design undertaken in stage 3.	x	x					

This final element of the model reflects the final stages in much of the business improvement literature discussed in sections 2.3.4, 2.4.3 and 2.4.4. (see section 3.7). Whilst a number of respondents indicated agreement with the stage presented in the conceptual model, with comments such as “agree” and “logic”, a re-occurring theme from the analysis is the need for additional review and feedback opportunity.

The analysis of the comments for stages 4 and 5 enabled enhancements to the model (version 2) which are illustrated in figure 5.32, These include an additional review, learn and feedback loop in stage 5, together with additions to the elements of stage 4 to make more explicit and inclusive of respondents comments as highlighted in table 5.11.

Figure 5.31 - Stage 4&5 model Version 1

(For reference)

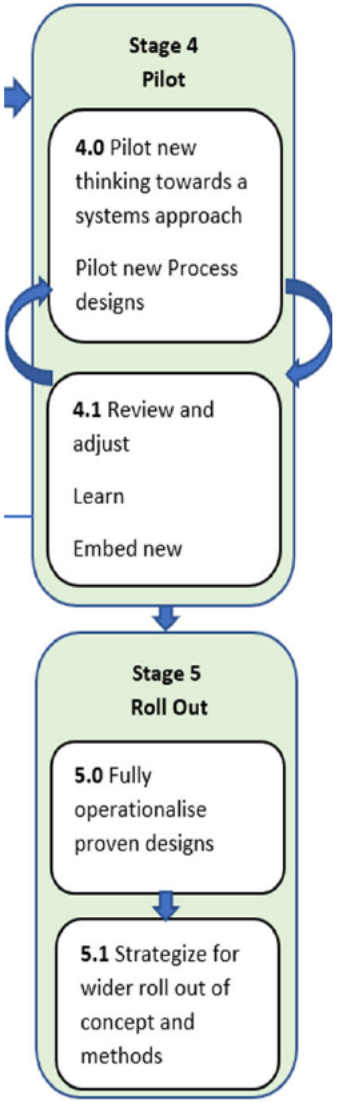
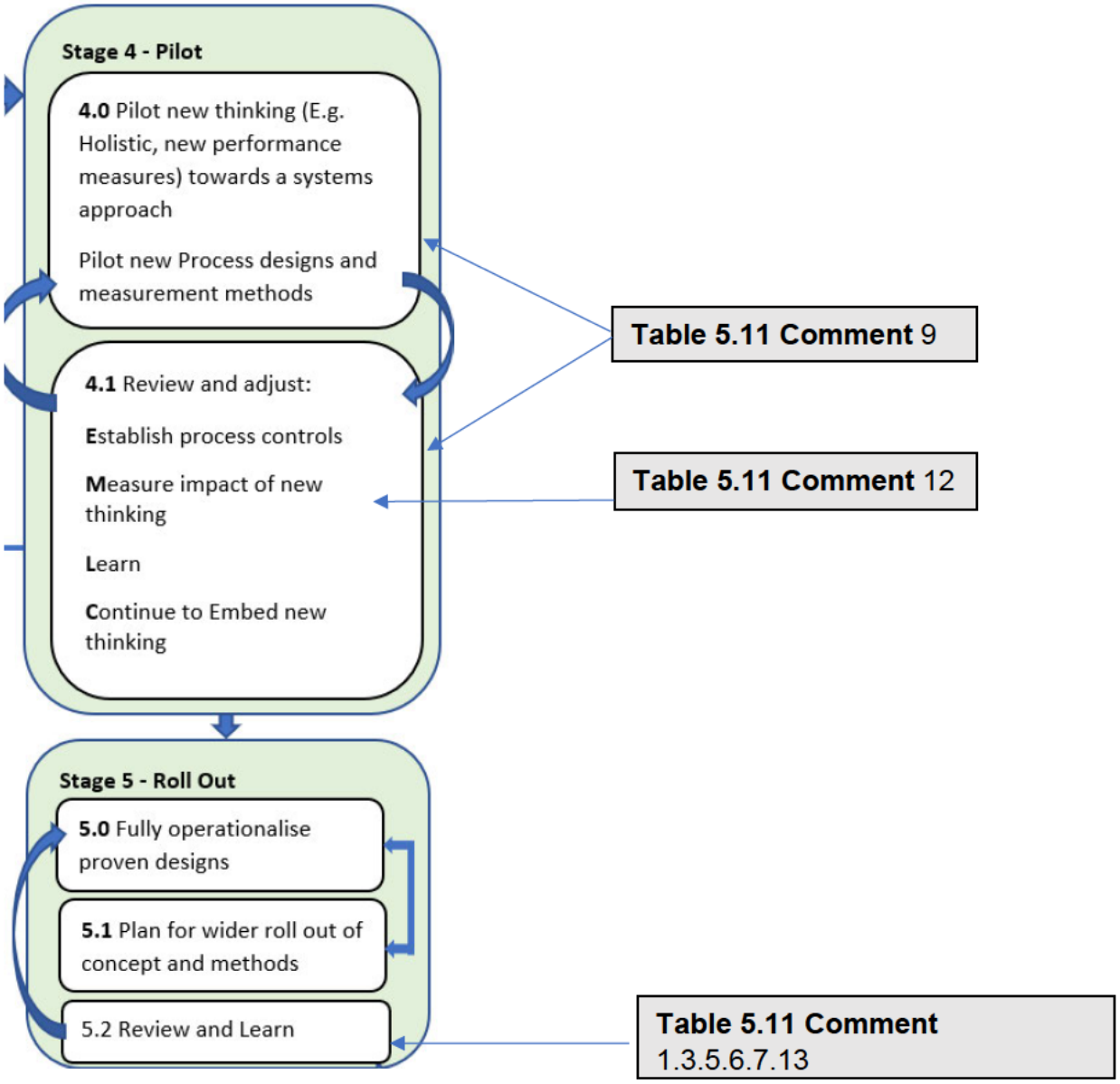


Figure 5.32 - Stage 4&5 model Version 2



To review the updates made to stages 4 and 5 of the model (highlighted in figure 5.32 above) the following questions in table 5.12 were included within survey No2 for Delphi round 2.

Table 5.12 – Questions for survey 2 to seek views on stages 4 and 5 of the enhanced model (version 2 of the model)

Survey V2 Question Number	**Question**
Question 17	Please indicate below the clarity of stage 4 and 5.
Question 18	Please indicate below how logical you think stages 4 and 5 are.
Question 19	If you scored 3,4 or 5 on either or both of the previous 2 questions please indicate why.

5.2.8 Updated Model

Figure 5.33 presented on the following page is the updated model (Version 2) which has been informed by the results and analysis of Delphi round 1. In addition, figure 5.34 and figure 5.35 on the proceeding page illustrate the Annexes referenced in stage 2 of the model which were discussed earlier in this chapter.

The testing of the tuned version (version 2) of the conceptual model presented in figure 5.33 was undertaken via the second round of the Delphi study and the results and analysis are presented in chapter 6.

Figure 5.33 – Enhanced Model (model Version 2)

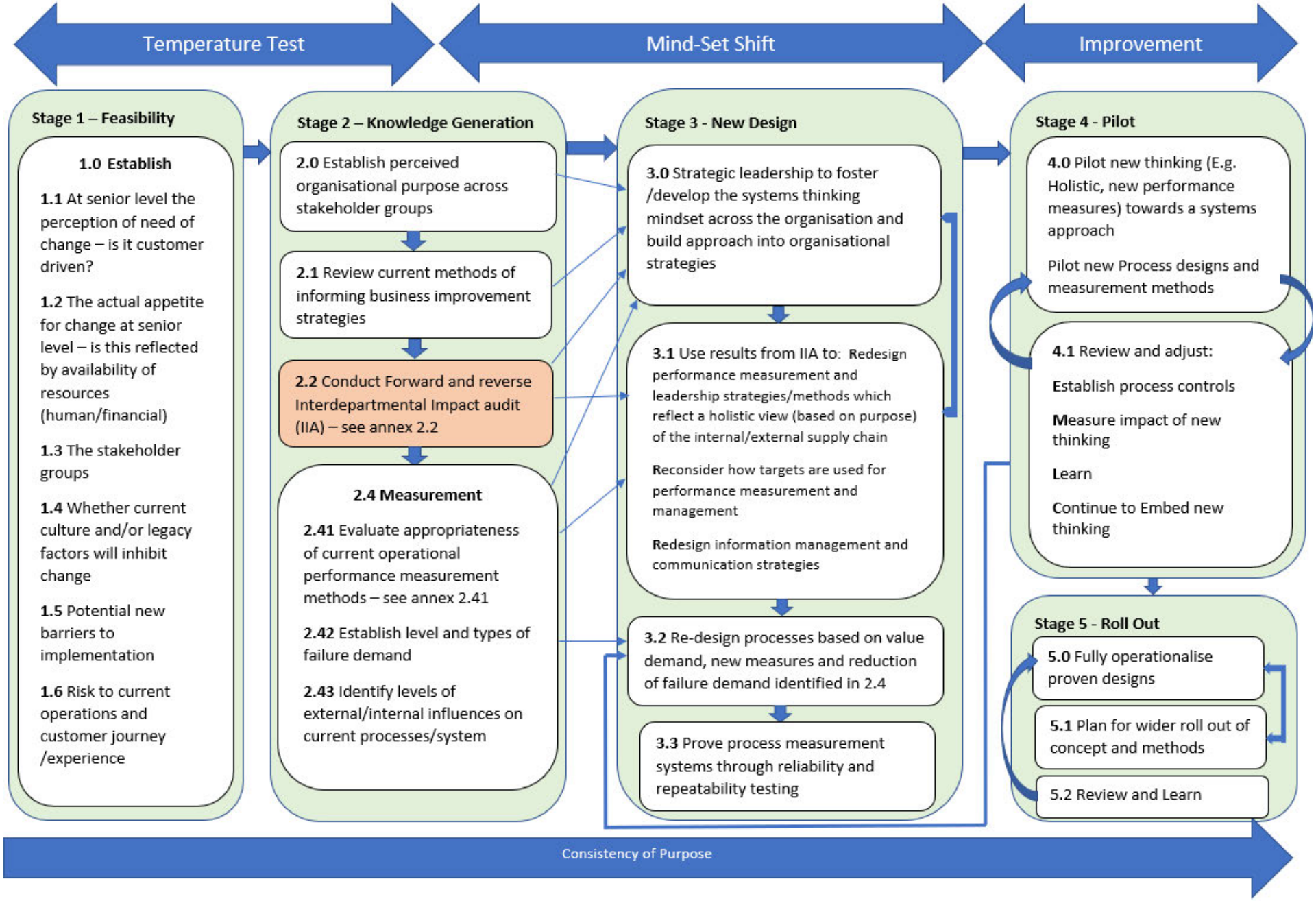


Figure 5.34 - Annex 2.2 IIA (Interdepartmental Impact Audit)

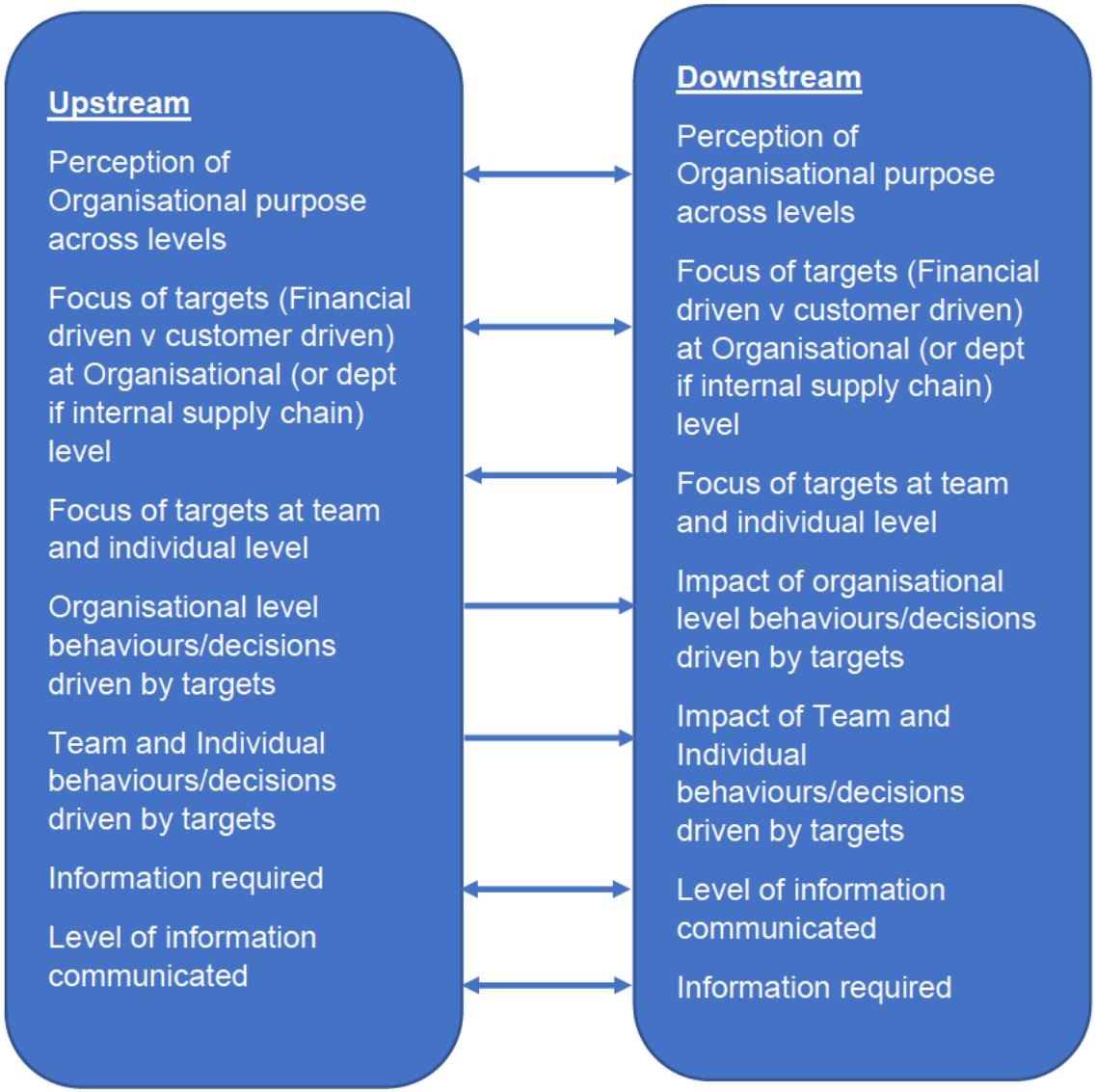


Figure 5.35 - Annex 2.41 Expanded element 2.41

Annex 2.41

2.41 Evaluate appropriateness of current operational performance measurement methods i.e.

Being holistic or activity based

How prominent is purpose?

Do they reflect true value demand?

Are they a true measure of end to end performance?

Are they reliable and consistent?

Do they consider the wider supply chain?

How is value identified and measured?

How are the measurement methods validated for accuracy?

Does explicit knowledge align to tacit knowledge amongst stakeholders?

5.3 Overview and Conclusions

This chapter has presented the results of Delphi survey No1, which is the first stage of the model verification process. The results returned a high level of consensus to the relevant quantitative questions, which is a very positive outcome. The results and analysis of the qualitative questions returned a high number of positive comments, which supported the verification of the model. In addition, there were several comments that offered constructive criticism, which provided opportunity to enhance the model (enhancements presented throughout the section). Table 5.13 below gives an overview of the model verification after survey 1, through linking the question outcomes to associated subject areas of the model. The table highlights the quantitative questions and consensus, and where the qualitative question comments support verification of the model stages.

Table 5.13 – Overview of model verification after Delphi Round 1

Model stage	Links to Question No	Subject Area of Model	Qualitative	Quantitative
Stage 1	Q8	Change driven by leadership		Consensus
	Q9	Commitment of leadership		Consensus
	Q12	Agreement with areas within stage 1		Consensus
Stage 2	Q3-6	Targets	The mixed views on the use of targets support the need and value of the IAA	
	Q7	Targets	The mixed views on the use of targets support the need and value of the IAA	
	Q10	Links to informing business improvement strategies		Consensus
	Q14	Links to understanding		Consensus

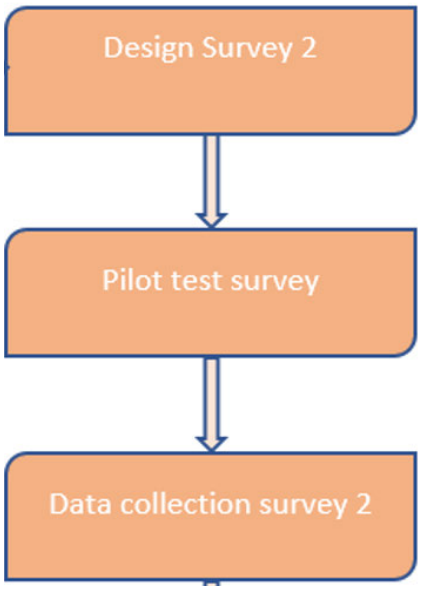
		perceived organisational purpose across stakeholder groups. Specific to purpose element of IIA.		
	Q15	Links to IIA and inclusion of upstream and downstream supply chain.		Consensus
	Q16	Understanding any impact departmental targets may have on the overall performance of the organisation. Specific link to IIA		Consensus
	Q17	Links to supporting the communication aspect of the IIA		A mixed result supports verification
	Q18	Links to supporting the information aspect of the IIA		A mixed result supports verification
	Q19	Links to measurement criteria	Qualitative analysis highlighting many comments to support verification of the measurement element. Other comments provided opportunity to enhance the model, tested further in Survey 2.	
Stage 3	Q8	Change driven by leadership		Consensus
	Q9	Commitment of leadership		Consensus
	Q10	Specific to strategies for		Consensus

		model implementation		
	Q11	Agile processes - Specific to re design of processes based on demand		Consensus
	Q14	Specific to leadership strategies/methods reflecting a holistic view (based on purpose)		Consensus
	Q15	Links to holistic approach of performance measures		Consensus
	Q20	Links to the redesign element and iterative nature of the model		Consensus
	Q21	Links to proving process measurement methods element		Consensus
	Q22	Links to leadership strategies incorporating new thinking (systems thinking)		Consensus
	Q23		General comments to support verification of stage 3 and opportunities to enhance the model.	
Stage 4	Q24	Links to piloting of ST approach and process designs		Consensus
	Q25		Includes general comments to support verification of stage 4	

Stage 5	Q26		Includes some general comments to support verification of stage 5	

The analysis enabled the identification of links to relevant literature. The results highlighted that whilst many responses regarding the model design concurred with the literature, responses to some questions indicated that in practice, the situation was not ideal. For example, the literature argues the importance of information sharing and communication for effective and efficient supply chains (see section 2.2.3), but from the panels experience this is often a weakness in organisations, supporting the verification of the Interdepartmental Impact Audit (IIA), which is a key and unique feature of the conceptual model. This is in conjunction with assessing the impact of targets, where perceptions are broad ranging when considering the impact and focus of targets, which also justifies the IIA and its inclusion of this within the model.

Completion of the analysis of Delphi round 1 enabled the progression of the steps highlighted in figure 5.36.



Compiled from the elements highlighted in analysis of Survey 1 and method highlighted in section 4.6.2.4. – see Appendix D for full survey.

Completed as highlighted in section 4.6.2.5

Completed and presented in Chapter 6

Figure 5.36 – Next steps after Delphi round 1

The following chapter (Chapter 6) presents the results from the Delphi round No2, which incorporated a survey (survey No2) designed to seek views on the enhanced model (model version 2) and further build on the level of verification achieved from the Delphi round 1 (as presented in table 5.13).

Chapter 6 - Analysis of Delphi Round 2

6.1 Introduction

Chapter 5 presented the results and analysis of Delphi round 1, highlighting a high level of verification for the conceptual model (model is constructed in a considered and robust manner and could theoretically achieve the desired purpose if applied to an organisation – see section 4.6.2).

This chapter presents the results of Delphi round 2, which is the second stage of the model verification process (see section 4.6.2.3). The chapter builds from the results and analysis presented from Delphi round 1, through presentation of results and analysis of survey 2 (Delphi round 2). The questions within survey 2 were devised from analysis of survey 1, to further explore certain themes and to seek views and levels of consensus on the model enhancements, with inclusion of the questions highlighted throughout chapter 5. The questions within survey 2 were designed (see figure 6.1) using a range of question types (see section 4.6.2.4), with a pilot study being undertaken (as per figure 6.1) as discussed in section 4.6.2.5. Survey 2 is presented in Appendix D.

This chapter presents the elements in Figure 6.1 highlighted by the red circles.

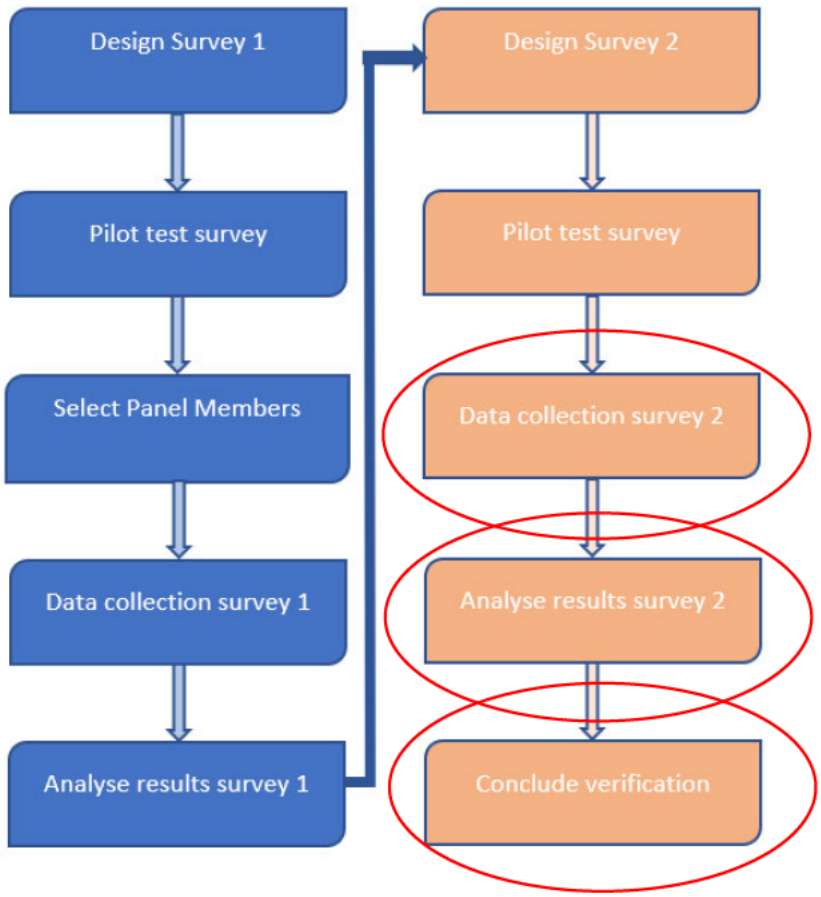


Figure 6.1 – Chapter 6 highlighted Delphi Process steps

As with Delphi round 1, the value of 80% (see section 4.6.2) or above was used as panel consensus for relevant quantitative questions. The inclusion criteria for consensus considers:

- For Likert type question design the combination of the top 2 answers on the scale were counted, for example, if 1 = fully agree and 5 = fully disagree, the percentage answers for 1 and 2 on the scale were considered as positive for agreement and combined.
- The same approach was adopted for rating type questions, for example:
    - Strongly Agree
    - Mostly Agree
    - Mostly Disagree
    - Strongly Disagree
    - No View

In this case the combined percentage answers for Strongly Agree and Mostly Agree were counted. If a panel member returned a No View answer, this was disregarded. The results for all quantitative questions are presented after each question in the following sections.

Also as with survey 1, the open questions within the Delphi survey questionnaire generated qualitative data, which was analysed in a systematic way, i.e., reviewing and analysing responses for each question and then identifying themes and any linkages or commonalities between responses, reflecting an open and inductive approach aligning with Grounded analysis (Easterby - Smith et al et al, 2013). The analysis is presented in tables with additional commentary where deemed appropriate, with the main themes being presented after each table.

Findings from the quantitative questions were used to:

- Evaluate the level of consensus on the question, which links to subject fields of the model

Findings from the qualitative questions were used to:

- Highlight areas of supporting model verification
- Identify considerations when applying the model

The combined results of the qualitative and quantitative analysis for contribution to model verification are presented as an overview in table 6.11.

Survey No2 yielded 16 respondents, whilst a lower number than survey No1, 16 is still a suitable number when using the Delphi method, this study was aiming for 12-20 panel members to respond - as discussed in section 4.2.6.7.

6.2 Analysis

6.2.1 Organisational Targets

Survey 1 highlighted that there were mixed views regarding the use of targets (see section 5.2.1) which supported the verification of the IIA (Internal Impact Audit) aspect of the model (see section 3.4). As discussed in section 5.2.1, the responses gave further opportunity for investigating the perceptions of targets, which was undertaken through questions 3-7 of survey 2. These questions are not seeking a consensus level agreement but offer the opportunity to understand potential organisational landscapes (in relation to target usage) for application of the model. In addition, they also give opportunity for identifying factors (e.g., comments) that support verification of the model.

Note: questions 1&2 were related to the survey administration (see Appendix D for full survey No2).

3) What is the purpose of using targets when measuring performance in organisations?

In Survey 1 most respondents had the view that targets are needed in organisations for measuring performance. This question sought general views as to the purpose of such targets; table 6.1 presents the results, followed by thematic categorisation.

Table 6.1 - Results of Question 3 Survey No2

No	Respondent Comment
1	To drive productivity and efficiency
2	It's always possible to improve anything, but wisely set targets may help the employees to prioritize their efforts. Target reached--> less efforts right now; far from target --> area needs focus. Also, targets make it possible to be happy with a result without reaching perfection. Targets should trigger a preferred behaviour.
3	Improve the decision-making process
4	To drive improvement and set governance
5	Some sort of measurements for monitoring progress
6	To facilitate continuous improvement.
7	To be able to track how we are performing compared to where we wanted or expected to be
8	To evaluate/benchmark the person or outcomes against the defined/expected level of achievement.
9	identify inefficiency in operations and improvement areas for service to the customer
10	I think when you don't have a target you cannot measure the performance and performance gaps to improve an operations in SCM.
11	To support the assessment of current performance against a perceived expectation of performance. This should focus the organisation in drawing out activities & data in order to drive improvement in performance.
12	Knowing if you are progressing in the right direction. "What you measure is what you get".

13	Targets allow tracking internal and external performance against some standard to know when and where gains and losses occur to take corrective action.
14	To give clear direction and accountability.
15	Establishing a link with the Organisation's strategic objectives
16	To be able to track how we are performing compared to where we wanted or expected to be

From the results presented in table 6.1, the responses can be grouped into the thematic areas as to the purpose of targets:

As a driver

- Productivity and efficiency
- Direction and accountability
- Focus the organisation for data to drive improvement and performance
- For improvement and Governance

As a Monitor

- Current position against desired position
- For individuals – against benchmarks
- Identification of inefficiency
- Identification of areas for continuous improvement
- To support the assessment of performance against expectation
- To know whether going in the right direction
- Tracking performance against a standard and know when to take corrective action

As a facilitator

- For continuous improvement
- For direction and accountability
- For linking with strategic objectives

The results to question 3 still highlight a mixed view towards the purpose of using targets for measuring performance, whilst there is a common theme of performance measurement within the results, the thematic grouping above highlights the potential different purposes of using targets from the results. Interestingly, only 1 respondent mentioned the customer, with most of the responses lacking an external dimension. An interesting comment was that of "targets should trigger a preferred behaviour" (response No 2), which can be assumed as a positive behaviour, rather than the negative behaviours discussed in section 2.3.4.

The mixed views presented give further support to the verification of the IIA element of the model (stage 2.3) and the notion of aligning the understanding of 'purpose' (from the customers perspective - a core concept of the model derived from the literature in section 2.3.4) across the stakeholder groups (stage 2.0).

4)What should be the focus for departmental performance related targets

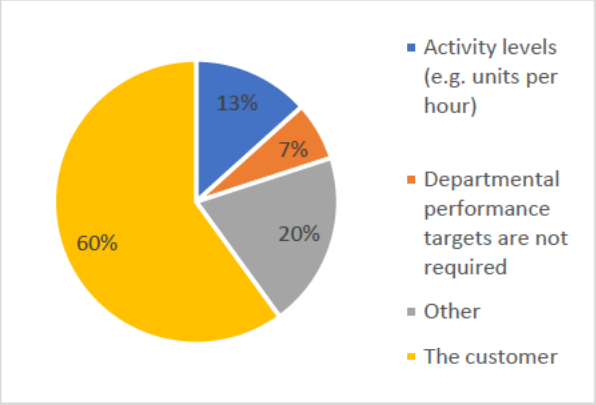


Figure 6.2 – Results of Q4 Survey No2

This question is linked to Q3 but is seeking views on whether the focus of targets should be related to activity (e.g., items picked per hour) or be customer focused.

The majority of respondents perceive the customer should be the focus of departmental performance targets. However, there are mixed views amongst the remaining respondents, including activity type targets approach and the selection of 'other', which could reflect targets from the supply chain metrics literature discussed in section 2.2.4. Whilst the majority of respondents have selected customer, which

links to the notion of 'purpose' (from the customers perspective) within the conceptual model, when comparing to the qualitative results from Q3, only 1 respondent mentioned the customer when seeking the views on the purpose of using targets within organisations, which further highlights mixed perceptions and a potential lack of consistency. This further highlights the value of the IIA element of the model (in investigating departmental targets and impacts) and the need for a common understanding of purpose.

The following question (Question 5) gave opportunity to understand potential rationale for the selections made in question 4.

5) Please give the reason (and any other comments) for your answer to Q4

Table 6.2- Results and analysis of Question 5 Survey No2

No	Respondent Comment	Comments/analysis
1	Because the activity ultimately serves the customer	It could be argued that not all activities serve the customer (failure demand – see section 2.3.4), hence the implementation of business improvement programmes.
2	Whether you take a flow-oriented perspective, or customer oriented perspective, departmental targets very seldom support this. I believe those two are key to success, departmental targets satisfy the management control and auditing people, it won't bling prosper to any organisation.	Aligns to the literature in section 2.3.4 and customer purpose – one of the key concepts of the model for this study. In addition. Also aligns to the literature (in section 2.3.4) that departmental targets are used to control – via a vis, command, and control style management.
3	Operationally speaking, by optimising the activity level, you end up reducing costs and improving the level of	This reflects working on functional activity rather than the more holistic

	adherence to the customer demand. Other ways to improve that are related to tactical and strategical elements	approach to working on flow (see section 2.3.4).
4	Linking targets to what your customer perceives as value will drive improvements in the right direction for the department	Targets linked to customer, interesting comments about such links driving improvements, this could be in the context of focusing on the 'value' activities of the operations.
5	Focus on productivity/output against targets at the department level	A similar viewpoint to No3, reflecting a functional activity approach.
6	Without customer satisfaction we don't have a business. Cost measures are also important though.	Targets linked to customer with appreciation of managing the costs.
7	There a number of statutory and safety things which need to be adhered to or delivered, the performance of delivery of, which needs to be monitored alongside delivery for customers	Targets linked to customers, but valid points made about statutory requirements. This area will potentially grow with increased desire for carbon reduction and other environmental goals (as discussed in chapter 1).
8	It's a blend of multiple things that should be focused as target. While achieving through-put (units per hour) might be a good target but doing so with bad customer service or poor process management is not ideal.	Interesting points made, with some reference to the customer.
9	We could be the cheapest/profitable supply chain/warehouse/operation, but if it led to poor customer interaction and experience the targets against sales performance wouldn't be met.	As with No8, interesting points made, with some linkage to the customer. Suggests a lean towards sales performance targets.

10	We need to fulfil the customer needs and create value for them, so targets need to concentrate on the customers.	linkage to the customer.
11	It could be any of the above. Different organisations have different needs, and therefore measurement and target should be developed based on what is critical to that function. A "Zero Defect" approach enables organisations to assess measurement across all functions and disciplines in order to draw out and challenge itself to eliminate failure, striving for perfect performance.	Comments about 'zero defect' approach across all functions, which perhaps suggests common targets. It could be argued that whilst 'perfect performance' could be strived for by eliminating failure, if the product/service is not aligned to 'customer purpose' the process in itself could be considered 'failure demand' (see section 2.3.4).
12	Only one response allowed, but I would suggest a type of Balanced Scorecard, that can use a few measures and targets.	A 'balanced scorecard' could help with internal linkages across the value chain and link to strategy (see section 2.7.2).
13	It should all start with the customer per Peter Drucker, either internal or external so that departmental improvement can properly address and shortcomings in customer service and satisfaction.	Linkage to customer
14	The Customer is at the heart of everything we do, productivity targets enable your service to customers.	Linkage to customer, although the customer could get lost within activity-based productivity targets.
15	Customer should be the main target of departmental performance. Actually, the departmental performance will contribute to the entire performance of supply chains satisfying stakeholders	Linkage to customer

	expectations by meeting customer requirements.	
16	There is a number of statutory and safety things which need to be adhered to or delivered, the performance Of delivery Of which needs to be monitored alongside delivery for customers	Links to Customer

Many responses have made links to the customer through potential application of direct or indirect targets. There are still several links being made to activity type targets, reducing the potential for a holistic view of the supply chain, thus highlighting a change of mindset is potentially needed to view the supply chain as a system as indicated in the model.

6) Whilst responses were broad ranging, the majority of responses in the previous survey indicated that departmental performance targets have a very positive or mostly positive impact on the upstream or downstream supply chain - how do you think targets at departmental level can have a positive impact on the upstream or downstream supply chain?

This question explored the reasons for the views held about targets upstream or downstream of a supply chain function, gaining more information on the landscape of the mindsets towards targets. The results are presented in table 6.3, followed by thematic grouping of subject fields.

Table 6.3 - Results of Question 6 survey No2

No	Respondent Comment
1	Driving consistency and teamwork
2	I think they can, but they need to be constructed with the customer- and flow-orientation in mind. Most often, they are not.
3	"On the downstream side of the Supply Chain, targets are related to reduced cost to serve, reduced environmental impact (optimising routing), reduction in returns (by improving quality) and reducing lead time.
4	They can influence decisions being made and where focus / resources is required.
5	This will be more visible to the supply chain partners and ensuring the targets are met will reduce disruption in the supply chain
6	Customer (internal or external) targets feed into the customer side of the supply chain and should, therefore, facilitate clearer focus upstream. I am not convinced that this is the case with downstream. Cost targets do clearly impact on that side.
7	Knowing what your customer expects in terms of performance and how well it is going should be a key focus for any upstream supplier, and knowing how an upstream supplier is performing will be of central interest to a downstream customer
8	It defiantly is, at both for upstream and downstream targets help to provide a focused approach for efforts by all parties involved.
9	If targets are fully transparent, and all departments understand each other's roles, then you are able to use them in having clear conversations on performance. for example, inbound trailer arrival times don't meet the expectations of a warehouse which leads to delays in put away. by having transparency, you can prove and identify where the issue lies, therefore getting a better working relationship.
10	I think targets at departmental level can have a positive impact on the upstream or downstream supply chain if align with creating value for customers.
11	The key is for an organisation to align objectives/targets and measurement to ensure there is alignment for stakeholder impact. Robust/Smart

	(Specific, Measurable, Achievable, Realistic, Time bound) measures will reduce potential lag throughout the value chain, improving responsiveness and minimising "rework"
12	This will probably require that measures of upstream and downstream supply chain factors are included. If an internal departmental measure/target should be used and have an effect on upstream/downstream supply chain, it has to reflect those aspects.
13	Targets at departmental level can guide managers to deal collaboratively with suppliers and customers, either internal or external, to ensure better supply chain performance overall.
14	Do not understand the question
15	Targets at departmental level can contribute to a more integrated supply chain fostering improvements in terms of collaboration and efficiency.
16	Knowing what your customer expects in terms of performance and how well it is going should be a key focus for any upstream supplier, and knowing how an upstream supplier is performing will be of central interest to a downstream customer

From analysis of the results presented in table 6.3, the responses can be grouped into the thematic areas presented below:

People

- Driving teamwork
- By having transparency, you can prove and identify where the issue lies, therefore getting a better working relationship

Customer

- Driving consistency
- They need to be constructed with the customer in mind
- Customer (internal or external) targets feed into the customer side of the supply chain and should, therefore, facilitate clearer focus upstream

- Can have a positive impact on the upstream or downstream supply chain if align with creating value for customers

Decision Making

- They can influence decisions being made and where focus / resources is required.

Supply Chain visibility and integration

- This will be more visible to the supply chain
- Should facilitate clearer focus upstream
- Knowing what your customer expects in terms of performance and how well it is going should be a key focus for any upstream supplier
- knowing how an upstream supplier is performing will be of central interest to a downstream customer
- This will be more visible to the supply chain partners and ensuring the targets are met will reduce disruption in the supply chain
- Help to provide a focused approach for efforts by all parties involved
- This will probably require that measures of upstream and downstream supply chain factors are included
- If targets are fully transparent, and all departments understand each others roles, then you are able to use them in having clear conversations on performance
- The key is for an organisation to align objectives/targets and measurement to ensure there is alignment for stakeholder impact
- This will probably require that measures of upstream and downstream supply chain factors are included. If an internal departmental measure/target should be used and have an effect on upstream/downstream supply chain, it has to reflect those aspects
- Targets at departmental level can guide managers to deal collaboratively with suppliers and customers, either internal or external, to ensure better supply chain performance overall
- Targets at departmental level can contribute to a more integrated supply chain fostering improvements in terms of collaboration and efficiency

- Expectations in terms of performance

Process

- Driving consistency
- they need to be constructed with flow-orientation in mind
- Ensuring the targets are met will reduce disruption in the supply chain
- Robust/Smart measures will reduce potential lag throughout the value chain, improving responsiveness and minimising "rework"

The most common type of comment from the thematic grouping is the role targets can play for supply chain visibility and integration (see section 2.2.3). Whilst the comments generally highlight this positive notion, the literature argues that supply chain functions often do not look outside the function and are bound by a focus on departmental cost, creating functional boundaries (see section 2.2.2 and 3.4). If targets are to be used, transparency between functions (or stages in the supply chain) and a common understanding of impact (of targets) between functions would reduce functional barriers and silo working (see section 2.2.2), further highlighting the value of the IIA (Interdepartmental Impact Audit) and having a common purpose that is clear and understood.

The results of this question further support the verification of the model regarding the IIA and having purpose understood across the stakeholder groups (i.e., functions, departments).

7) Analysis of the comments from the previous survey highlighted that the 'type' of target and 'how' a target is set can impact performance within teams\departments and the wider supply chain. What type of target(s) do you believe can generate positive impacts within an organisation and the wider supply chain?

This question continues building from the previous questions relating to targets, with a specific focus on positive impacts. To analyse the results, 3 categories have been used which identify the response in relation to whether it would reflect activity/departmental only type targets (e.g., items picked per hour), or whether the response can be considered more holistic (i.e., thinking beyond the department/function). An additional column has been included for any specific customer related responses.

Key:

A – Activity based type target

H – Holistic related type target

C – Customer related type target

Table 6.4 - Results of Question 7 Survey No2

No	Respondent Comment	A	H	C
1	Targets that encourage end to end activities		X	
2	Customer satisfaction targets, and derivates of that which support improved customer service.			X
3	Probably activity level/ quality	X		
4	Focusing on things such as delivery, waste reductions, errors etc. Can highlight area's for potential improvement. Targets can influence behaviour amongst the department and wider teams.	X	X	
5	Time related and quality targets	X		
6	Targets that clearly link with wider supply chain performance - upstream and downstream - and		X	

	which clearly reflect higher level strategic priorities. The latter need to have a clear focus on the organisations various beneficiary groups or stakeholders.			
7	Targets should be designed to reflect what it is that the customer for that process needs or expects			X
8	Instead of types of targets, I think the process of target setting is more important. I would say that setting targets with team's participation is important so they are engaged in process and later more committed to it.	X	X	
9	Targets that do not contradict! I have worked in businesses where one department has a target for the number of complaints they raise against logistics, so it became proactive complaints rather than reactive from actual customer data.		X	
10	Maybe targets such as collaboration, resilience, work life balance, creating value for customer, problem solving, creativity and innovation, time, cost, customer satisfaction ...		X	
11	Cross functional engagement, SMART (as above) and aligned measures/targets through a Policy Deployment style approach can have a really positive impact on an organisation as this "should" align to the goals of the organisation, enabling a "siege mentality" and empowerment within the workforce to understand and achieve their part of the organisation which drives sustainability, profitability and growth.		X	
12	Targets that are fully aligned with the supply chains goals - particularly downstream goals.		X	
13	The targets need to be appropriate for any department's "mission" and hence modus operandi.	X	X	

	They need to be SMART but also applicable. For example, a finance department's targets, besides obvious numerical accuracy and completeness, might include timeliness of reporting and breakdown by department and sub-unit. However, their targets likely wouldn't include contributions to a non-financial marketing campaign or human resources strategy.			
14	Financial	X	X	
15	Targets related to the integration, collaboration, efficiency and innovation across the supply chain		X	
16	Targets should be designed to reflect what it is that the customer for that process needs or expects			X

The results for question 7 continue to highlight mixed views on the focus and use of targets. The question refers to an organisation and the wider supply chain, with the majority of responses considering the wider supply, however, as with previous questions, a number of responses reflect activity-based type targets which are more likely to be less holistic and less likely to consider the wider supply chain. Also as with previous questions, few responses mention the customer, which continues to suggest they are more inward looking.

The results of this question further support the verification of the model regarding the IIA and having purpose understood across the stakeholder groups (i.e., functions, departments).

Summary of target related questions

From the analysis of results relating to target setting, there remain mixed views as to the type of target and the focus of targets for organisation(s) within a supply chain. Responses highlighting activity type targets would likely reflect numeric based target setting at a functional level and be associated with the functional drivers highlighted in section 2.2.4 (for example, transportation and inventory movement metrics). However, many responses to a number of questions did highlight a more holistic

viewpoint for using targets, with reference made to supply chain integration (see section 2.2.3) and transparency, which links to the notion of viewing internal and external activities within a supply chain as a system (see section 2.3.6), although as highlighted in the literature, genuine systematic perspectives are rare.

Whilst the response to question 4 highlighted the majority of respondents selecting the customer as a focus of targets, the qualitative questions had minimal reference to the customer, suggesting more of an inward facing perspective (i.e., not viewing from the customers perspective).

As with survey No1, this section continues to highlight mixed views towards target setting, specifically regarding the type and focus of the target, but also the impact upon a supply chain. This outcome highlights further the value of the IIA (Interdepartmental Impact Audit) aspect of the model, a method unique in construction to the conceptual model for this study, and how it informs future decisions for measuring performance.

6.2.2 Factors for Change Interventions

8) A high majority of responses from the previous survey indicated the importance for organisational change to be driven by the senior leadership team. Are there any circumstances where you think it is less important for the senior leadership team to drive organisational change?

This question is not seeking consensus of agreement but was included to further explore a minority response from survey 1 Q8.

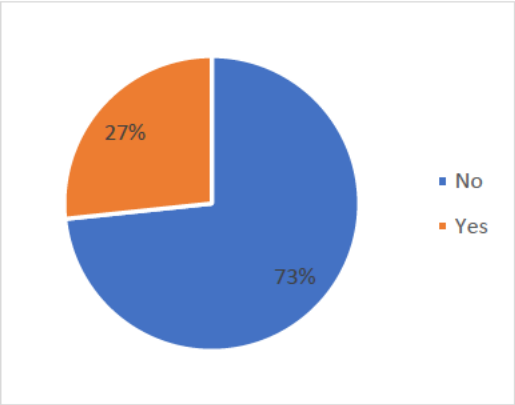


Figure 6.3 – Results of Q8 Survey No2

The results to Q8 in survey1 verified that senior leadership are an important factor for driving organisational change. The results from this question further support this notion, with the opportunity to add comments in Q9.

6.2.3 Model Stage 1 overview

9) Do you agree with the areas presented in the updated feasibility check (stage 1)? Please select one of the options below

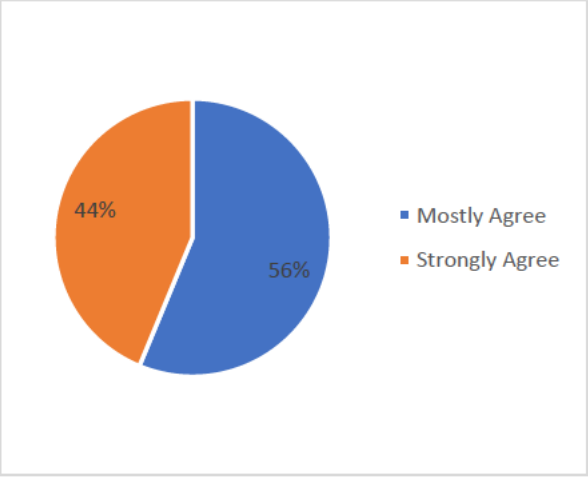


Figure 6.4 – Results of Q9 Survey No2

All respondents agree with the updated feasibility check, no respondents selected any of the disagree options, which is consensus and supports the verification of stage 1 of the model.

10) Do you have any further comments on the stage?

Table 6.5 presents comments and analysis of comments for stage 1 of the model, which can be considered for application of the model.

Table 6.5 – Response to question 10 Survey No2 (further comments on stage 1)

No	Respondent Comment	Comments/analysis
1	There may be instances where change is championed in one functional area, perhaps due to a risk averse culture at a senior level.	Whilst this would potentially create opportunity for improvement, it would lack a holistic /systems thinking mindset. The primary stages of stage 1 would identify the landscape.
2	1.1 kind of suggests that change should be customer driven. Most changes can surely be traced back to customer needs, changing markets etc., But I believe change can also be internally driven, and the customer perspective should be a test for whether it is viable to move on. Customers may, in the future, need something they are not aware of today. Such a change would not be customer driven, but in essence relate to the future customer needs and future competitiveness of the company.	Point understood and the terminology used in stage 1.1 could be refined for application. However, creating something for future customer needs can still be considered as customer driven, in essence, creating value through product or service evolution or new product/service design. This stage is ensuring the links and associated value to the customer are understood.
3	The stakeholder groups (or beneficiaries) need to be clearly defined and their aspirations/objectives understood.	This would be included within stages 1.3 – 1.5.

4	I think important to address barriers and risk at this stage, so good adjustment.	A comment that further supports verification of the stage
5	The updated version provides a more comprehensive outlook (forward and reflection) which will enable a more robust assessment of need.	A comment that further supports verification of the stage

The comments in table 6.5 highlights further points that support the verification of the model stage, whilst also offering points that can be considered during the application of the model.

6.2.4 Knowledge Generation

11) Do you think the updated model will help departments/elements of supply chains to understand the wider impact of targets?

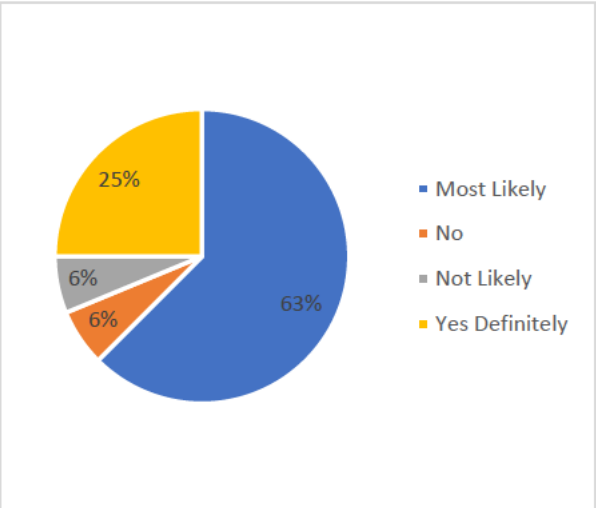


Figure 6.5 – Results of Q11 Survey No2

This question (see survey 2 in Appendix D) focuses on the updated IIA (Interdepartmental Impact Audit) element of the model (see fig 5.19, section 5.2.4). Whilst the original content of the IIA was supported in survey 1 through subject related questions (14 – 18), responses to other questions (3-7) gave opportunity to enhance the IIA and further understand the use of targets and associated impact on behaviour with a supply chain. The majority (over 80%) of respondents believe the updated model (IIA) will definitely or most likely help departments/elements of supply chains to understand the wider impact of targets, which is consensus and supports verification of the IIA at stage 2 of the model.

12) Do you think the updated model will help departments/elements of supply chains develop a greater understanding of the information needs between departments/elements of the supply chain?

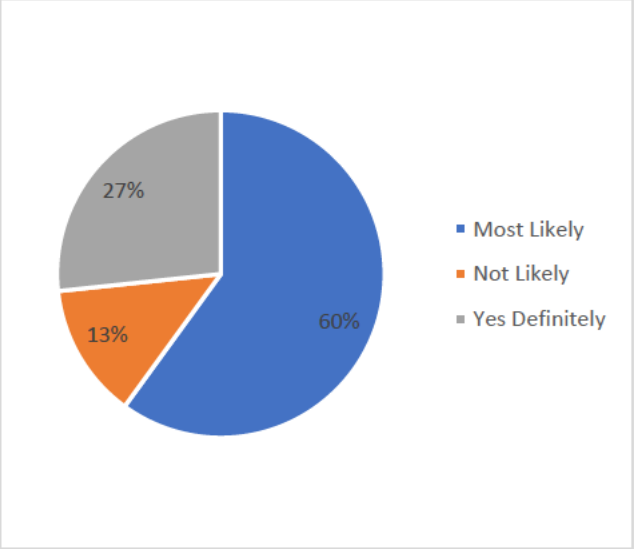


Figure 6.6 – Results of Q13 Survey No2

As per question 11, this question focuses on the updated IIA (Interdepartmental Impact Audit) element of the model (see fig 5.19, section 5.2.4). Whilst the original content of the IIA was supported in survey 1 through subject related questions (14 – 18), this question gave opportunity for further review of the updated model. A high majority of respondents (over 80%) considered the updated version of the model would most likely or definitely help departments/elements of supply chains develop a greater understanding of the information needs between departments/elements of

the supply chain, which is consensus and supports verification of the IIA at stage 2 of the model.

13) Please add any further comments you may have on the IIA

Table 6.6 presents further comments and analysis of comments for the IIA element of the model, which can be considered for application of the model.

Table 6.6 – Response to question 13 Survey No 2 (further comments on IIA)

No	Respondent Comment	Comments/analysis
1	Individual or simple functional targets can often conflict with the overall end to end objectives. The updated model will help avoid this.	A comment that supports verification of the content.
2	This is a rich model but its utility will depend on the various terms being clearly defined and contextualised. Every situation is different and there is a danger of a one size fits all approach.	Agreed regarding terms, this area would be very important in the practical application of the model and could be considered in further instructions for model application.
3	The "human" element in this always has risk, but this model will certainly allow a greater understanding of information required in supply chain environment which is part of the challenge in getting people on board	A comment that supports verification of the content.
4	Maybe assessing internal and external customer satisfaction	This could be a consideration when applying this element of the model in practice.

5	More comprehensive assessment to enable effective reflection and ultimately decision making	A comment that supports verification of the content - this response was compared with responses to previous questions, where the respondent selected very positive answers towards the model. Therefore, the context of the comment is considered positive.
6	The targets and model appear ethnocentric and do not appear to consider upstream/downstream partner needs.	This is a strange response as the IIA specifically investigates the upstream and downstream.
7	It all feels very over engineered to me	A point of view, but the only one of this nature.
8	Individual or simple functional targets can often conflict with the overall end to end objectives. The updated model will help avoid this.	A comment that supports verification of the content.

Table 6.6 presents a number of comments that further support the verification of the model, in conjunction with potential areas of consideration for application of the model.

6.2.5 Remaining Stages

14) What is your view of the expanded operational measurement criteria presented in 2.41?

This question seeks views on the updated measurement stage of the model (2.41) and the associated annex (see fig 5.22, section 5.2.4).

Table 6.7 – Responses to question 14 Survey No2

No	Respondent Comment	Comments/analysis
1	Far more likely to deliver a holistic result.	A comment which supports verification of the stage.
2	At first glance, they appear straight forward and easy to grasp, but thinking about the next step - implementation - there is a need to further define i.e. "true value demand", system boundaries. Those are cease dependent. Is there a need for an item for this here, or elsewhere?	Teaching\verifying the definitions such as 'true value demand' would be the role of the practitioner. This would happen prior implementation and could be included in instructions for application.
3	I think that the extra steps on the expanded operational measurement criteria provides better control of the operations	A comment which supports verification of the stage.
4	Much clearer and provides a path for the user of the model to follow. Set's a template / standard that can be used making it more practical.	A comment which supports verification of the stage.
5	they are sound and appropriate	A comment which supports verification of the stage.

6	It looks robust but I am unsure what some of the key words and phrases actually mean in the context of my organisation.	A comment which supports verification of the stage. The definitions in the context of the model were explicit int the surveys, however, teaching\verifying the definitions would be the role of the practitioner. This would happen prior implementation.
7	Much more holistic and grounded	A comment which supports verification of the stage.
8	It covers all major aspects.	A comment which supports verification of the stage.
9	I appreciate the further push to go in depth into evaluation. not leaving it up to interpretation	A comment which supports verification of the stage.
10	They are ok. you may add relevance, usability and refinement	A comment which supports verification of the stage. However, the additions suggested are not clear.
11	Concise definition. Being able to take a further step through the "what/where/when/how" is important to more consistently assess and ultimately apply across a range of personnel and abilities.	A comment which supports verification of the stage.
12	Sounds reasonable.	A comment which supports verification of the stage.
13	All a bit woolly as they say in UK. I.e., lots of motherhood statement regarding measurement, but less concrete elements that can be put into practice to measure and act upon. I.e. what is important to customers, internal and external,	This links to the notion of purpose, and measures to be derived from purpose.

	and how is that manifested in measures developed to track operations.	
14	Yes stating the obvious	A comment which supports verification of the stage.
15	It may contribute for the effectiveness of the performance measurement	A comment which supports verification of the stage.

Reviewing the results to question 14 highlights most comments support the verification of the model, only 1 comment from 15 was less supportive (see comments No13). The results from this table significantly support verification of this element of the model.

15) Do you think the stages in stage 3 are clearly presented in the updated model?

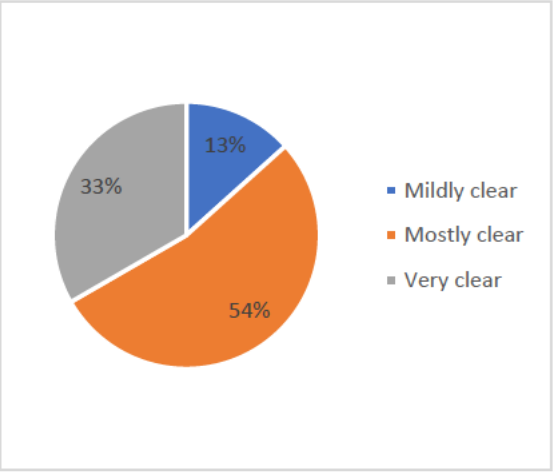


Figure 6.7 – Results of Q15 Survey No2

Whilst the themes in stage 3 were generally verified in survey 1, enhancements were made regarding links to strategy. The results highlight that the majority of respondents (over 80 %) believe the stages in stage 3 are either mostly or very clear, and therefore consensus. This supports the verification of stage 3.

16) Please add any further comments you want to make on stage 3.

This question gave opportunity for further feedback on stage 3, presented in table 6.8.

Table 6.8 – Responses to question 16 Survey No2

No	Respondent Comment	Comments/analysis
1	I really like the new 3.0. Another cultural aspect could be that of "change readiness". Without a culture that embraces change, the results wight stay with a very prominent analysis. Or is that included/understood in the systems thinking mindset?	A comment which supports the verification of stage 3. The shift in thinking (to a ST mindset) and the knowledge generation stage(s) of the model will highlight the 'change readiness.
2	Much clearer, IIA can be confusing if not aware of this concept and the new stage 3 design sets out meanings behind and steps to take	A comment which supports the verification of stage 3.
3	It looks logical but the overall clarity and utility would appear to be predicated on defining the various key words and phrases clearly.	Definitive guidance would be through application with a practitioner knowledgeable of the model and concepts.
4	From a clarity perspective, added reflection within 3.1 enables the "user" to assess more affectively, whilst also drawing out and signposting strategy and leadership within 3.0, provide a better structure and clarity.	A comment which supports the verification of stage 3.
5	Again, a bit woolly with little definitive guidance for the model	The same response No 13 for Q14. This is a high-level model, definitive

		guidance would be through application with a practitioner knowledgeable of the model and concepts.

Only 5 comments, 3 which support further verification of the model stage, 2 which are relevant to the application of the model as per the analysis comments to comment No 3 &5.

17) Please indicate below the clarity of stage 4 and 5.

1-Very clear ---------- 5- Not clear at all

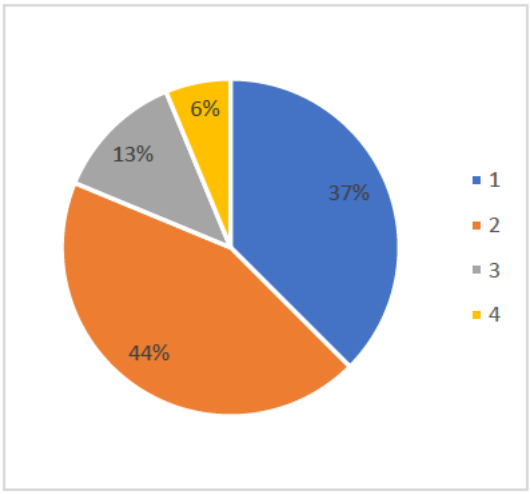


Figure 6.8 – Results of Q17 Survey No2

This question seeks views on the clarity of the final 2 stages after enhancements from the feedback from survey 1.

The question used a Likert scale to capture the participants view, the majority of respondents (over 80%) score either 1 or 2, which indicates that they believe the clarity of stages 4 and 5 is clear, which is consensus and adds to the verification of the stages. One respondent scored 4, which suggests a view of not being very clear, however this is likely an error when interpreting the scale as comments presented from the respondent in Q19 are positive and would suggest a score of 1 or 2.

18) Please indicate below how logical you think stages 4 and 5 are.

1-Very logical ---------- 5- Not logical at all

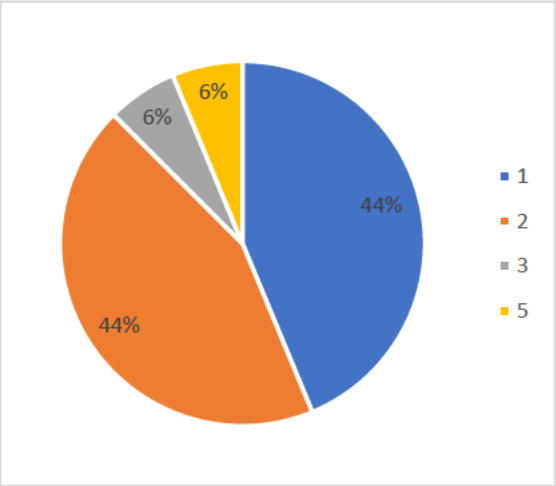


Figure 6.9 – Results of Q18 Survey No2

This question seeks views on how logical the final 2 stages are after enhancements from the feedback from survey 1.

The question used a Likert scale to capture the participants view, the majority of respondents (over 80%) score either 1 or 2, which indicates that they believe stages 4 and 5 are logical, which is consensus and adds to the verification of the stages. One respondent scored 5, which suggests a view of not being very logical, however, as with the previous question this is likely an error when interpreting the scale as comments presented from the respondent (same as in previous question) in Q19 are positive and would suggest a score of 1 or 2.

19) If you scored 3,4 or 5 on either or both of the previous 2 questions please indicate why.

This question was used to further consider any points useful during implementation of the model. Results are highlighted in table

Table 6.9 – Responses to question 19 Survey No2

No	Respondent Comment	Comments/analysis
1	The widespread communication of results, celebrating successes and rectifying issues must be a fundamental part of securing buy in.	This response is not related to the question being asked. However, the points made for securing 'buy in' are acknowledged. This respondent scored 2 for Q17 and Q18.
2	I did not, but score 2 on Q17 indicates that I don't understand the double-arrow between 5.0 and 5.1	The arrow is purely a signpost to indicate that 5.0 and 5.1 can potentially be undertaken concurrently. This point is noted, and consideration can be given for model implementation.
3	Follows a logical step, establish a new process / step / measurement and then test it to review. Only thing I would add is the plan for a wider roll out could be argued to be better placed once the concept has been fully operationalised and proven	Positive first comment which supports the verification of the stages. This respondent scored 4 for Q17 and 5 for Q18, which does not reflect the respondents first comment, it is therefore likely the respondent has mixed up the scale and scores are more likely to be 2 for Q17 and 1 for Q18.
4	The flow of process seems very logical and building upon the former steps with in each stage.	Positive comments which support the verification of the stages. This respondent scored 1 in the previous two questions.
5	The backward loop from 4.1 to 4.0 is not self-explanatory.	This step reflects the score of 3 given for Q17 from this respondent. The loop back from 4.1 – 4.0 indicates that upon piloting new designs, any adjustments made after review would need to be re-piloted to ensure the adjustments work as desired.

6	Again, lack of detail-driven objectives. Also, from an epistemological perspective why not ask "why" for any scores of 1 and 2?	A score of 3 for Q17 and Q18 from this respondent. It is not clear what is meant by ‘detail driven objectives’ at this stage of the model. From an academic perspective a noted point made about asking ‘why’ for scores of 1 or 2, for which the answer is that scores of 1 or 2 are considered as agreement (or a consensus), hence the focus on understand any disagreement with the stages. However, this is irrelevant to answering Q19.

Only 3 respondents scored anything other than 1 or 2 for Q17 and Q18, however, as noted in the analysis of Q17 and Q18 it seems likely that 1 respondent mixed up the scale. There are a total of 6 comments in table 6.9, some comments add to the verification of the stages, whilst some highlight a slight lack of clarity with the use of arrows within the model. These points are noted and consideration would need to be given upon implementation of the model in practice.

In addition to the survey questions, the opportunity was given for panel members to add any general comments about the model. These are presented in table 6.10 below.

Table 6.10 – General comments on the enhanced model (Model Version 2)

No	Respondent Comment	Comments/analysis
1	The model is more comprehensive and less "siloed" than the previous model, with a higher probability of delivering business wide success	A positive comment which adds contributes towards general verification of the model.
	Good luck, this will be really interesting!	A positive comment which adds contributes towards general verification of the model.
3	The new model shows an improvement - will definitely improve companies operations/ supply chains	A positive comment which adds contributes towards general verification of the model.
4	This looks really valuable from a supply chain process improvement perspective. It could be very useful provided that supply chain professionals understand: how it fits into an overall strategic improvement plan; what some of the language used really means; and, how different internal stakeholders are involved in the process. Any framework which facilitates more logical and systematic approaches to supply chain improvement is to be welcomed.	A positive comment which contributes towards general verification of the model. The points about fitting into a strategic plan and stakeholders are core to the model as highlighted in stages 1-3 of the model. As highlighted in the analysis of previous sections, the language used within the model would be defined with stakeholders in the primary stages of implementation.

5	Good luck with your PhD project!	Thank you !
6	Simon, i believe the updated model to be a very considered approach which could be used across a range of organisations and disciplines. Whilst business is varied and diverse, it is important to provide sufficient structure to support the self reflection process (enabling organisational maturity and continuous improvement) Organisations must continue (even more so in the current climate) to evaluate, drive (or die) and therefore key methodologies which enable the "challenging of the norm" are key to a business achieving its potential. Thank you for inviting me to support this, i have found this very intuitive and will seek to assess how we can influence our own business approach.	A positive comment which adds contributes towards general verification of the model.

Table 6.10 highlights 6 general comments, which are complimentary, with some adding further verification to the whole model.

6.3 Overview and Conclusions

As highlighted in section 5.4, analysis of survey 1 (Delphi round 1) indicated a high level of verification for the conceptual model. This chapter has presented the results of survey 2 (Delphi round 2), which is the second stage of the model verification process. The survey gave opportunity to further explore certain themes and seek views and levels of consensus on the model enhancements (presented in model No2). Table 6.11 presents the further verification of the model from the analysis of results of the questions in survey 2, the table highlights the related quantitative questions and consensus levels, and where the qualitative question comments support verification of the model stages.

Table 6.11- Overview of additional verification (of the model) from survey 2

Model Stage	Links to Question No	Subject Area of Model	Qualitative	Quantitative
Stage 1	Q6 & 7	Links to updated stakeholder groups	Comments supporting verification of understanding stakeholder groups	
	Q9	Agreement with areas within stage 1		Consensus
	Q10	Feasibility – stage 1	Further comments to support verification of stage 1	
Stage 2	Q 11	Updated IIA understanding impact of targets		Consensus
	Q12	Updated IIA information needs		Consensus
	Q13	Updated IIA general comments	Comments to further support the verification	
	Q14	Updated operational measurement criteria	Majority of comments support the verification of the updated stage	
Stage 3	Q15	Updated stage 3 is clear		Consensus
	Q16	Themes of stage 3	Comments to further support the verification of the stage content	
Stage 4	Q17	Clarity of stage		Consensus
	Q18	Stages are logical		Consensus
Stage 5	Q17	Clarity of stage		Consensus
	Q18	Stages are logical		Consensus

Table 6.11 highlights consensus in the quantitative questions presented, in conjunction with a high level of supporting comments from the range of qualitative questions. In addition, the results and analysis of questions 3-7 further highlight the

mixed views towards the type and usage of targets, which also contributes to the model verification, specifically the need for the IIA (Interdepartmental Impact Audit) to understand the impacts of targets across functions, with links to having a common purpose. As discussed throughout this study, the development of the IIA from the literature (discussed in section 2.3.4) is one of the unique features of the model, which contributes to the body of knowledge in the supply chain field of study.

The combined results from survey 1 and survey 2, and the overviews of verification presented in tables 5.8 and 6.11 highlight a very high level of agreement with the model content and approach, in this sense, the level of model verification can be considered as very high and using the Delphi approach with 2 rounds has been successful. It is accepted that a few of the qualitative comments still offer the opportunity to enhance the model further, however, most points can be considered during application of the model (as highlighted in the analysis tables), future work could entail the devising of a manual for implementation (see section 8.4.1).

Through application and analysis of the Delphi study rounds 1 and 2, Research Objective 3 has been achieved.

- Through empirical research with experts', verify the developed conceptual model

From this evaluation the model was deemed ready for the next stage of research, which was the validation stage as discussed in section 4.6.3. Chapter 7 presents the model validation.

Chapter 7 Model Validation

7.1 Introduction

Chapters 5 and 6 demonstrate a high level of verification of the model, which gave a high confidence level that it is constructed in a considered and robust manner and could theoretically achieve the desired purpose if applied to an organisation. Whilst the results were very positive, an opportunity was sought to further test the model and validate the concepts. As discussed in section 4.1, the term model validation is used to identify whether the model can be applied in practice, in essence, moving from concept stage to actual application (does it work if applied to an organisation?). The research strategy adopted to validate the model was case study (see section 4.5.1), which enabled testing of elements/themes of the model within a live organisation using data collection methods discussed in section 4.6.3.

This chapter includes information about the case organisation, including selection criterion and relevant background information to the study. This is followed by validation criterion, which presents a structured approach for model validation. This is then followed by presentation of the model stages applied to the organisation and the concluding levels of validation.

7.2 Organisation Criterion

As discussed in section 2.9, there are several practicalities and challenges associated with implementing a model for improving business performance over a whole supply chain that could include several external organisations. In particular for this study was the limitation of time, with this in mind more manageable application would be within a larger vertically integrated organisation (Johnston et al, 2011). A criterion was devised to reflect the preferred specification of the organisation to act as a case organisation. In addition, it was deemed important to find an organisation that could enable future comparative studies to be undertaken within the same context. Developing such a criterion reflects a comparative case strategy (Ghauri et al, 2020); the criterion for the case organisation was developed by the author as follows:

Sector – There was flexibility on the sector type, as the model application would be the same whether the organisation was concerned with moving finished goods or raw materials. The main criterion being that the organisation forms part of a supply chain.

Size – Ideally a larger organisation that vertically integrates several supply chain activities (e.g., storage, distribution, purchasing), this would potentially offer more areas to investigate as most likely more departments, more people, more complexity. In addition, a more complex organisation has better opportunity to correspond to a theoretical framework (Ghauri et al, 2020), i.e., the conceptual model.

Location – For logistical purposes a UK location was preferred, but the location could be one of many if an opportunity presented itself in a large organisation

Maturity – It could be argued that a well-established organisation could have more experience of business improvement projects, with larger organisations also having experience of more complex issues (Ghauri et al, 2020). Therefore, an established organisation was deemed beneficial.

Level of Vertical Integration – As discussed in section 2.9, an organisation that has a high level of vertical integration would provide more manageable opportunity for application of the mode across different supply chain functions.

7.2.1 Case Organisation

After searches and numerous enquiries undertaken, an opportunity became available to work with a global supply chain management company. Whilst the company will remain anonymous within the study, the specification of the company can be presented using the criterion presented in section 7.2.

Sector –The organisation works across 6 different sectors, from Aerospace to Pharmaceutical, undertaking comprehensive third-party and fourth-party logistics management of customers supply chains. The sector of the case organisation for this study is Aerospace, specifically providing products and supply chain services for new build and aftermarket (e.g., servicing) projects/products.

Size – The case organisation is part of a global company, with 10 major locations across Europe, America(s) and Asia. The company has recently merged, it acquires products from over 7000 suppliers and has over 8000 customers. The UK site (case organisation) has circa 600 staff and operates across 2 locations.

Location – The location of the case organisation is the UK, with sister and parent sites across Europe, Asia and America(s).

Maturity – The UK division of the company has been established for over 70 years, other locations date back further, circa 100 years. In this regard the case organisation can be considered a mature company.

Level of Vertical Integration – High level of vertical integration regarding component purchasing and supply, storage and distribution of goods to the customers.

As detailed above, the specific case organisation is the UK division and employs approximately 600 people. The criterion of the case organisation for validation of the model was met and the opportunity to undertake the research within a company of this size and stature was considered very positive for the study.

7.3 Validation Criterion

One of the key factors influencing the validation of the model was time available with the case organisation. To fully validate the complete model many weeks/months would be required, especially if measures such as productivity or impact on the customer were to be measured. Such constraints meant a systematic approach was taken to maximise the time with the organisation and enable specific elements of the model to be tested. The following sequence of events devised by the author were followed to maximise the opportunity with the case organisation:

Stage 1 - Identify most suitable (see section 7.3.1) aspects of the model to test

Stage 2 - Generate a semi structured set of questions/criteria for model application

Stage 3 - Visit organisation, obtain overview and structure of the business

Stage 4 – Apply aspects of model, analyse data from application and identify validation aspects

Stage 5 - Identify future validation options and or opportunities

7.3.1 Stage 1 - Identify most suitable aspects of the model to test

As discussed in section 7.3, a finite amount of time was available to spend with the case organisation. With this knowledge and the time limitations of undertaking the PhD study, key areas of the model were chosen, mainly focused on the knowledge generation areas of the model (see fig 5.31), which includes novelty areas such as the IIA (Interdepartmental Impact Audit). This represents partial validation of the conceptual model as discussed in section 7.4.

As discussed throughout this study, one of the main unique features of the model is the evolution of the systems thinking theory discussed in section 2.3.4, in particular the use of targets as a performance measure and how they impact the internal/external supply chain. The development of the IIA (Interdepartmental Impact Audit) discussed and presented in sections 3.4 and 5.5 demonstrated the evolvement of the literature for specific application within a supply chain context, which obtained a high level of verification through the Delphi study (presented in chapters 5&6). Testing this element of the model would validate its inclusion within the model and the rationale for evolvement of the related literature (main aspects presented in sections 2.3.4 and 2.2.3). Another significant aspect of the model is the changing of mindset (to a systems thinking mindset), having a common understanding of purpose (see sections 2.3.4 and 3.4) and the associated strategic leadership (discussed in section 3.5).

Testing these elements of the model enabled the deduction of a level of validation, which included whether the stages generate sufficient related knowledge to implement further stages of the model, the specific model areas are presented in table 7.1 (in section 7.3.2).

7.3.2 Stage 2 - Generate a semi structured set of questions/criteria for model application

As discussed in section 7.3.1, the focus of the model application would be in the generating knowledge stage of the model (mainly stage 2). Table 7.1 illustrates the

areas of the model tested, with rationale and comments for the questions used, the full model and annexes are presented in section 5.2.7 and in Appendix B.

As the model has already been tested for verification (see chapters 5 & 6), the questions for validation were developed in line with the model stages/elements and themes, it was not therefore necessary to pre-test the questions from a subject perspective. However, the chosen areas of focus were presented for evaluation and commentary to the case organisation senior management prior to application to the case organisation, this enabled testing for ambiguity or other concerns, no points were raised.

The research was conducted with staff from each main department (discussed in section 7.3.4) of the organisation. As highlighted in chapter 4, to reduce the risk of bias of the participants the model was only presented at the time of the interviews, therefore reducing the possibility of preformed perceptions. In addition, interviews were conducted with respondents on a departmental basis, negating risk of any unintentional bias through noise or influence of other participants.

Table 7.1 below presents the areas of the model applied to the case organisation, including the initial questions designed to generate information. The table is presented with the following column headings:

Questioning Subject Area – Initial question to seek information and start discussion, this would be the same for each department for consistency.

Model Stage/Area being validated – Specific aspect of the model application.

Rationale for validation area/Comments – Narrative of line of enquiry.

Table 7.1 - Areas of the model and initial questions for application of the model

Questioning Subject Area	**Model Stage/Area being validated**	**Rationale for validation area/Comments**
What is the purpose of using your organisation/service/dept from the customers perspective?	Stage 2.0 and 2.2 IIA Perception of organisational purpose.	These areas of questioning seek to enquire about the position of the company in relation to the Interdepartmental Impact Audit element of the model, specifically to acquire knowledge for understanding the use of targets, known targets and potential associated behaviours. In addition, the enquiry will help establish the position regarding known organisational purpose. This knowledge generation is key to the application of the Interdepartmental Impact element of the model. The questions will help establish the current position of the company.
Do you have departmental KPI's/Targets?	Stage 2.2 IIA Focus of targets.	
Are you familiar with targets across departments/wider supply chain	Stage 2.2 IIA Focus of targets.	
Are there individual/team targets/kpi's?	Stage 2.2 IIA Focus of targets.	
What is the focus of dept/team/individual targets?	Stage 2.2 IIA Focus of targets.	
What happens if Targets/KPI's are not achieved?	Stage 2.2 IIA Behaviours/ decisions Driven by targets.	
Can you identify any behaviours associated with the targets?	Stage 2.2 IIA Behaviour associated with targets.	
Are you aware of the information needs either side of the dept?	Stage 2.2 IIA Information needs.	These areas of questioning seek to enquire about the position of the company in relation to the

Would it be beneficial to understand more (have more information) about the wider supply chain?	Stage 2.2 IIA Information needs.	Interdepartmental Impact Audit element of the model, specifically to acquire knowledge for understanding departmental information needs and whether the needs are met.
Do you always have the information you need from other depts to work efficiently?	Stage 2.2 IIA Information needs.	
Do you think it would be beneficial to undertake a more detailed investigation of these areas (targets and information) across your organisation?	Specific to investigating the areas of the IIA to validate value of applying this aspect of the model further.	A general question to seek further validation of the IIA
How do you measure operational performance of the dept /team/individual?	Stage 2.41 operational performance measurement.	Questions to generate knowledge about the types of performance measure, for example activity v flow and whether the accuracy of the measurement methods employed are known. This enquiry will help establish whether there is opportunity to improve accuracy of measurement methods.
Do you have a method of testing the accuracy of the measurement methods?	Stage 2.41 operational performance measurement.	
Is there a known organisational strategy for business improvement?	Stage 2.1 and 3.0/3.1 Understanding and informing business	These questions were designed to understand how well current business improvement strategies and methods are known within the organisation and whether this includes departments

	improvement strategy.	working outside of their own area - holistic thinking. Whilst they directly help establish stage 2.1 of the model, they also can provide valuable information to help inform stage 3.0 and 3.1- the development of strategy.
Is it clear how depts/teams feed into improvement strategies?	Stage 2.1 and 3.0/3.1 Understanding and informing business improvement strategy.	
What is the current approach to improving processes/operations?	Stage 2.1 Methods of informing business improvement strategy.	
Does the approach encourage/include working across depts – is it holistic?	Stage 2.0 and 2.1 - To understand general level of holistic thinking when implementing business improvement interventions.	
Is it easy for people to be involved in process improvements?	Stage 1.5 and 2.43 To give basic perceptions of potential barriers and influences on the system.	Although a brief line of questioning, these 2 questions are included to generate some information regarding known barriers and/or influences on the system that could inhibit making changes.

Are there any factors that inhibit making changes	Stage 1.5 and 2.43 To give basic perceptions of potential barriers and influences on the system.	
What would a holistic approach to improving operations culture look like?	Core Systems Thinking principle of the model.	A general theme to support the Systems Thinking concepts within the model.
Would further application of the model be useful?		A general question to help establish potential value of the model.

7.3.3 Stage 3 - Visit organisation, obtain overview and structure of the business, apply model

Business Structure

Prior to testing the model, a context learning exercise was undertaken, this included presentations from the senior management team and time spent in the main area of physical operations (movement of goods). The high-level structure and context are highlighted in section 7.2.1, with the model application taking place at the UK main site.

The information provided highlighted that the main UK site was structured around four main areas of business focus, as illustrated in figure 7.1.

Figure 7.1 - Case organisation departmental structure

Customer Solutions - This was the customer facing department of the business, including developing propositions and managing day to day issues/opportunities. In essence, this department manages the customer journey and customer experience. As this is the customer facing part of the business, the department must interact with all the other departments to communicate customer requirements and manage the customer experience.

Warehousing - This was the main area of operations for storing and moving goods. The warehouse stores thousands of stock keeping units (sku's), ranging from low value nuts and bolts to high value production sub-assemblies. The high-level operational flow is illustrated in Figure7.2 below.

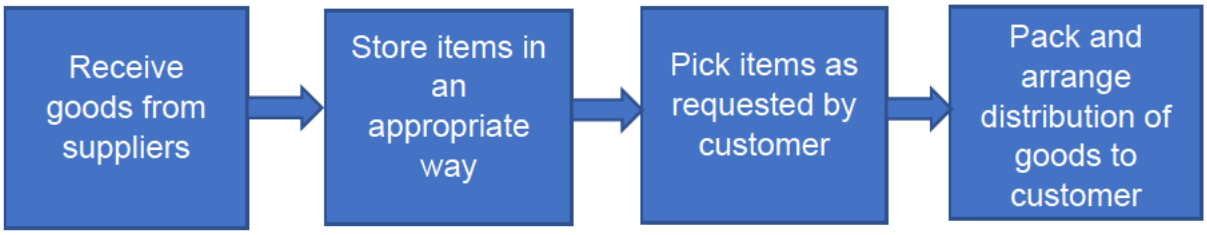


Figure 7.2 – High - level flow of case organisation warehouse operations

Whilst this is the main operational element of the business, it fully relies on the other departments for external communications and relationships, for example, supplier or customer communication and information.

Supply Chain - The focus of this department is supplier relationships (in conjunction with the global procurement team) and maintaining the supply of items (or SKU's) that are stored and distributed from the warehouse to the customer. The warehouse is reliant on this department for maintaining the supplier relationships and any associated communications that may be required. The organisation uses an MRP (materials resource planning) system to help maintain the orderbook management and communicate inventory status across the departments.

Quality - The quality department works across all departments, with many primary activities within the warehouse. Such primary activities are focused on assurance that the customer receives the correct items with no defects.

To summarise, the case organisation has 4 distinctive departments for managing the supply chain of goods and materials to a major global customer. The organisation is part of a global supply chain company, and therefore has significant links regarding high-level strategy development and deployment, together with links to global resources such as the procurement function. Through initial discussions and presentations regarding structure (some prior to the visit), the identification of the 4 distinctive areas of the UK organisation enabled the strategy for model application to be developed and the question development as presented in table 7.1.

7.3.4 Stage 4 – Apply model, analyse data from application and identify validation aspects

The application of the model took place with the senior manager(s) of each department. Each department were asked the same set of questions as outlined in table 7.1, with each question acting as a trigger for discussion around the topic area and investigation of each stage of the model in relation to the question.

Table 7.2 presents the model application and analysis, through highlighting the responses to the subject areas of enquiry, which is presented using the following columns:

Model stage /element of validation - The related area of the model being tested

Model Subject Area and related questions – This is the subject area of the model and the related questions from table 7.1.

Departmental Perceptions – This is the department managements perception in relation to the questioning and enquiry. For example, perceptions on the behavioural impacts of targets. The text reflects to the response of the related question and any further discussion. This includes any observations noted through the discussion of the topic area, for example, additional points made that link to the topic area.

Analysis and Model Validation – Brief analysis of the responses linking to how the implementation of the model stage supports the model validation. The validation is highlighted in grey.

Table 7.2 below presents the model application, analysis and validation, this is followed by discussion of the areas tested. The rationale for the themes tested within the model is presented in section 7.3.1.

Table 7.2 - Model application, analysis and validation

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.0 and 2.2 IIA Perception of organisational purpose.	**Organisational purpose**: Related question - *What is the purpose of using your organisation/service/dept from the customers perspective?*	Getting parts to customer that are fit for use and on time. Having Cost effective processes – a good deal for the service delivered.	This line of enquiry sought to understand how consistent the perception of organisational purpose (from the customers perspective) is across the departments/functions. Whilst there were concise departmental level answers, and similarities in the answers, the application of this element of the model has highlighted a potential lack of known organisational level purpose across the departments. An observation during the discussion highlighted lack of knowledge of a known organisational mission statement. Identification of these points Validates the investigation of 'purpose' aspect of the Interdepartmental Impact Audit (stage 2.2) and stage 2.0 of the model. Further investigation in this area aligned to the model could help develop an understanding of organisational level purpose from the customers perspective.
		To give efficiencies (in the management of supply chain) that the customer cannot get form managing the service themselves.	
		Sustainable performance of suppliers. To be a service provider for aerospace parts.	
		Streamlining the forecasting and management of delivery and cost of product - giving added value (to the customer).	

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.2 IIA Focus of targets.	**How are targets used:** Related questions – Do you have departmental KPI's/Targets? Are there individual/team targets/kpi's? What is the focus of dept/team/individual targets?	**Dept** – Ontime in full delivery, monthly weekly, daily. **Teams** – Number of lines picked per hour, number of faulty pics. **Individual** - number of lines picked per hour, number of faulty pics, attendance. Observations: There is a Zero defect target for incorrectly picked items.	Applying this aspect of the model enabled an understanding of the focus of targets being used across the organisation, which proved to be a good first step before investigating further into the impact of the targets. Many activity-based targets, some set with knowledge that they can be achieved quite easily, for example the 90% figure. There are minimal qualitative targets. Some targets appeared to be arbitrary, including targets stretching into the wider supply chain (for example, reduction of stoppages on customer sites due to failing to supply part). The impact of this type of target is likely to cascade through the organisation, therefore understanding interdepartmental targets and how they contribute this type of external target (customer driven) is valuable.
		Dept - Reduce build stoppages by 50% (engine builds in customers factory due to parts not supplied by the case company). **Team** – Related to on time in full delivery (otif). **Individual** - rolls up into team targets, e.g., how many checks are done over time for accuracy of bin contents. Observations:	With reference to above, and the identification of target focus from individual to departmental level supports the validation of the Interdepartmental Impact Audit stage (stage 2.2) of the model.

		In general, a mix of activity based and broader targets. Some targets are arbitrary (i.e., set based on minimal information) – e.g., the 50% target.	
		Dept – On time supplier delivery performance **Managers** – 90% On time supplier delivery performance **Engineers** – 90% of actions closed out on time. Observations: 90% figure is in place because deemed achievable!	
		Dept – Operational KPI's against WIP, backlog. Turnaround time. Targets very quantitative and include: Defects to customers Defects from suppliers, defects created internally. **Team** – Length of time to do things, activity based, project kpi's e.g., achievement of project milestones Individual – include activity based, e.g., audits per hour.	

		Observations: Dept targets very quantitative, targets can be impacted by other depts and external supply chain.	

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.2 IIA Understanding the focus of targets across wider supply chain.	**Familiarisation with targets across internal and wider supply chain** Related Question - Are you familiar with targets across departments/wider supply chain?	Targets not known, any errors are reported back to supply chain team and left with them (to resolve). An example is faulty parts from a supplier.	This aspect of the model is to seek information as part of the IIA to find out how much each stage of the internal (or external) supply chain understands about the performance targets of other stages (or depts). The research undertaken has highlighted a general lack of knowledge/understanding of targets being used outside of the functional areas or depts. This gives the perception that alignment between depts on what is considered good performance is potentially unknown, or at least not fully clear. If an organisation is to have fully aligned performance measurement (or targets) it could be argued they must first understand the current position in terms of what is known. This highlights the importance of this stage if the model within the IIA (stage 2.2).
		Only from work directly associated with but not seen actual targets (of other depts/wider supply chain)	
		Only familiar with the targets that link directly to the dept within the organisation, however wider targets are given to suppliers to meet.	
		Targets not known of other depts, more focused on functional targets. Observations: Noted that different departmental targets can cause clashes, e.g., if procurement buy poor quality products, it can impact targets in other areas if there is a product failure (e.g., not in spec).	

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.2 IIA Behaviours/decisions Driven by targets.	Consequence if targets not achieved. Related Question – What happens if Targets/KPI's are not achieved?	Dept level – investigate, use tools such as root cause analysis to establish problem Individual - put on performance improvement plan, look at training, are other roles more suitable. If incorrect part picked, zero tolerance and disciplinary action if proved the fault of the picker. Observations: Noted that some people are faster pickers than others. Try to understand why not met – has something else taken priority. Investigate why, if an individual target not being met it could lead to a PDR discussion and performance token not given.	This line of enquiry was undertaken to help understand potential drivers of behaviours in relation to targets, and how targets can impact decision making if not met. Applying this area of the model did identify the decision-making process, including indirect loss of reward through the PDR process and disciplinary action if related to inaccurate picking of goods. It also highlighted decisions and approach to working towards targets irrespective of resource, i.e., team targets remain the same when there are lower levels of human resource. Understanding this position enables future areas of research within the case organisation to understand further the impact of such decisions, for example, impact on quality, employee motivation, links to associated behaviours. Identifying the areas through applying this element of the model further proves the model works in practice and further validates the application of the IIA (stage 2.2)

		Any that impact the customer can be escalated up the hierarchy – can incur penalties. Observations: There are operational costs to rework. In this area team and dept targets remain the same even if resource is lower. E.g., same quantitative targets irrespective of human resource numbers.	**Further notes from analysis:** A common theme is that the first stage is to understand why a target is not met. Performance tokens as part of the company PDR process are indirect reward for achieving targets. In essence, tokens have a financial value related to pay – the more PDR tokens you have the better the rate of pay. In brief, no token awarded means the person remains lower than could be on the PDR scale and no uplift in pay. Further research, if targets not met, but no fault of the individual, does this impact tokens? Incorrectly picked item leads to automatic disciplinary if human error by the picker – a draconian approach which will has the potential to influence types of behaviour.

Model Stage/element of validation	Model Subject Area and related questions	Departmental Perceptions	Analysis and level of Model Validation (How does the implementation support model validation)
Stage 2.2 IIA Behaviour associated with targets.	Behaviours associated with targets. Related Question - Can you identify any behaviours associated with the targets?	Currently team promotes quality over quantity. However, previously people have rushed their work and cut corners to achieve their targets. Once target reached, e.g., 25/25 picks achieved, people would sit back, Observations: Targets have been reduced in recent times so they can be achieved in good time and the focus can be quality, previously success was based on quantity. However, there is a feeling amongst managers that targets will need to be increased.	This line of enquiry was to generate information for understanding current or potential behaviours associated with working to target as per the IIA. Exploring this area highlighted that negative behaviours have been evident in the past, and there is potential for again in the future, for example if targets are increased. Uncontrollable external factors across the wider supply chain can influence behaviour such as motivation related. It raises the question should external factors be allowed to impact dept/team targets which could lead to negative impact on individuals - e.g., non-achievement of PDR tokens (as discussed above). The concept of having the same targets with reduced resource was questioned, and the notion of having rolling targets was seen as a more suitable methods of setting targets. Applying the IIA in this area did generate knowledge in understanding behaviours associated with targets, which could then be shared across the internal supply chain to understand potential impacts on the downstream supply.
		Could foresee how targets could impact behaviour, but not experienced any currently. Observations: This is the least transactional area of the business, with seemingly less activity-based targets.	

		Short staffing means people will push for target and potential to make errors External targets for suppliers can impact the KPI's across the company. Observations: If an external element of the supply chain fails to meet target it can impact the internal targets of the organisation. If this leads to potential non-achievement of dept/team targets the team lose moral due to having no influence over the target achievement due to the external factors – e.g., lack of raw materials.	This further validates the application of the IIA element of the model (stage 2.2).
		Target can detract from people's engagement: If target too high to achieve. If customer sets unachievable targets and demotivates staff as they are cascaded down through the organisation Observations:	

		It was proposed (by the participant) that rolling targets would be better as these would reflect any changes. It was noted that the customer facing team do not understand the targets and pressures of other depts which can cause friction.	

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.2 IIA Information needs.	Understanding of Information needs of other depts. Related Question - Are you aware of the information needs either side of the dept?	Generally, a good awareness of needs from other depts, not aware of additional need they may have (*e.g., in non-standard situations)* Understand information needs from other departments Yes, com's improved over last 2 years, I.T System helps with communication and information Observations: Information is provided by dept and made transparent Monthly meetings with suppliers help with information across the wider supply chain. Yes, in the majority of cases	This line of questioning sought perceptions as to whether dept's believed they understood the information needs of other depts they work with in the supply chain. In general, the departments perceive to understand the information needs of other departments. This element links to the next, see comments in next element.

Model Stage/element of validation	Model Subject Area and related questions	Departmental Perceptions	Analysis and level of Model Validation (How does the implementation support model validation)
Stage 2.2 IIA Information needs	Having information from other depts to work efficiently. Related question: Do you always have the information you need from other depts to work efficiently?	Does not always receive information for any non-standard orders. E.g., inventory coming in, what needs to go out – outbound products to customers. Sometimes have to chase information for purchase orders which "halts the process". Have information needed from other departments Constantly have to chase for information from other depts, which causes delays Observations: Causes delays and potential knowledge issues (lack of) in other depts. Has to keep going back and forth between depts to chase information to resolve issues	This element builds on the previous and offers the opportunity to compare perceived understanding of upstream/downstream departmental information needs against actual information communicated. In the previous element all depts perceived they understood the information needs of other depts within the internal supply chain. However, a deeper dive into whether all depts receive the information they need to work efficiently highlighted that information is not always presented when needed and sometimes must be consistently chased. It is clear that improved information flows between depts at times would improve efficiency of the department(s), with the potential to improve the end-to-end flow time of the products/service. Such improvements could have positive impacts on the customer journey and positively contribute to achievement of customer driven targets (e.g., reduce customer production stoppage times). This element demonstrates a lack of correlation between what depts think other depts need and what they actually need for efficient operations. This lack of correlation

		Some knowledge in most departments is tacit, so sometimes hard to access e.g., if person holding the knowledge is not here or busy.	demonstrates the value of having the information/communication flow component within the IIA element of the model (stage 2.2) and therefore validates its inclusion in the model.
		Generally, yes, although if not routine it can be hard to find the information.	

Model Stage/element of validation	Model Subject Area and related questions	Departmental Perceptions	Analysis and level of Model Validation (How does the implementation support model validation)
Stage 2.2 IIA Information needs.	Benefits of Information from wider supply chain (outside of organisation) Related question - Would it be beneficial to understand more (have more information) about the wider supply chain?	Generally, just focused on own dept, so does not feel the need for wider information from the supply chain. Observations - Highlighted that more knowledge of other depts within the company could potentially be very beneficial – *which can be considered as supply chain due to vertical integration of the company*	This element was seeking to enquire about the perceptions of understanding the information needs of the wider (external) supply chain. Analysis above highlighted the sometimes lack of correlation of information needs within the internal supply chain for efficient operations. This element highlights that in several cases having more information of the wider supply chain (e.g., suppliers, customers) would be beneficial. Understanding the bigger picture could enhance holistic and systems thinking. Further investigation could detail the context/type of such information, but this initial line of enquiry continues to support the validation of the information component within the IIA stage of the model (stage 2.2) by identifying specific areas of opportunity i.e., customer/supplier information needs.
		More known about the wider supply chain would help give a full picture to satisfy customers. Observations: *Links to having to chase information between departments to resolve issues.*	
		Sometimes would be beneficial but can be too much information.	

		Depends on the role, more information in some roles would help an understanding of how people can impact the customer. More information about customer or supplier requirements would be very useful. Observations: More information could help inform why things must be done in a certain way.	

Model Stage/element of validation	Model Subject Area and related questions	Departmental Perceptions	Analysis and level of Model Validation (How does the implementation support model validation)
Stage 2.2 IIA Information needs and Targets overview	Related Question – Would it be beneficial to undertake a more detailed study of these areas (targets and information as in the IIA) across the organisation?	Yes, especially if key depts are involved Yes, because outside of normal otif goals it is challenging to get things done. Yes, it is a beneficial part of the model. Yes, it would be useful	This question was asked to offer perceptions on the benefits of IIA application to the organisation. All departments agreed that it would be beneficial to study the targets and information areas (IIA) of the model in more depth within the organisation, Further application of this element of the model would potentially enable higher levels of integration between functions/departments and help navigate across different functions regarding a common purpose and associated measurement of performance. This outcome adds further validation of the IIA aspect of the model and the value having it within the model.

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.41 operational performance measurement.	Types of performance measure. Related Question – How do you measure operational performance of the dept /team/individual?	Mainly transactional e.g., parts packed per hour. As in above section, mainly associated with what is built into customer contracts. Observations: Manages overall movement of materials and signals other depts.	Investigation of operational performance measures sought to understand in more depth specific measures of operational performance, for example activity v process flow measures, quantitative v qualitative measures. Time was quite limiting, which inhibited a deep dive into the area, however, the measures discussed mirror the focus of targets target presented in the previous section for the various depts. Further delving into this area would allow greater analysis as to whether the measures being used are the most appropriate or effective, especially when measuring against a common purpose type measurement across the organisation, which as highlighted earlier, is not common across all depts. The line of questioning and discussion enabled the above observations to be made, which supports the validation of this component of the model (stage 2.41).

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.41 Operational performance measurement.	Method of testing measurement system. Related question - Do you have a method of testing the accuracy of the measurement methods?	Generally quantitative transactional measures pulled off IT system, so relies on IT system accuracy. Some calibration between customer and company records for quantitative measures. Qualitative measurement methods testing not known. e.g., surveys. Proof testing with qualitative supplier measuring methods. Quantitative measures come direct off the system. System based measures are tested. Qualitative measures such as views, opinions do not have a standard method for testing measures.	This element of model application sought to understand how well the accuracy is understood regarding the methods used to measure performance. This will later link to stage 3.3 of the model when methods would be applied to validate the measurement systems of new process design. Gaining a current understanding of methods gives opportunity to review current levels of reliability in the information being used to inform current decision making. Most activity-based measures appear to be taken straight from IT system, with a general feeling that the numbers on the system must be correct. However, this does not rule out ambiguity over how quantitative measures are analysed between functions, for example, do the numbers mean the same thing to each dept. In addition to measures presented by the I.T system, qualitative measurements are used areas such as customer feedback or supplier information. The testing of these measurements is variable between depts, i.e., some are tested through pilots, others have no known testing.

			This investigation highlights that actual testing of the measurement systems and methods is variable, especially with qualitative data. This gives potential for ambiguity due to how depts may interpret the data, including data produced by the I.T system. In this scenario measurement systems analysis would help realise the accuracy of the data on which decisions are being made, including qualitative data and information. These points highlight the value of assessing the accuracy of the measurement system and therefore supports the validation of the measuring system components of the model (stage 2.41).

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.1 and 3.0 Understanding and informing business improvement strategy.	Known strategy for business improvement. Related Question - Is there a known organisational strategy for business improvement?	Not known, used to be a Business Improvement team, but now departmental responsibility. Observations: No improvement objectives at departmental level as overall business improvement objectives not known. Not known. Not known. Not known what it is.	This line of questioning was designed to investigate the current understanding of organisational strategies for business improvement. The knowledge from which would give insight to the level of holistic thinking and help inform what needs to be considered for stage 3 of the model. The investigation highlighted that that organisational business improvement strategy is not clear and depts do not know what the holistic picture is towards business improvement. The impact of not been able to align any specific departmental BI objectives demonstrates the need for a holistic strategy towards BI. The findings above highlight the need for a BI strategy to be espoused if departments are to be aligned with approach. This validates the inclusion of strategic leadership to foster a systems mindset and build into organisational strategies (Stage 3.0) within the model, and how integration into such strategy could give a holistic understanding of methods and philosophy toward making improvements.

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.1 and 3.0/3.1 Understanding and informing business improvement strategy.	Clarity how depts/teams can feed into future strategy. Related question – Is it clear how depts/teams feed into improvement strategies?	No mechanisms Ideas are logged locally. Not at the moment. Not clear. Observations: More difficult since merger *Seems more top down than bottom up.* More departmental at the moment. Not at shop floor level, but at Management level yes.	This line of enquiry was to generate knowledge as to how people in teams/departments can feed into the informing of business improvement strategies. Ideas are captured at departmental level only. Potentially good ideas generated but it is not known who is doing what across the organisation, and therefore not holistic. Investigating this area highlights that mechanisms at departmental level are not known for feeding into the bigger organisational strategy. Identifying this position validates the inclusion of stage 2.1 and 3.0/3.1 of the model and will help in understanding the starting point for developing the strategic leadership of a systems mindset across the organisation.

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 2.1 Methods of informing business improvement strategy.	Current approach to BI projects. Related question - What is the current approach to improving processes/operations?	Local knowledge and tool used such as SPC, FMEA. Local initiatives Application of generic tools such as SPC and cause and effect	This element builds from above and investigates how depts currently approach BI projects. The investigation further highlighted a lack of holistic thinking and a potential need for a known organisational strategy. This further supports validation of the model stage 2.1 and 3.0/3.1 as discussed in the previous 2 questions above.

Model Stage/element of validation	Model Subject Area and related questions	Departmental Perceptions	Analysis and level of Model Validation (How does the implementation support model validation)
Stage 2.0 and 2.1 - To understand general level of holistic thinking when implementing business improvement interventions.	Does current approach to BI include working across depts, is it holistic? Related question - Does the approach encourage/include working across depts – is it holistic?	Feels very local and disjointed, minimal cross departmental working. Not holistic. Not consistent across areas, collaboration when appropriate. Approx. 60% departmental, 40% cross functional.	This line of enquiry enabled an understanding of perceptions towards how holistic business improvement interventions are regarding the wider organisation. The investigation revealed that (as highlighted in previous elements) there is a general lack of holistic thinking, discovering this highlights the importance of this line of enquiry within the model and further supports validation of stages 2.0 and 2.1 of the model.

Model Stage/element of validation	Model Subject Area and related questions	Departmental Perceptions	Analysis and level of Model Validation (How does the implementation support model validation)
Stage 1.5 and 2.43 To give basic perceptions of potential barriers and influences on the system.	Related Question - Is it easy for people to get involved in process improvement work.	Locally yes, non-locally more difficult. Observations –: Locally because everyone is focused on their own areas. Difficult to look at anything outside of budgetary control. If resource allows depending on where the person is at a functional level. Observations: BI is encouraged, whilst still doing the day job. No BI team at the moment.	This area was included to generate some information regarding known barriers and/or influences on the system that could inhibit making changes. In general, the findings support the validation of the systems thinking concept, in the context of understanding the wider supply chain by opportunities to work with other functions/depts.

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
Stage 1.5 and 2.43 To give basic perceptions of potential barriers and influences on the system.	Factors that inhibit change. Related question - Are there any factors that inhibit making changes?	The ability to sustain change. There is often a big launch, then the focus changes. Can't think of any but would be useful to find out. The signing off large-scale changes takes time. Observations: Governance has improved within the organisation. Lack of communication of strategy as to why the company is doing things. Observations: Communication of strategy very important so people understand where they fit in and how it supports people day to day.	This section aimed to identify barriers or factors that inhibit change within the organisation. The results highlighted that previous improvement methods have lacked sustainability, and lack of strategy. The lack of sustaining change projects supports that notion in the model that the philosophy needs to be embedded in the culture and continuously driven by senior management. This supports the inclusion of strategic leadership to foster a systems mindset and build into organisational strategies (stage 3 of the model). The line of questioning identified this situation, therefore validating the investigation of barriers and system influences Stage 1.5 and 2.43 of the model).

Model Stage/element of validation	**Model Subject Area and related questions**	**Departmental Perceptions**	**Analysis and level of Model Validation** (How does the implementation support model validation)
A general theme to support the Systems Thinking concepts within the model.	**Question -** What would a holistic approach to improving operations culture look like.	A structure that tries to work holistically across sites (because of merger). Currently difficult to see the bigger picture across the organisation and would be beneficial to see it. Observations: *Possible culture differences across sites acts as a barrier.*	This line of enquiry sought to acquire general perceptions from the departments. The responses further validate the systems thinking nature of the model through highlighting the need for more holistic thinking. The fact that changes are sometimes made without informing other depts highlights a potential silo effect, which also further validates the IIA element of the model (stage 2.2), specifically the information needs and communications flows aspects.
		Dept does involve other people when required, however, dept experiences other depts changing things without communication of the changes.	
		Having a common KPI set or understanding of other people's KPI's	

Model Stage/element of validation	Model Subject Area and related questions	Departmental Perceptions	Analysis and level of Model Validation (How does the implementation support model validation)
A general Question to support validation of the model.	Related question - Would further application of the model be useful?	Yes, particularly based on the questions already asked and the systems thinking approach. Would be of potential further benefit to the organisation.	A general question to seek views on further application of the model within the case organisation. Very clear indication that the model has value and very positive comments which validates that the model was well received, and further implementation of the model would be of value.

Although the application of the model was limited in time, investigating the areas proved very informative when considering the validation of the model. As discussed in section 7.3.3.2, the same semi-structured interview approach was applied to all four areas of the operation and through the questioning and discussion, key information about the position of the organisation in relation to the themes was drawn out. In addition, prior to the interviews, a plant tour enabled observation of some of the operations, including anecdotal discussions with staff and visual observation of some of the processes. This method of enquiry aligned to the model stages being tested proved effective and insightful, with the main areas summarised below:

Interdepartmental Impact Audit (IIA)

Purpose:

Whilst in this instance there were commonalties in the perception of organisational purpose (see section 2.3.4) from the customers perspective, discussing the notion of purpose did highlight that there was no common statement of intent at organisational level, including no reference made to any company mission type statements. As highlighted in the various sections of table 7.2, frequent references were made to thinking at departmental level, which aligns to the literature and the potential for functional barriers to exist and potential silo working (see section 2.3.6), where in the future the risk could be reduced by having a known purpose at organisational level.

The results highlight that this stage of the model was successful in generating information towards the understanding of organisational purpose. Therefore this can be considered as a key stage of knowledge generation, for understanding current perceptions of purpose (see sections 3.5 and 5.2.5.1), and therefore informing future strategy for leading a systems thinking mindset (see section 3.5).This result validates the purpose element of the IIA.

Targets:

Gaining knowledge of how the organisation uses targets proved very insightful. Some targets at both individual and team/dept level are very activity based (for example, items picked per hour) and do not reflect a holistic view required to understand flow (this is reflective of the knowledge gained from the literature in section 2.3.4), with some being less direct and more focused on the wider supply chain (for example, reduce customer build stoppage times). In virtually all the cases discussed, targets were set in an arbitrary way (I.e., Set by managers not directly involved in the work and not based on evidence or evaluation of information), which as discussed in the literature can lead to inaccurate operational decision making (see section 2.3.5) and have the potential to generate negative behaviour amongst staff. For example, if an arbitrary target is unrealistic (e.g., reduce unit cost by x%) staff morale could be impacted in the form of demotivation, this particularly reflects the systems thinking theory discussed in section 2.3.4.

The recognition of the potential for targets to drive negative behaviour was especially apparent where activity-based targets were set to be quite easily achievable because of the known potential negative impacts on individuals of not achieving targets (e.g., demotivation – see section 2.3.4). However, in some instances activity-based targets remained the same irrespective of fewer human resources. Some of the wider supply chain targets identified could impact departmental/team performance figures, without the department/team able to have a direct influence on the outcome, which could also influence negative behaviour such as reduced motivation.

In addition to identifying the focus of targets and recognition of negative behaviours, the application of the IIA highlighted a general lack of knowledge/understanding of targets being used outside of the functional areas or depts, which could negatively impact holistic and collaborative working between departments, with the existence of functional silos in places (see purpose section above and section 2.3.6).

As highlighted in table 7.2, application of the IIA element of the model has enabled target associated knowledge to be generated built from the literature (particularly sections 2.3.4 and 2.3.5), including behaviours, level of knowledge outside of individual departments and focus of targets. The sharing of these findings will enable

departments to have a better understanding of potential impacts they can have on the wider internal/external supply chain, and through further application of the model change approach and methods of working accordingly to improve the operations and level of customer service.

These results from application of the IIA element of the model highlight the value of the model when applied to a supply chain context, demonstrating the positive contribution the model has to knowledge in the area of supply chain and business improvement. These findings significantly contribute to the validation of the IIA element of the model.

Information/Communication:

On initial investigation there was a general perception by each department that they understood the information needs (from them) of other departments. However, further application of the information element of the IIA identified that there are cases where information is not received to allow efficient working and constant chasing occurs between departments to seek the required information, in these instances there can be a considered a lack of supply chain integration (see section 2.2.3) and holistic thinking. A higher level of supply chain integration and more integrated working across the value chain (see section 2.5.2) in these areas would offer the opportunity to be more efficient with a potential better level of service for the customer.

These results from application of the IIA element of the model highlight the value of the model when applied to a supply chain context, demonstrating the positive contribution the model has to knowledge in the area of supply chain and business improvement. These findings significantly contribute to the validation of the IIA element of the model. Further investigation and application of the model would enable identification of additional scenarios (to those highlighted in table 7.2) and inform the redesign of processes to work in a more holistic nature (reflecting the next stages of the model).

IIA General Comment:

All departments agreed it would be beneficial to further apply the IIA, especially with areas outside the standard otif (on time in full) targets (see section 2.2.4). This consensus between departments (or functions) further validates the IIA aspect of the model and further endorses the value of IIA design and its evolvement from the literature. In particular, this includes the systems theory in section 2.3.4 and the supply chain integration theory in section 2.2.3, thus further demonstrating the positive contribution the model has to knowledge in the area of supply chain and business improvement.

Performance Measurement:

The knowledge generation aspects of the model regarding performance measurement were lightly investigated due to time constraints. However, application of this stage of the model highlighted that many of the measures reflected the areas discussed in the IIA aspect of the model, specifically in relation to targets. This confirmed the transactional or activity nature of many of the performance criteria at operational level (e.g., items picked per hour, QA tests done over time), which inhibits measures of flow (as presented in section 2.3.4) and a holistic view of the internal supply chain.

Application of this stage of the model also highlighted that accuracy testing of the measurement systems and methods is variable, especially with qualitative data. This gives potential for ambiguity due to how depts may interpret the data, including data produced by the I.T system. This highlights the value of having measurement systems testing within the model, which was influenced by the Six Sigma literature in section 2.4.3 and demonstrates the effectiveness of the model incorporating and evolving literature from other concepts to those of Seddon discussed in section 2.3.4.

The findings contribute to the validation of stage 2.4 (measurement) of the model, specifically to stage 2.41 (evaluation and appropriateness of current performance measurement methods). Undertaking this stage of the model application after the IIA stage (stage 2.2 of the model) proved beneficial in terms of validating sequencing as

the knowledge generated from the IIA was directly related in terms of measurement methods and context to the internal supply chain departments/functions.

Strategy:

Stage 3.0 and 3.1 of the model is important for driving both associated organisational change and the method for business improvement (the model) through the organisation and potentially wider supply chain (see section 3.5), including building systems thinking mindset across the organisation.

Trying to understand the current position regarding known organisational strategy proved useful, as the investigation discovered that organisational level strategies for business improvement were not currently known, nor were mechanisms for departments to help inform such strategies (stage 2.1 of the model, see section 3.4). It was highlighted that currently most business improvement initiatives were undertaken at departmental level only, with comments such as “feels very disjointed”, highlighting the lack of a holistic approach to viewing the supply chain.

The lack of known strategy for business improvement across the organisation highlights the need for inclusion within the organisations espoused strategies at different levels (i.e., corporate, business and operational levels) as presented in the analysis of the literature in section 2.7.2. This is particularly important for informing the strategic leadership for the transformation to a systems thinking mindset (see section 2.7.4).

Gaining the knowledge through lines of enquiry related to strategy validates stage 2.1 of the model and aspects of stage 3.0/3.1, as the knowledge gained identified the lack of clarity/knowledge of current organisational strategy and provided a starting point for the organisation, for considering how they might develop such strategies in the future, which reflects stage 3.0/3.1 of the model.

Barriers for making business improvement changes:

Through investigating how difficult it is for people to be involved with process improvement work and general perceptions of the barriers that inhibit change, the knowledge generated highlighted that it is more difficult for people to work on initiatives outside their own area, further highlighting potential existence of functional barriers and silo working (discussed above and in the literature section 2.3.6). In addition, there were several other barriers to implementing change identified, as highlighted in table 7.2.

Investigation of this line of enquiry and the identification of associated barriers to change validates the related stages of the model (1.5 and 2.43). The knowledge generated in this area is important when moving to the next stages of the model, in particular, understanding the current position for new strategy development and leadership of change (see section 2.7.3 and 2.7.4).

7.3.5 Stage 5 - Identify future validation options and or opportunities

To further understand the model validation a return visit to the organisation was made, which incorporated a presentation of the findings from the research to members of the senior management team, including the business improvement manager. The management team highly valued the research conducted and found presentation of the outcomes very insightful in 2 significant ways:

- **Validation of their own thoughts about a lack of known strategy for business improvement across the organisation –**
  Managers were aware that since a recent company merger the focus to improve supply chain performance had lost direction, with previous structured business improvement teams being disbanded. The results from the research highlighted the lack of known strategy across the departments and wider internal supply chain, and how each department now seemingly works in isolation (silo) regarding making business improvements. This highlighted the need for strategy development for business improvement.

- **Application of the IIA (Interdepartmental Impact Audit) –**

  Application of the IIA proved very informative for further highlighting a lack of holistic working between departments/functions, including the potential negative impacts of current and future use of target setting, in conjunction with highlighting that current information needs are not always met, and thus negatively impacting overall supply chain performance to the end customer.

In summary, the organisation found the research to be very informative and would like to apply the model further across the UK business as soon as practically possible, with the potential for international application across the other business sectors of the portfolio.

7.4 Overview, Discussion and Conclusions

Partial application of the conceptual model to the case organisation enabled the study to move from concept stage to application, with key areas of the knowledge generation (see fig 5.31) phase of the model applied and verified. The vertically integrated (Johnston et al, 2010) nature of the organisation enabled testing of the model (through application) across 4 different stakeholder groups in the form of departments (or functions) within the organisation.

The empirical testing of the model (selected areas) enabled application of core concepts, that were developed through further evolvement of the SCI literature (Zhang et al, 2015; Mangan and Lalwani, 2016; Vanpoucke et al, 2017;Tai et al , 2022), by evolvement and application of Seddon's (2003,2008) systems thinking theory. In addition, the case organisation enabled testing of the convergence of supporting theories (that further evolved the systems thinking theory) within the model, including stakeholders (Hayes, 2014; Jones et al ,2020; Johnson et al, 2010) and strategic leadership (Norzailan et al ,2016; Schoemaker et al ,2013 ;Tickle et al ,2016, Samimi et al ,2020).

The case organisation provided opportunity to test the evolved systems thinking theory that has differences to the core theories espoused by scholars such as Checkland (1999) and Jackson (2001) - these are discussed in section 2.3.4. The evolvement of the Seddon (2003,2008) theory enabled knowledge generation as to the use of targets as performance measures and associated potential negative behaviours, in addition to the level of understanding (within each supply chain function) of the performance measures (targets) used outside of the functional area/department – leading to understand the potential impacts. In addition, the SCI literature is prominent regarding the importance of flow of information across a supply chain, the conceptual model evolved the SCI theory through a means of evaluating information flows between functions/departments. These 2 areas were combined within the design of the IIA (Interdepartmental Impact Audit) aspect of the model, unique to this study, which enabled a method for analysing the current situation within the vertically integrated supply chain, and therefore contributing to the novelty of this study.

Applying the unique IIA to the case organisation validated its inclusion within the model, as results found that situations exist within the case organisation that influence the performance of the supply chain. Evolving Seddon's (2003,2008) systems thinking theory through design and application of the IIA enabled identification of scenarios which aligned to both the SCI and systems thinking literature. This included identifying the potential of negative behaviours associated with activity based and arbitrary set targets within the organisation, aligning to the literature of Seddon (2003,2008) and Deming (1982). Whilst also identifying that knowledge of individual departmental targets (and therefore potential associated impact) was largely unknown outside of the functional areas. This identified a high potential for functional silos and a lack of viewing the supply chain as a system, aligning to the SCI literature (Christopher, 2016; Skipworth, 2016). Application of the IIA also enabled actual investigation as to the perceived information needs of the forward and reverse internal supply chain, and whether these were met. The results highlighted that whilst there was a general perception by each department that they understood the information needs of other departments, the reality is that information is not always received to allow efficient working, with an impact of potential weak levels of supply chain integration, aligning with the literature of Zhang et al (2015) and Mangan and Lalwani (2016). Application of the IIA and the resulting alignment with the literature validates this unique aspect of the model. Validation is confirmed as the method enabled the generation of knowledge that identified opportunities for performance improvement that were new to the organisation. The novelty of this aspect of the study is the application of core concepts of Seddon's (2003,2008) systems thinking theory to the context of supply chain, in addition to evolvement of the said theory through the IIA design, which uniquely combines and evolves aspects of the SCI literature and systems thinking literature.

Further novelty of this study is the convergence of literature to inform the different stages of the model, addressing the gaps identified in the Seddon (2003, 2008) literature (see chapter 2.3.4) and espoused method for analysing an organisation with a view to making subsequent improvements. This includes a lack of strategic leadership within the method (Marshall, 2012), the research found a lack of awareness within the case organisation for knowing the business improvement strategy, which is fundamental for achievement of organisational goals (Jones et al,

2020) and realisation of organisational strategy (Johnson et al (2010). This highlights the importance of strategic leadership within the model and a positive enhancement of Seddon's (2003,2008) method. In addition, the research identified a lack of strategy for communicating and sustaining change, further highlighting the rationale for inclusion of strategic leadership within the model and contributing to the model validation, whilst aligning to the literature presented by Marshall (2012) and Jadhav et al (2014).

The model also converges the theory of stakeholders within the model, building on the literature of research highlighting the importance of understanding stakeholders. Investigating this area through application of the model highlighted there was sometimes differences of opinion between departments, aligning to the literature of Hayes (2014); Jones et al (2020) and Johnson et al (2010), together with a lack of holistic understanding of the organisations purpose from the customers perspective, an area key to the systems thinking theory (Seddon, 2003, 2008). The generation of knowledge through application of the converged themes within the model have highlighted the importance of their inclusion of the model, thus further contributing to the model validation.

Summary

The empirical research demonstrated the novelty of this study through application (of aspects) of the conceptual model, unique in design, which evolves a system thinking method not previously applied in the context of this study. Successful application of the model enabled areas of research to be undertaken that were not previously explored in the SCI or systems thinking literature (i.e. method for understanding impacts of performance measures/targets and information flows), thus contributing to new knowledge through the design and validation of the conceptual model.

Application to the case organisation enabled various aspects to be identified that were not currently known (to the case organisation), with potential implications if not addressed. The most significant implication being the risk of functional barriers and associated negative behaviour (Christopher, 2016; Skipworth, 2016; Seddon, 2003), potentially limiting supply chain integration and holistic thinking, vis a vis, viewing the supply chain as a system. The resulting identification of such aspects proved the

iterative nature of the model, as the knowledge generated was suitable and plentiful for informing the next stages of the model. In essence, the implications of applying the primary stages of the model provided managers the opportunity to re-think the strategies for business performance improvements, through consideration of performance measurement (vis a vis use of targets) and the general mindset towards operations between departments/functions through developing a systems thinking mindset across the organisation – thus giving potential for reducing functional barriers and improving supply chain integration. Recognition of these factors through application of the model validate the theoretical concepts and design structure of the models tested areas, in particular the application of an evolved systems thinking theory, which included convergence of theories in the design and structure of the model - moving the model from proven concept stage (through the Delphi study) to application and validation.

The next stage for the research and case organisation would be to apply the remainder of the model, giving opportunity to further measure the current situation, followed by undertaking the mindset shift and implementation stages of the model.

This chapter has presented the successful application of key selected areas of the model within a supply chain related organisation, and thus satisfies Research Objective 4:

- Through empirical research within a chosen organisation, validate key aspects of the developed conceptual model.

Chapter 8 presents the conclusion of the study, including reference to all research objectives.

Chapter 8 - Conclusions, Limitations and Future Research

This chapter is the eighth and final chapter of the study. Chapter 1 outlined the aim and objectives of the study, in conjunction with presenting the rationale for the study topics, which included the authors background and experience in industry and academia. Chapter 2 presented review and analysis of literature for identification of gaps in the core systems theory, together with analysis and presentation of thematic literature for evolving and informing the development of the conceptual model. Chapter 3 presented the development of the conceptual model, including how each stage was informed from the literature and the unique attributes that contributes to new knowledge developed from the core systems thinking theory. Chapter 4 presented the research methodology for development, verification and validation of the conceptual model. Chapter 5 and 6 presented the verification stages for the conceptual model, including revisions to the model made through the Delphi study process, and presenting the high level of verification (model is constructed in a considered and robust manner and could theoretically achieve the desired purpose if applied to an organisation). Chapter 7 validated the conceptual model (it works in practice) through application of core elements of the model, with a post application visit to the organisation further highlighting the value of the model and core concepts.

8.1 Conclusions

The rationale for this study was based on the need for organisations working within a supply chain to continually review and attempt to improve performance as discussed in section 1.3. Drivers included the need to remain competitive in markets and in more recent times (to the start of this study) related to environmental factors such as sustainability and carbon reduction. Additional rationale was related to the authors previous industrial and academic experience, in particular the exposure to systems thinking concepts and how application made positive impacts in service organisations.

Exploration and review of literature highlighted that there are several methods used for improving business performance within supply chains, such as Six Sigma and Lean. However, investigation into the application of a systems thinking method, with the core philosophy based on how targets are used and having organisational purpose (from the customers perspective) as the prime driver of performance measurement, highlighted a gap in the literature (when relating to the context of supply chains). This study evolved the core concepts of Seddon's (2003,2008) systems thinking theory through the merging and convergence of known approaches and themes for implementing business improvement philosophy and methods within organisations. The merging of such concepts was presented in the form of a conceptual model, with 5 iterative main stages - Feasibility, Knowledge Generation, New Design, Pilot and Roll Out. Each stage was informed by the former stage, with substages that were derived from the review of literature presented in chapter 2.

After completion of the model development, it was tested through 2 stages, verification, and validation. The verification (the conceptual model is constructed in a considered and robust manner and could theoretically achieve the desired purpose if applied to an organisation) was conducted through the application of a Delphi study, which engaged a panel of experts for opinion and review of the model. The results highlighted a high level of verification through consensus of a range of questions designed to test various stages of the model, supported by additional comments from qualitative analysis, which also gave opportunity to enhance the model (presented as version 2). Upon successful verification, the model was validated (identify whether the model can be applied in practice, in essence, moving from concept stage to actual application) using a case study organisation working in the context of supply chain. Selected aspects of the model were applied, with a very successful outcome, primarily that the elements of the model tested worked in application, providing detailed knowledge for future application of the next stages of the model (new design stage onwards).

The outcomes of the study can be highlighted further through review of the research objectives, which enabled realisation of the research aim - *to develop a method for improving business performance within a supply chain. The method is to be presented in the form of a high-level conceptual model, designed for implementation by organisations working within a supply chain to improve business performance for the movement of goods/materials to an end customer. The term high-level in the context of this study can be identified as key themes or macro level, as opposed to a high level of micro detail (i.e., explicit instructions). The research aims to build on the core concepts of Seddon's (2003,2008) systems thinking philosophy and method, through exploration of additional themes and concepts to inform construction* of the conceptual model.

Research Objective 1: To research and give critical review to the literature for informing the design and construct of a high-level conceptual model.

Research objective 1 was achieved through Chapter 2, which included critical review of the core systems thinking philosophy (Seddon, 2003,2008) identified in Chapter 1. This included highlighting gaps in the approach. i.e., a method for fully identifying and understanding the impact of performance targets between functions/departments and consideration of how strategic leadership strategies are informed and formed to implement and sustain the method. In addition, was highlighting a lack of measurement methods testing within the literature associated with the method. The review of the SCI and systems thinking literature organically led to review and analysis of further subjects for evolving the theory, including review of popular approaches for improving business performance (i.e., Lean and Six Sigma) and strategic leadership and change.

Research Objective 2: Through convergence and further development of concepts identified in the literature, develop a high-level conceptual model for analysing business performance, with a view to identifying and implementing improvement opportunities.

The literature presented in chapter 2 informed the development of a conceptual model by evolving the SCI and systems thinking theory (presented in chapter 1), through convergence of additional theories and concepts for analysing and improving business performance. The convergence informed the themes and

structure of the model, in particular the further development of the systems theory related to using targets as performance measures and the notion of customer driven purpose, resulting in the development of the unique IIA (interdepartmental impact audit) aspect of the model. Whilst aspects of the model have parallels with other approaches presented in the literature, elements such as the feasibility stage offer a uniqueness to the compilation of themes, components and illustrations of the stages (i.e., linkages between substages).

The achievement of research objective 2 is evidenced in Chapter 3, which presents the high – level conceptual model, with explanation and rationale for each stage, together with how each stage was informed from the convergence and further development of concepts identified in the literature.

Research Objective 3: Through empirical research with experts', verify the developed conceptual model.

Verification of the conceptual model was achieved through the Delphi study rounds 1 and 2 conducted with a panel of experts. Through an inductive process, the analysis of results from round 1 informed enhancements made to the model which were presented in round 2. The combined results (from rounds 1 and 2) highlighted a very high level of agreement with the model content and approach and therefore the level of model verification (the model is constructed in a considered and robust manner and could theoretically achieve the desired purpose if applied to an organisation) was very high. The high level of verification enabled achievement of research objective 3.

Research Objective 4: Through empirical research within a chosen organisation, validate key aspects of the developed conceptual model.

A case study approach enabled achievement of research objective number 4, where there was successful knowledge generation in relation to the stages of the model that were tested, proving that the application of the stages worked, which was further supported by the case organisation highlighted through a return visit. It was only possible for partial implementation of the model due to the timeline required for full implementation, however, the stages implemented proved to be very insightful and

enabled testing of the IIA (Interdepartmental Impact Audit) which is unique to the model. The results from the implementation enabled identification of factors for implementation of the next stages of the model, further validating the concepts and approach. The case organisation would like to undertake full implementation of the model as soon as feasible.

8.2 Theoretical Research Contribution

This study contributes to the subject fields of systems thinking and supply chain management, through the development, presentation and testing (through verification and validation) of the conceptual model.

Review of the systems thinking literature highlighted that evolving the systems thinking theory for application to the context of supply chain gives opportunity to address some of the gaps that exist within the supply chain literature, in particular barriers to SCI and the problem of functional silos. Evolvement of the work of Seddon (2003,2008) gave opportunity (through development of the conceptual model) to further understand the impact supply chain functions have upon each other, particularly in relation to the influence of current performance measurement and use of targets.

Through design and application of the conceptual model, the systems thinking literature has been evolved from the work of Seddon (2003, 2008), which has commonalities and linkages to core systems thinking literature by scholars such as Checkland (1999), Jackson (2001) and Flood (1999). The uniqueness of Seddon's work in contrast to the previous systems thinking literature is the focus on performance measurement (vis a vis re-thinking the use of targets as a performance measure), and the notion of organisational purpose from the customers perspective. However, Seddon's literature and espoused method (in the form of check, plan, do model) has limitations as identified in chapter 2. These limitations have been addressed within the design and subsequent verification and validation of the conceptual model. In particular, and a novelty of this research is the design of the IIA (Interdepartmental Impact Audit) within the model, which evolved the systems thinking theory related to the use of targets as performance measures. In addition, the testing of the IIA validated the convergence of SCI (supply chain integration)

theory regarding information flows, the convergence further evolving the SCI literature (Zhang et al, 2015; Mangan and Lalwani, 2016; Vanpoucke et al, 2017; Tai et al , 2022).

Through the empirical research (see chapter 7), the evolved theory was validated through successful knowledge generation, which enabled a higher level of Knowledge to be generated (in relation to the impact performance targets) than would have been through application of the previous systems thinking and SCI literature – thus contributing to the supply chain and systems thinking literature.

Further novelty of this study is the convergence of literature to inform the different stages of the model, further addressing the gaps identified in the Seddon (2003, 2008) literature and related supply chain improvement literature. The empirical research highlighted the importance for the model to include areas such as strategic leadership, an area that is lacking in Seddon's literature (Marshall, 2012), in addition to stakeholder theory (Hayes, 2014; Jones et al, 2020; Johnson et al, 2010), whilst also combining aspects from the business improvement literature such as MSA (measurement systems analysis). The high level of verification achieved through the Delphi study (see chapter 6), and the validation of the partially applied model confirm the convergence of relevant subjects within the model. The sequence and structure of the subjects in the design and construct of the model are unique to this study, therefore giving more novelty and further contribution to the systems thinking and supply chain literature.

The literature review highlighted that Seddon's (2003, 2008) systems thinking theory was predominantly focused within the context of public sector related organisations, insurance companies and call centres, with application to supply chain largely unexplored. Evolving and subsequent application of the systems thinking theory to the context of supply chain further highlights the novelty of this study. The validation of the knowledge generation aspects of the model demonstrated that it is effective when applied in a supply chain context, therefore further illustrating the contribution of new knowledge to the supply chain literature.

8.3 Practical Research Contribution

A major practical contribution of this study is that the empirical research validated partial application of the conceptual model, which when applied generated knowledge to enable identification of scenarios and aspects previously unknown to the case organisation. This enables managers to analyse the potential impacts and implications on supply chain performance (previously unknown) and develop strategies to improve performance.

Further practical contribution is a structured approach to review and analyse current influencers of supply chain performance, through adopting a systems thinking approach and systems thinking mindset. Through the iterative approach of the model, the systems thinking mindset will give opportunity for managers to re-think how the performance of supply chain functions are measured and the effectiveness of information flows, with the potential to reduce the risk of functional barriers and associated negative impacts on supply chain performance – in essence, a more holistic approach to measuring performance and flow of information to improve supply chain integration.

Whilst it is likely that supply chain organisations may have implemented business improvement methods such as six sigma or lean, the novel aspect of re-thinking the use of targets, combined with the notion of organisational purpose, are key aspects derived and evolved from the systems thinking literature which are novel in application to supply chain organisations (through this study). This offers supply chain managers the opportunity to identify supply chain improvements that other methods (such as lean and six sigma) would not. In addition, the model has uniqueness to many areas of structure and sequence, enabling iterative application of its unique features not featured in other business improvement methods, thus giving further opportunity to identify opportunities for performance improvement not previously realised.

Furthermore, application of the model gives practical contribution for organisations to evaluate the understanding of current organisational strategies for improving supply chain performance. As highlighted in the empirical research for this study, it is feasible that different stakeholder groups (e.g., functions) have no clear picture of the organisational strategy or goals in this area. Understanding the current levels of

understanding between the stakeholder groups give further opportunity for managers to develop strategies for enabling a more holistic and integrated supply chain, through application of the remainder of the model.

Although the context for this study is supply chain, other sectors could benefit from adopting the principles of the method presented, particularly if they are multi-faceted (i.e., have multiple departments or functions), including linkages with external organisations – see section 8.5.

8.4 Limitations

Sections 8.1 – 8.3 highlight the achievement of the aim and objectives of this study. However, as with all research there are limitations. One of the limitations to this study was that the validation of the model was conducted in one organisation and with time constraints. It was recognised that the practicalities and challenges of implementing the model over a supply chain that could include several external organisations would have been too complex, although potentially achievable without time and access constraints (the author has experience of adopting approaches to business improvement required by primary customers). With this in mind, more manageable (but effective) application of the model is most likely within large organisations that have a high level of vertical integration (internal supply chain). In addition, if the model was applied to a very different type of organisation, i.e., overseas, with a different cultural and economic position, additional limitations could be identified.

Another limitation of the research is that the model was only partially implemented, further implementation would offer the opportunity to test the concepts related to new designs, which could highlight opportunities to fine tune the model further.

8.5 Future Research Directions

This research has focused on the context of supply chain organisations; however, the conceptual model has been developed from literature that is not all exclusive to supply chains. Therefore, whilst the model has a focus of application to supply chain organisations, future research within different sectors would enable potential

adaptation and development of the model for application in a different context. Potential examples include higher education, NHS or other multi-faceted public sector organisations. In addition is the ever-increasing focus on net-zero carbon and sustainability, further research in this context would also inform adaptability of the model for understanding the subject and related themes as a system. This is in addition to having the potential for a better understanding of current and future performance measurement methods – where the definition of performance has a different context, e.g., holistic measurement of net-zero achievement.

Adopting a longitudinal approach to the research would realise the opportunity for full implementation of the model, which the case organisation for this study has already indicated they would like to do. Additional implementation could also be undertaken within a different organisation or several supply chain related organisations. These scenarios would enable additional research and analysis to be undertaken to further validate the implementation stages of the model and inform any necessary changes, this would include analysis and comparison of results against the literature that informed the implementation sections. In addition, full implementation would enable research into the impact of changes made through application of the model and feedback to further inform the method - as per the feedback loops presented within the current model.

Furthermore, action research can be undertaken to gain further understanding of the different stakeholder groups within a supply chain, this could be in the context of informing the development of micro instructions for model implementation (for example, detailed leadership styles, specific instructions for measurement and analysis of performance). Such research would enable detailed understanding of the stakeholder requirements and inform any appropriate adjustments to the model. Stakeholder groups would include different department/functions of an integrated supply chain as per the case organisation.

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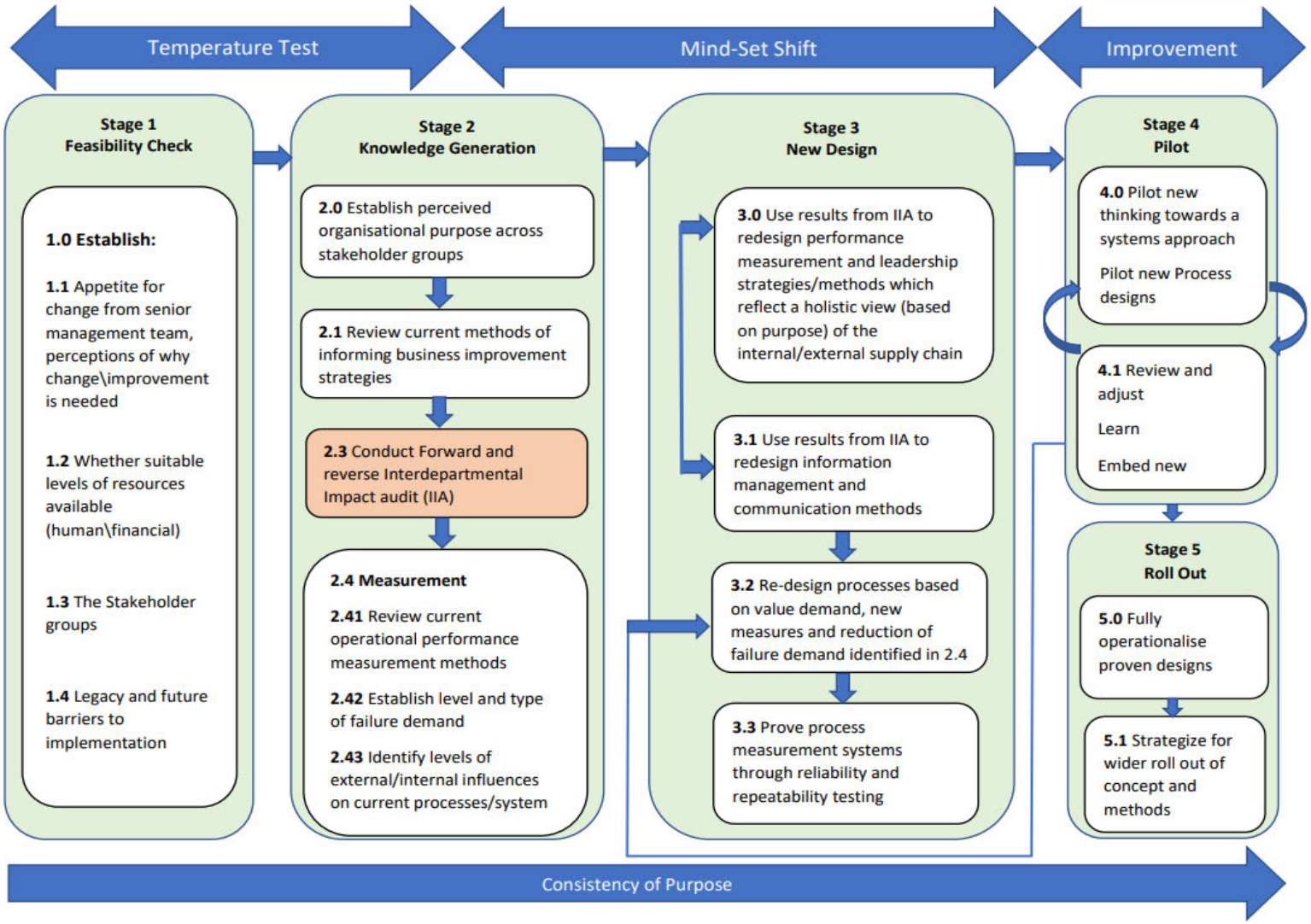
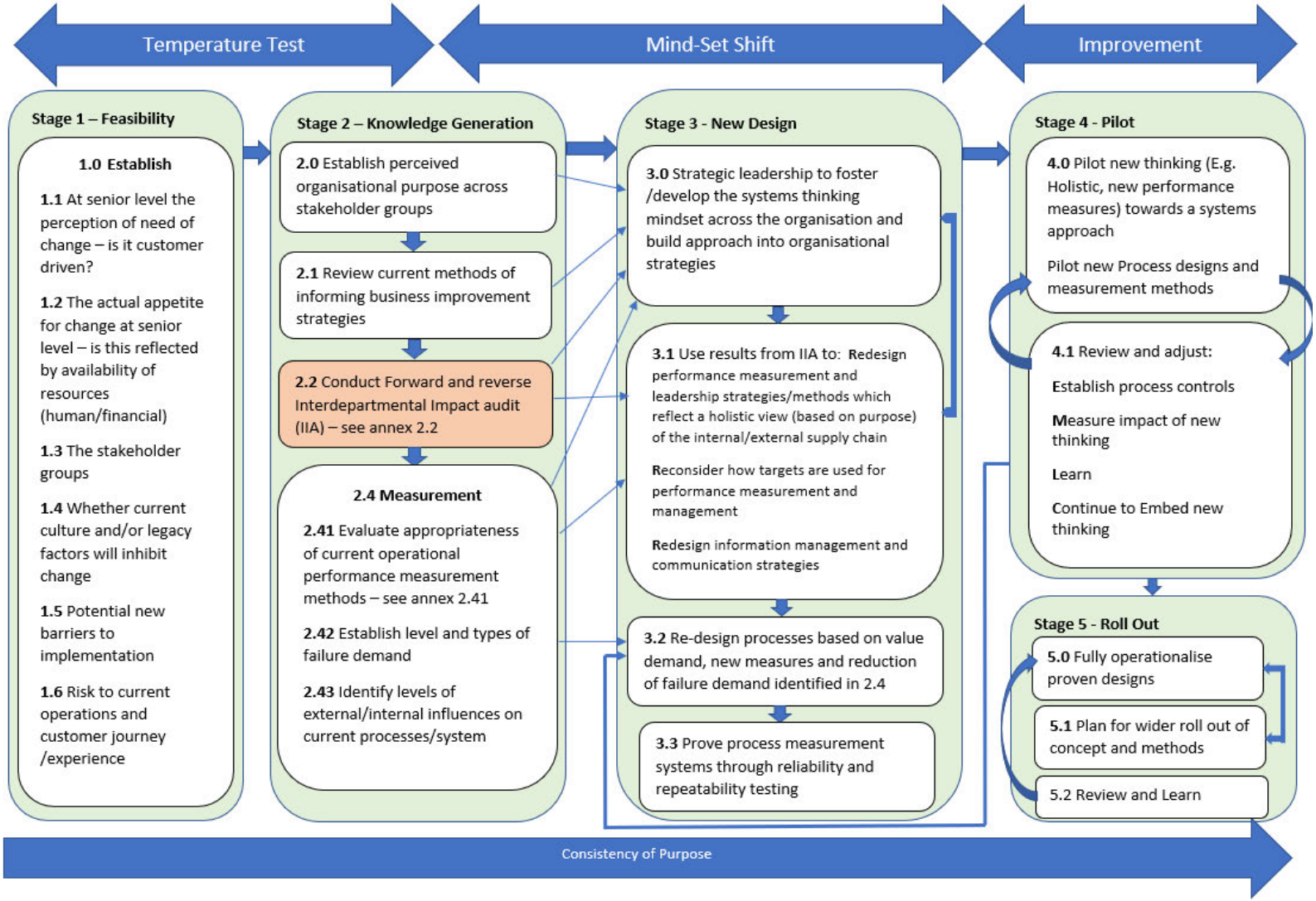
Appendix A – Conceptual Model Version 1



Appendix B – Conceptual Model Version 2 (Enhanced model post Delphi round 1)



Annex 2.2 IIA (Interdepartmental Impact Audit)

Annex 2.41 Expanded element 2.41

Annex 2.41

2.41 Evaluate appropriateness of current operational performance measurement methods i.e.

Being holistic or activity based

How prominent is purpose?

Do they reflect true value demand?

Are they a true measure of end to end performance?

Are they reliable and consistent?

Do they consider the wider supply chain?

How is value identified and measured?

How are the measurement methods validated for accuracy?

Does explicit knowledge align to tacit

Appendix C – Delphi Round 1 Survey

PhD Study - A Model for Making and Sustaining the Improvement of Business Operations Within Supply Chain Organisations

Privacy Notice and Consent:

The information that you supply for this online survey will be held securely and processed in compliance with the Data Protection Act 2018, the General Data Protection Regulation (GDPR) and subsequent legislation.

This information will be used by Simon Smith (s.smith@derby.ac.uk) in the context of his research on the PhD programme. The lawful basis for collecting and processing this data is that it forms part of a PhD programme of study at the University of Derby.

The survey is voluntary and is part 1 of staged research (Delphi method), and the researcher may contact you to invite you to participate in an additional survey for same research.

The participant agrees that if they wish to withdraw from the study they will, within 21 days of providing data, communicate with the researcher to indicate they wish to withdraw and provide the self-generated unique identifier below. All data and information relating to the individual requesting withdrawal will be deleted.

The data from consenting participants will be kept anonymous and will be retained until project completion and the student has received their grade and award. Following this, participant data will be securely destroyed by Simon Smith. It is anticipated that the overall findings of the study will be published in academic and/or professional journals/platforms.

If you would like any further information about the study, including any please contact s.smith@derby.ac.uk

As a data subject you can request withdrawal of consent at any time by contacting gdpr@derby.ac.uk

Our Data Protection Officer (DPO) is James Eaglesfield on (01332) 591762. Our Deputy DPO is Helen Rishworth on (01332) 591954. Alternatively you can email gdpr@derby.ac.uk

Further information on how we handle your information can be found here on our website - https://www.derby.ac.uk/its/datagov/privnotice/

1) By selecting below I agree to the terms of this survey *

☐ I agree

2) Please add a unique identifier, 3 Letters & 3 Numbers (not name, birth date etc) *

Your answer

Next

Page 1 of 11

Clear form

Section 2 of 11

Glossary of Terms

The survey is built from Systems Thinking theory which uses the following terms:

Purpose – The purpose of the operation(s) from the customers viewpoint (why does the operation exist), for example:

- To deliver the right product, at the right time, in the right condition, to the right place

Failure Demand - Any demand on the operation that creates the need for unnecessary resource or creates unnecessary delay, for example:

- Doing things twice due to error and/or generation of waste
- Handling customer returns due to faulty products

Value Demand – Demand on the operations that is focused on providing customer value, whilst aligning the product/service to purpose, for example:

- Delivering the right product, at the right time, in the right condition, to the right place

After section 2 Continue to next section

Section 3 of 11

Organisational Targets

Please indicate your thoughts to the following questions by selecting the most relevant answer to your opinion.

3) Do organisations need to use targets to help measure performance? *

- ○ Yes definitely
- ○ Most of the time
- ○ Occasionally
- ○ No definitely not
- ○ No View

4) Do departmental performance targets ensure the customer is the No1 focus of the operations? *

- ○ Yes definitely
- ○ Most of the time
- ○ Occasionally
- ○ No definitely not
- ○ No View

5) What type of impact do departmental performance targets have on the downstream supply chain (internal or external) ? *

- ◯ Very positive impact
- ◯ Mostly a positive impact
- ◯ No impact
- ◯ Mostly a negative impact
- ◯ Very negative impact
- ◯ No View

5) What type of impact do departmental performance targets have on the upstream supply chain (internal or external) ? *

- ◯ Very positive impact
- ◯ Mostly a positive impact
- ◯ No impact
- ◯ Mostly a negative impact
- ◯ Very negative impact
- ◯ No View

6) Do you think that Individual performance targets based on output volume (e.g. items packed per hour) are mostly positive or negative for team working? *

- ◯ Definitely Positive
- ◯ Mostly Positive
- ◯ No Impact
- ◯ Mostly Negative
- ◯ Definitely Negative
- ◯ No View

7) Please add any comments you may like to add regarding the questions you have just answered. For example, views on use of targets related to individual, team or departmental performance.

Long answer text

After section 3 Continue to next section

Section 4 of 11

Factors for Change Interventions

For the following factors, please rate on the scales your view of the level of importance for implementing successful and sustainable organisational change.

8) How important is it for organisational change to be driven by the Senior Leadership Team *

	1	2	3	4	5	
Very Important	○	○	○	○	○	Not important

9) How important is it to have the commitment of Local/Departmental Leadership when implementing organisational change *

	1	2	3	4	5	
Very important	○	○	○	○	○	Not important

10) How important is it for change projects to be incorporated in organisational strategy *

	1	2	3	4	5	
Very important	○	○	○	○	○	Not important

11) How important is it to have agile processes in supply chains (i.e Processes that can be changed at pace if required to meet new demands or situations) *

	1	2	3	4	5	
Very important	○	○	○	○	○	Not important

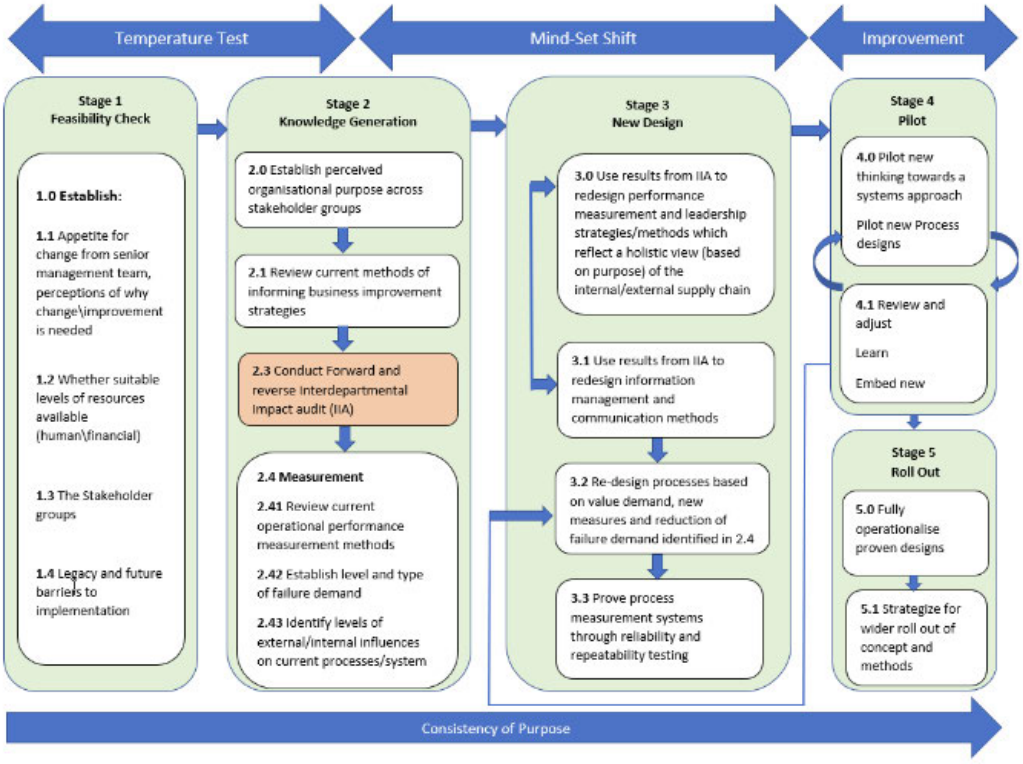
Section 5 of 11

A Model for sustaining Business Improvement

The model below has 5 stages and is designed to offer a method for sustaining business improvement within an organisation. The model is derived and adapted from Systems Thinking based theories, which include core concepts regarding the use of organisational targets and associated impacts on behaviour and operational performance.

The questions presented after the diagram of the model will relate to each stage :

A Systems Thinking Based Model For Business Improvement



After section 5 Continue to next section

Section 6 of 11

Model Stage 1

This stage is to assess the appetite for change , in essence a temperature test to establish whether significant change is possible.

Stage 1

12) Do you agree with the areas presented in the feasibility check (stage 1) ? Please select one of the options below. *

- ○ Strongly Agree
- ○ Mostly Agree
- ○ Mostly Disagree
- ○ Strongly Disagree
- ○ No View

13) Are there any areas you would add or remove from stage 1? Please indicate below.

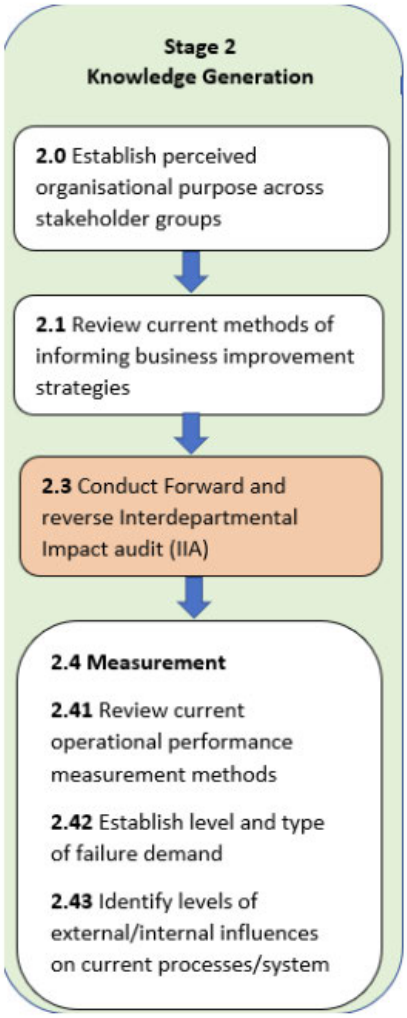
Long answer text

Section 7 of 11

Model Stage 2

This stage is to assess the current position regarding the impact of targets, communications and process measures. It adds to the feasibility check, but also starts the process of thinking differently. Please answer the questions following the diagram.

Stage 2


Stage 2
Knowledge Generation
2.0 Establish perceived organisational purpose across stakeholder groups
2.1 Review current methods of informing business improvement strategies
2.3 Conduct Forward and reverse Interdepartmental Impact audit (IIA)
2.4 Measurement
2.41 Review current operational performance measurement methods
2.42 Establish level and type of failure demand
2.43 Identify levels of external/internal influences on current processes/system

14) How important do you think it is for employees to understand the purpose (from the customers perspective) of the business operations? *

- ○ Very Important
- ○ Sometimes Important
- ○ Not Very Important
- ○ Not Important
- ○ No View

15) To what extent do you believe business improvement methods should focus just at departmental level, or they should also consider the wider organisation/supply chain? *

- ○ They should always consider the wider organisation/supply chain
- ○ They should mostly consider the wider organisation/supply chain
- ○ They should mostly just consider departmental level
- ○ They should always just consider departmental level
- ○ No View

After section 7 Continue to next section

Section 8 of 11

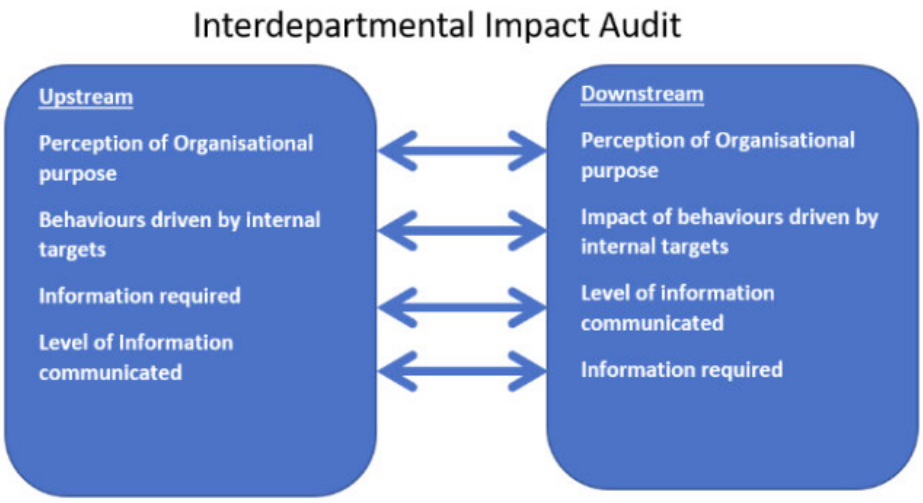
Untitled Section

The diagram (model) below highlights 4 areas of investigation (Interdepartmental Impact Audit) designed to help understand the organisation and potentially the wider supply chain more holistically, specifically regarding the impact of target driven behaviours and information flows on performance. The knowledge generated from the investigation will inform the re-design of the 'system' and associated processes.

The application of the model will require the investigator/researcher to spend time in other departments and/or the wider supply chain to gain knowledge of performance metrics and potential associated behaviours, whilst generating knowledge from within their own dept to gain knowledge of the same.

Please answer the questions following the model which are based on each phase of the model.

Stage 2.3 - Forward and Reverse Departmental Impact Audit



16) Do you think it is important to understand any impact departmental targets may have on the overall performance of the organisation? *

- Always
- Sometimes
- Rarely
- Never
- No view

17) In your experience do departments communicate information across the organisation in an effective manner? *

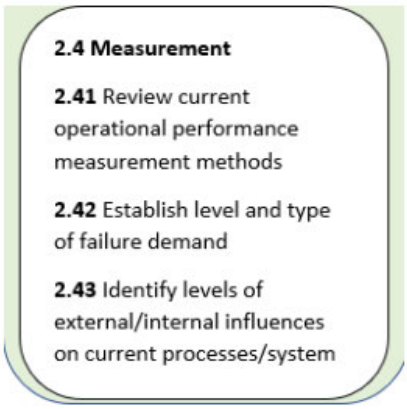
- ◯ Always
- ◯ Sometimes
- ◯ Rarely
- ◯ Never
- ◯ No View

18) In your experience do departments receive the required level of information from other areas of the organisation to ensure efficient delivery of service\product? *

- ◯ Always
- ◯ Sometimes
- ◯ Rarely
- ◯ Never
- ◯ No View

Measurement of Current Operations:

This part of the model measures down to process level, the term "Failure Demand" represents any demand on the operation that should not be there (waste) but creates the need for resource - e.g. Unnecessary process steps, call handlers for complaints, doing things twice etc. This element will determine in true terms how efficient and effective the processes are.



19) What is your view of the operational measurement criteria presented in 2.4 ?

Long answer text

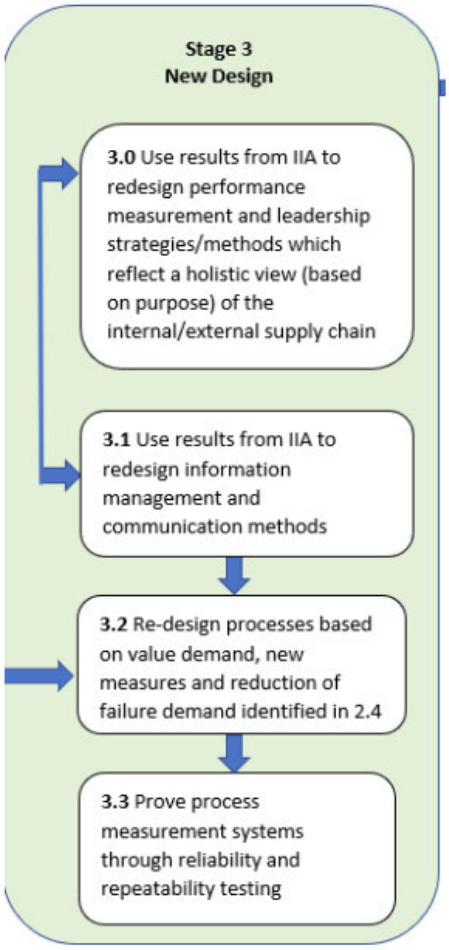
After section 8 Continue to next section

Section 9 of 11

Model Stage 3

Once the Knowledge generation has taken place, new measures of performance can be designed and incorporated into new system and process designs. This stage influences a mind-set shift regarding performance measurement methods and the level of collegial working across the organisation and wider supply chain.

Stage 3



20) Do you think the re-design elements in stage 3.0 build logically from the knowledge generation in stage 2? *

- ○ Very Logical
- ○ Mostly Logical
- ○ Mildly Logical
- ○ Not Logical

21) How important do you think it is to prove the accuracy of the measurement methods of processes ? *

- ○ Very Important
- ○ Sometimes Important
- ○ Not Very Important
- ○ Not Important
- ○ No View

22) If an organisation is trying to change the way it thinks, how important is it to incorporate new thinking into the development of organisational strategy? *

- ○ Very Important
- ○ Sometimes Important

23) Do you have any further comments on stage 3?

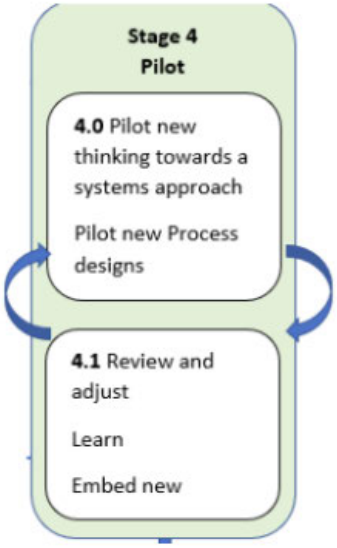
Long answer text

Section 10 of 11

Model Stage 4

This stage pilots new processes and continues to embed a new way of thinking (Systems Thinking). Pilot processes will be adjusted as required until fully proven before fully implemented in stage 5.

Stage 4



24) How important is it to run pilots before rolling out a change intervention across the whole organisation? *

- ○ Very Important
- ○ Sometimes Important
- ○ Not Very Important
- ○ Not Important
- ○ No View

25) Do you have any further thoughts on this stage?

Long answer text

After section 10 Continue to next section

Appendix D - Delphi Round 2 Survey

PhD Study - A Model for Making and Sustaining the Improvement of Business Operations Within Supply Chain Organisations

Privacy Notice and Consent:

The information that you supply for this online survey will be held and processed in compliance with the Data Protection Act 2018, the General Data Protection Regulation (GDPR) and subsequent legislation.

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The participant agrees that if they wish to withdraw from the study they will, within 21 days of providing data, communicate with the researcher to indicate they wish to withdraw and provide the self-generated unique identifier below. All data and information relating to the individual requesting withdrawal will be deleted.

The data from consenting participants will kept anonymous and will be retained until project completion and the student has received their grade and award. Following this, participant data will be securely destroyed by Simon Smith. It is anticipated that the overall findings of the study will be published in academic and/or professional journals/platforms.

If you would like any further information about the study please contact s.smith@derby.ac.uk

As a data subject you can request withdrawal of consent at any time by contacting gdpr@derby.ac.uk

Our Data Protection Officer (DPO) is Helen Rishworth on (01332) 591954. Alternatively you can email gdpr@derby.ac.uk

Further information on how we handle your information can be found here on our website - https://www.derby.ac.uk/its/datagov/privnotice/

1) By selecting below I agree to the terms of this survey *

I agree

2) Please add a unique identifier, 3 Letters & 3 Numbers (not name, birth date etc)

Short answer

Short answer text

Required

After section 1 Continue to next section

Section 2 of 11

Glossary of Terms

The survey is built from Systems Thinking theory which uses the following terms:

Purpose – The purpose of the operation(s) from the customers viewpoint (why does the operation exist), for example:

- To deliver the right product, at the right time, in the right condition, to the right place

Failure Demand - Any demand on the operation that creates the need for unnecessary resource or creates unnecessary delay, for example:

- Doing things twice due to error and/or generation of waste
- Handling customer returns due to faulty products

Value Demand – Demand on the operations that is focused on providing customer value, whilst aligning the product/service to purpose, for example:

- Delivering the right product, at the right time, in the right condition, to the right place

After section 2 Continue to next section

Section 3 of 11

Organisational Targets

The responses to the previous survey indicated the following:

- The majority of respondents believe organisations definitely need to use targets to help measure performance or use them most of the time - 19% of respondents believe they should only be used occasionally or not at all
- A slight majority of all responses indicated that departmental level performance targets only occasionally or do not at all ensure the customer is No1 focus of the operations
- The majority of all responses indicated that individual performance targets based on output volume (e.g. items packed per hour) are mostly negative for team working
- The majority of all responses indicated that departmental performance targets have a very or mostly positive impact on the upstream or downstream supply chain(s) (internal or external)

To help inform this area a little further, please answer the questions below:

3) What is the purpose of using targets when measuring performance in organisations ? *

Long answer text

4)What should be the focus for departmental performance related targets? *

- ○ The customer
- ○ Activity levels (e.g. units per hour)
- ○ Reducing cost
- ○ Departmental performance targets are not required
- ○ Other

5)Please give the reason (and any other comments)for your answer to Q4 *

Long answer text

6) Whilst responses were broad ranging, the majority of responses in the previous survey indicated that departmental performance targets have a very positive or mostly positive impact on the upstream or downstream supply chain - how do you think targets at departmental level can have a positive impact on the upstream or downstream supply chain ? *

Long answer text

7) Analysis of the comments from the previous survey highlighted that the 'type' of target and 'how' a target is set can impact performance within teams\departments and the wider supply chain. What type of target(s) do you believe can generate positive impacts within an organisation and the wider supply chain?

Section 4 of 11

Factors for Change Interventions

Description (optional)

8)A high majority of responses from the previous survey indicated the importance for organisational change to be driven by the senior leadership team. Are there any circumstances where you think it is less important for the senior leadership team to drive organisational change? *

- ◯ Yes
- ◯ No

After section 4 Continue to next section

Section 5 of 11

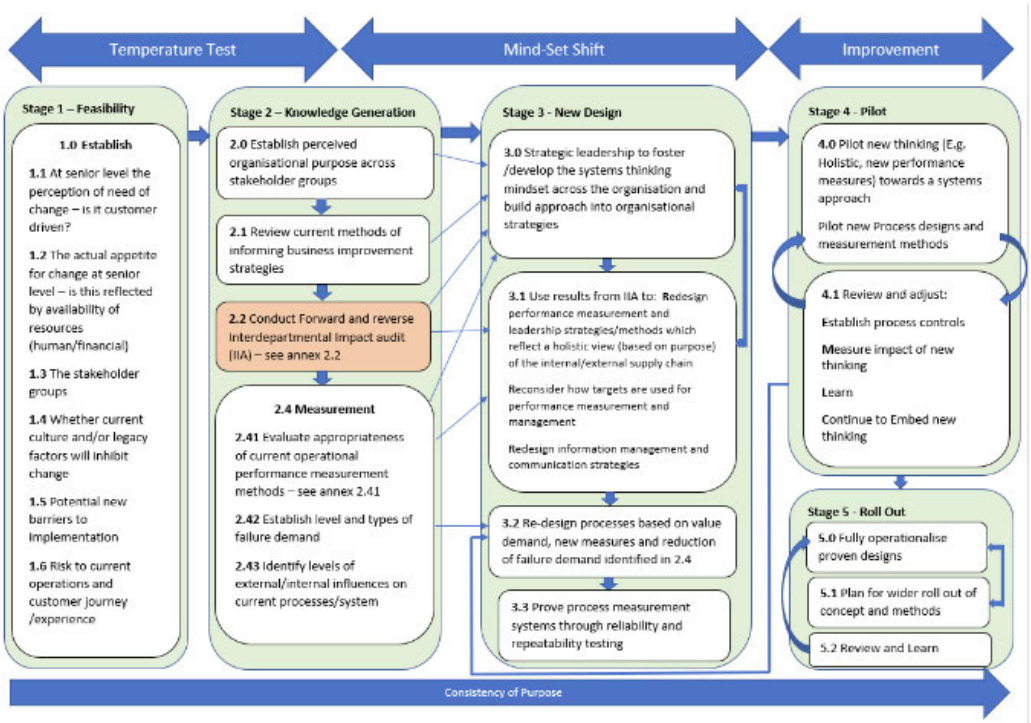
A Model for sustaining Business Improvement

The model presented below is an updated version which incorporates factors from analysing the results from the previous survey. There are still 5 stages which are designed to offer a method for making and sustaining business improvement within an organisation. The model is derived and adapted from Systems Thinking based theories, which include core concepts regarding the use of organisational targets and associated impacts on behaviour and operational performance.

The questions presented after the diagram of the model will relate to each stage and are derived from the resulting analysis of the previous survey.

Note:- The model is designed as a high level method and therefore does not include specific micro level methods for undertaking each element.

A Systems Thinking Based Model For Business Improvement - V2



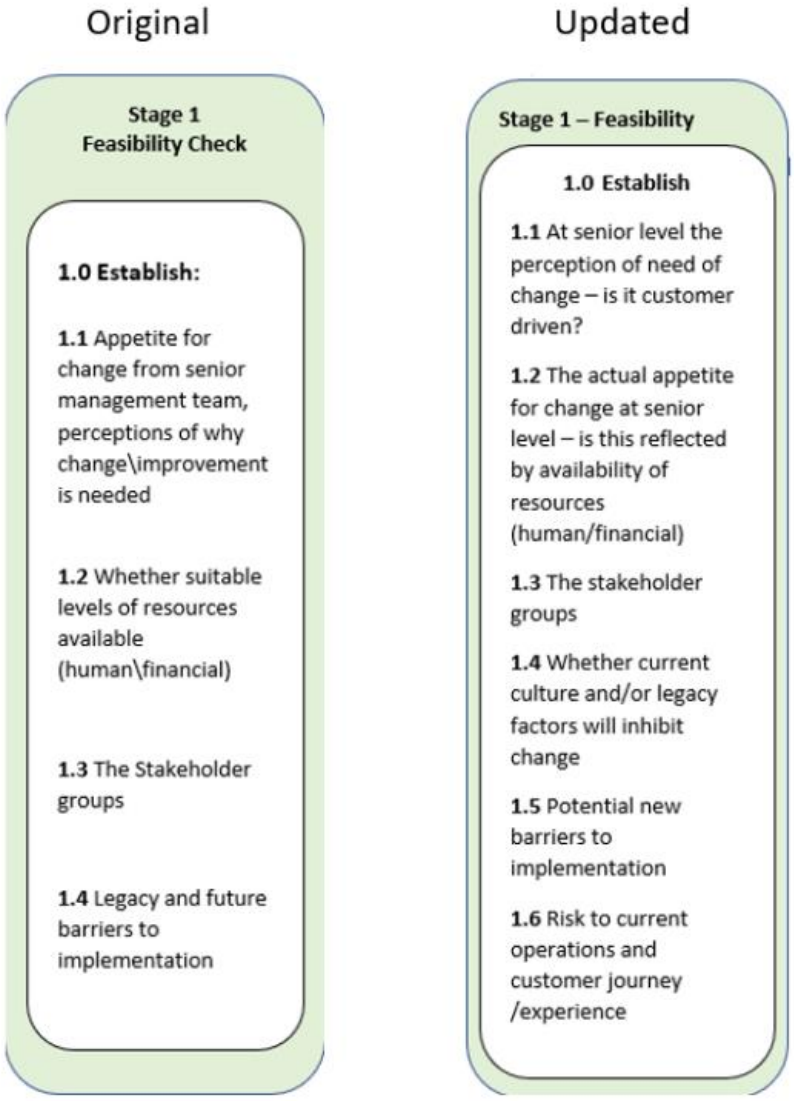
After section 5 Continue to next section

Section 6 of 11

Model Stage 1

This stage is to assess the appetite for change , in essence a temperature test to establish whether significant change is possible. Results from the previous survey indicated that no respondents disagreed with the stage, with a high majority either strongly agreeing or mostly agreeing with the stage. Analysis of comments have led to minor additions to the stage as presented below.

Stage 1



9) Do you agree with the areas presented in the updated feasibility check (stage 1) ? Please select one of the options below. *

- ○ Strongly Agree
- ○ Mostly Agree
- ○ Mostly Disagree
- ○ Strongly Disagree
- ○ No View

10) Do you have any additional comments about the stage? Please indicate below.

Long answer text

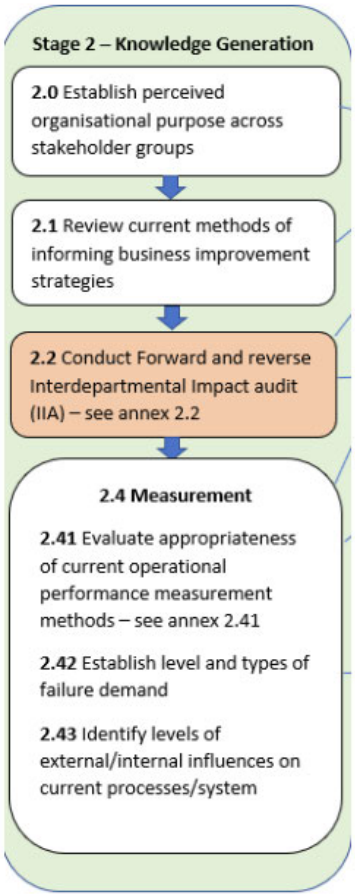
After section 6 Continue to next section

Section 7 of 11

Model Stage 2

This stage is to assess the current position regarding the impact of targets, communications and process measures. It adds to the feasibility check, but also starts the process of thinking differently. The resulting analysis of the previous survey has validated the steps in stage 2, analysis of additional comments has led to the expansion of step 2.2 and 2.4 as following the model section below.

Stage 2 - Knowledge Generation



After section 7 Continue to next section

Section 8 of 11

2.2 Interdepartmental Impact Audit

The diagram (model) below highlights areas of investigation (Interdepartmental Impact Audit) designed to help understand the organisation and potentially the wider supply chain more holistically, specifically regarding the impact of target driven behaviours and information flows on performance.

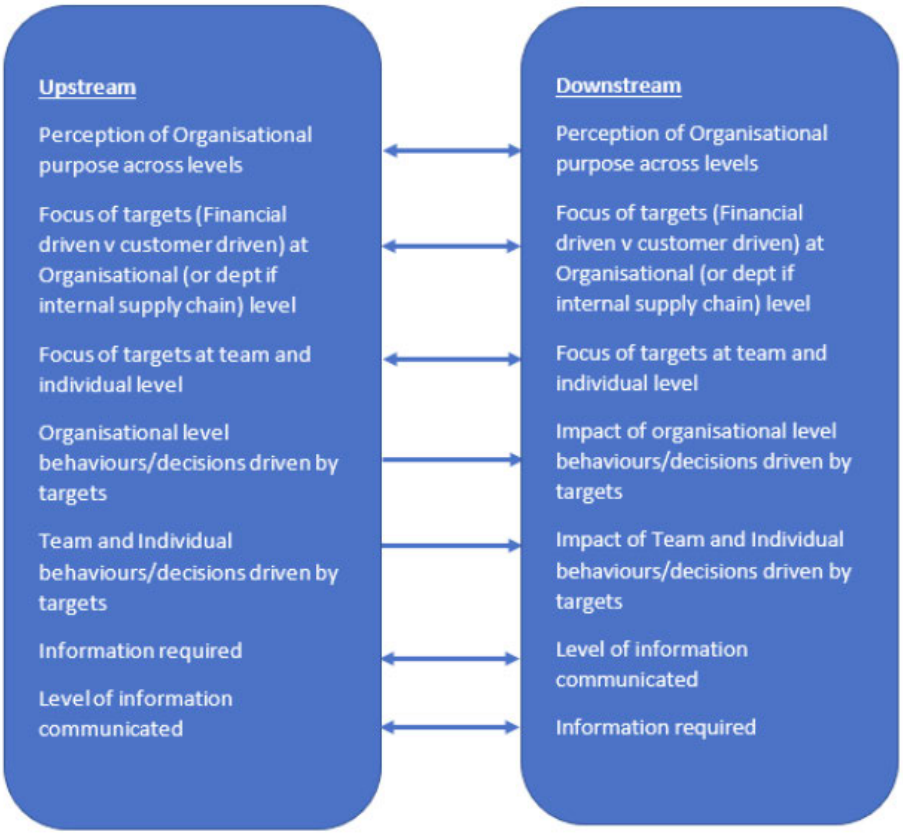
The previous survey validated the appropriateness of the IIA by strongly indicating the need for organisations to understand the impact departmental targets have on the wider organisation; in conjunction with the majority of responses indicating that departments only sometimes or rarely communicate information across an organisation in an effective manner.

Analysis of additional comments within the previous survey also highlighted that it would be beneficial to differentiate between departmental and organisational targets when measuring the impact in the IIA.
The model below has been updated in line with the resulting analysis of the previous survey. The knowledge generated from the IIA will inform the re-design of the 'system' and associated processes.

The application of the model will require the investigator/researcher to spend time in other departments and/or the wider supply chain to gain knowledge of performance metrics and potential associated behaviours, whilst generating knowledge from within their own dept to gain knowledge of the same.

Stage 2.2 - Interdepartmental Impact Audit

Annex 2.2 IIA (Interdepartmental Impact Audit)



11) Do you think the updated model will help departments/elements of supply chains to understand the wider impact of targets? *

- ○ Yes Definitely
- ○ Most Likely
- ○ Not Likely
- ○ No
- ○ No view

12) Do you think the updated model will help departments/elements of supply chains develop a greater understanding of the information needs between departments/elements of the supply chain? *

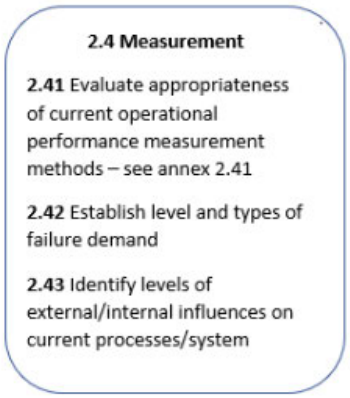
- ○ Yes Definitely
- ○ Most Likely
- ○ Not Likely
- ○ No
- ○ No View

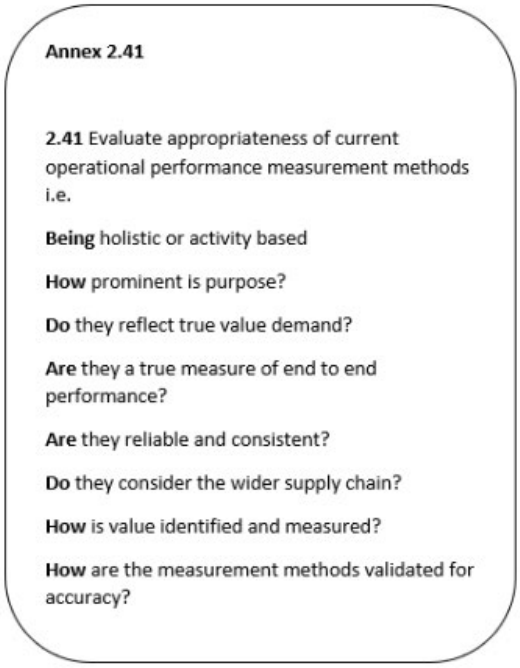
13) Please add any further comments you may have on the IIA

Long answer text

Measurement of Current Operations:

This part of the model measures down to process level, the term "Failure Demand" represents any demand on the operation that should not be there (waste) but creates the need for resource - e.g. Unnecessary process steps, call handlers for complaints, doing things twice etc. This element will determine in true terms how efficient and effective the processes are. The resulting analysis of comments from the previous survey has led to the expansion of section 2.41as illustrated below.





14) What is your view of the expanded operational measurement criteria presented in 2.41 ? *

Long answer text

After section 8 Continue to next section

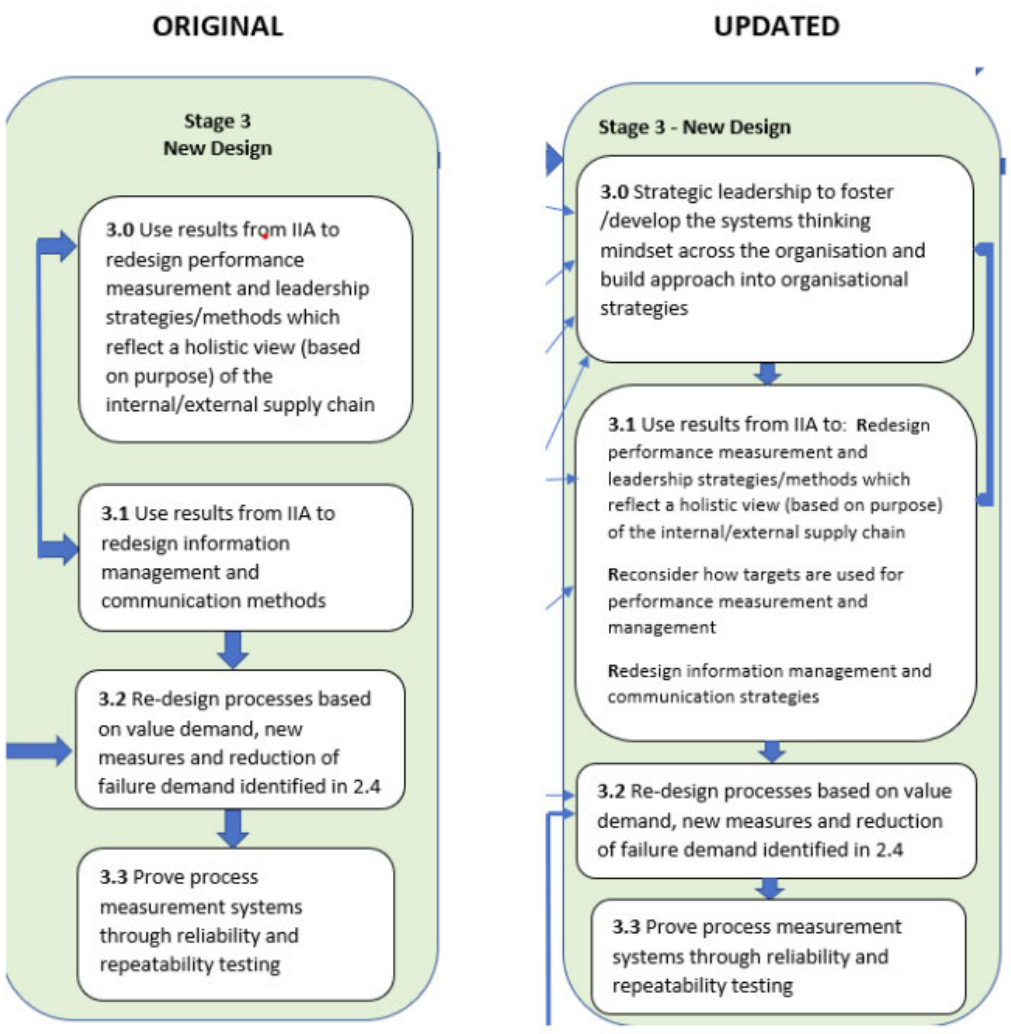
Section 9 of 11

Model Stage 3

Once the Knowledge generation has taken place, new measures of performance can be designed and incorporated into new system and process designs. This stage influences a mind-set shift regarding performance measurement methods and the level of collegial working across the organisation and wider supply chain.

Analysis of the previous survey validated the steps in stage 3, with a high majority of responses indicating that stage 3 builds logically from stage 2, and the majority of responses indicating that it is very important to incorporate new thinking into the development of organisational strategy; whilst also proving the accuracy of process measurement methods. Based on the analysis of additional comments in the previous survey, a little more clarity has been given to strategic leadership and the redesign element.

Stage 3 - New Design



15) Do you think the stages in stage 3 are clearly presented in the updated model? *

- ○ Very clear
- ○ Mostly clear
- ○ Mildly clear
- ○ Not clear at all

16) Please add any further comments you want to make on stage 3.

Long answer text

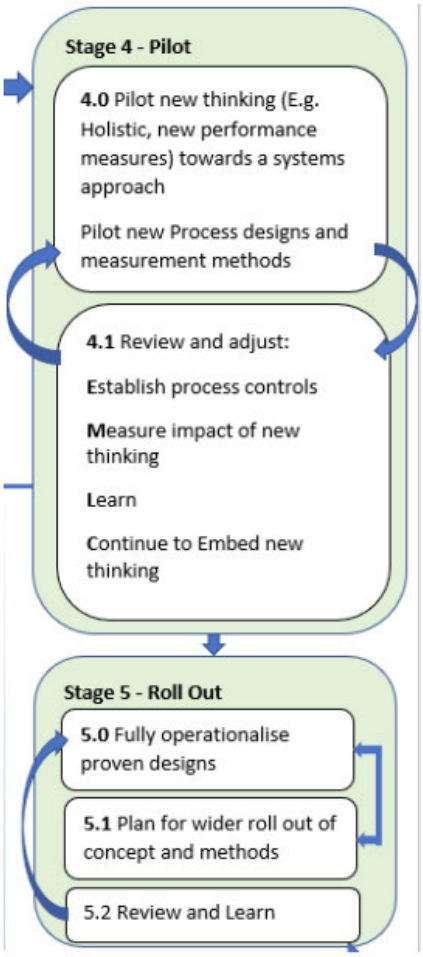
After section 9 Continue to next section

Section 10 of 11

Model Stage 4 & 5

Analysis of comments from the previous survey indicated the need to consider additional feedback loops for learning and potential adjustment in these stages. The inclusion of impact measures at stage 4.1 and a review and learn learn loop at stage 5.2 make the need for review and make potential adjustments more explicit within the model.

Stage 4



17) Please indicate below the clarity of stage 4 and 5. *

	1	2	3	4	5	
Very clear	○	○	○	○	○	Not clear at all

18) Please indicate below how logical you think stages 4 and 5 are. *

	1	2	3	4	5	
Very logical	○	○	○	○	○	Not logical at all

18) Please indicate below how logical you think stages 4 and 5 are. *

	1	2	3	4	5	
Very logical	○	○	○	○	○	Not logical at all

19) If you scored 3,4 or 5 on either or both of the previous 2 questions please indicate why.

Long answer text

After section 10 Continue to next section

Section 11 of 11

Thank You

Many thanks for spending the time on this survey, if you have any further comments on the themes presented please add them below. Please press submit at the end of the section. Kind Regards Simon Smith

General comments welcome below please:

Long answer text

Appendix E - Ethics Information

Ethical Approval Notification

College of Business, Law & Social Sciences
Kedleston Road, Derby
DE22 1GB, UK

T: +44 (0)1332 590500

Simon Smith
Doctoral Student
University of Derby
Derby

12th April 2018

Dear Simon

Re: Supply Chain Improvement: Convergence of business improvement methods, strategy and leadership for business sustainability in supply chain organisations.

This letter is to confirm that your RD7 has received ethical approval with the recommendations, listed below, for the primary research through the College of Business, Law and Social Sciences Research Ethics Committee.

- Yellow highlight to be removed – and Appendix 1 completed as necessary
- Articulate how the data is to be analysed
- Sample questionnaire (survey) to be submitted and or outline how interviews will be structured.

Note: should your research evolve and further ethical considerations arise you will need to submit an amended ethical application.

Yours sincerely

[redacted]

Dr Polina Baranova PhD FHEA CMgr MCMI
Senior Lecturer in Strategic Management
Chair of College of Business, Law and Social Sciences Research Ethics Committee
University of Derby
Kedleston Road
Derby
DE22 1GB
Tel: 01332 591192
Email: P.Baranova@derby.ac.uk

Researcher Ethical Approval Application Forms and Templates

Request for ethical approval for research undertaken by staff, post-graduate research and post-graduate professional students

Please submit your completed form to the chair of your college research ethics committee (CREC)

Your Name	Simon Smith
College	Business, Law & Social Science
College Research Ethics Committee	Business, Law & Social Science
Staff ID	SBUS204
Student ID	9114500
Unimail address	s.smith@derby.ac.uk
Programme name / code	PhD
Name of supervisor(s)	**Christine Jones , Jose Arturo Garza-Reyes**

Title of proposed research study

Supply Chain Improvement: Convergence of business improvement methods, strategy and leadership for business sustainability in supply chain organisations.

Background information

Has this research been funded by an external organisation (e.g. a research council or public sector body) or internally (such as the RLTF fund)? If yes, please provide details.	No
Have you submitted previous requests for ethical approval to the Committee that relate to this research project? If yes please provide details.	No
Are other research partners involved in the proposed research? If yes please provide details.	No

Signatures

The information supplied is, to the best of my knowledge and belief, accurate. I clearly understand my obligations and the rights of the participants. I agree to act at all times in accordance with University of Derby Policy and Code of Practice on Research Ethics: http://www.derby.ac.uk/research/uod/ethics/

Signature of applicant	[redacted]
Date of submission by applicant	02/02/18
Signature of supervisor (if applicable)	
Date of signature by supervisor (if applicable)	

Chapter 9 For Committee Use *Reference Number (Subject area initials/year/ID number)*

……..

Date received ……..	Date considered …….
Committee decision ……..	Signed ……

1. What is the aim of your study? What are the objectives for your study?

The aim of the research is to investigate and make recommendations for sustaining business improvement within a supply chain context. In particular to investigate potential gaps between the strategic leadership of organisations and business improvement strategies and methods**.**

Objective 1:
To research and give critical review to the literature relevant to business improvement and the strategic leadership of improvement interventions, reviewing the inter-relationships and critically applying these to the context of supply chain management.

Objective 2:
Build from literature reviews by conducting initial exploratory primary research, with a purpose of informing the main primary/ imperial research methods and informing initial model development. The research will inform with regard to:

- Identifying key determinants and challenges of sustaining business improvement within different scales and type of businesses (e.g. SME v Large logistics company), to inform and build the main research questions for each type of business.

- Identify and evaluate potential factors affecting different types of business (e.g. small transport v large retailer) with regard to current operational performance, to inform and build the next stage of research. For example, the detail and subject narrative (e.g. type of factor/issue) of specific research questions relative to identified factors.

Objective 3:
Through empirical research, develop a sustainable model for application to supply chain organisations for improving business systems\processes and the alignment of such business improvement methods with strategic leadership.

Objective 4:
Identify and recommend opportunities for further research and implementation of the model to different sectors and professions.

2. Explain the rationale for this study (refer to relevant research literature in your response).
Rising customer expectation and the notion of Omni channel (customer viewed as one entity across all retail channels, i.e., on-line, shop, phone) logistics are examples of how organisations working within supply chain sectors are having to improve their operations for business sustainability. Failure in service is very costly, for example, according to analysts IMRG & Blackbay (2014), failure of first time delivery could have potentially cost e-retailers in the region of £771 million during 2014. This is a significant cost to the sector, and only represents the last mile logistics element (i.e. from that last place of storage to the customer's front door) of the whole supply chain!

Research shows there has been minimal empirical research conducted within the context of supply chain management with regard to sustaining business improvement through leadership of business strategy and strategy development, particularly the strategic leadership of Systems Thinking methodologies, which are used in other sectors as a business improvement philosophy.
According to Christopher (2011) the concept of Supply Chain Management (SCM) was in its infancy less than 25 years ago, with following years evoking a shift in thinking towards what creates competitive advantage and a now much higher level of strategic thinking towards the management of supply chains. Cabral (2012) linked competitive advantage to the supply chain as a whole, but argues that few people have discussed the combined application of improvement methods such as Lean, Agile, Resilience and Green (LARG) as one model across the supply chain.
Christopher (2011) discusses many facets of SCM, including strategy, and offers sound discussion for building the foundations of a supply chain operation. However, the literature does not consider in any depth methodologies for sustainable business improvement and subsequent leadership strategies. Whilst Cabral (2012) does address the application of improvement methods, the leadership of such interventions is not discussed. Christopher (2011) follows a similar approach to other authors, where the

supply chain is broken down into sections and strategies formulated for each section, this approach arguably does not view the supply chain as a 'system' (Seddon, 2008) and therefore highlights the potential to explore and exploit a Systems Thinking methodology within future supply chain literature and application to such organisations.

This study will focus on three main areas of research – Business improvement methods, Leadership and Organisational strategy. The research will be applied to organisations providing products and services within a supply chain, the context of which includes any one or more element of the supply chain, for example, a large manufacturing organisation operation operating across various areas of a supply chain, or a SME (small to medium enterprise) working at one end of the supply chain.

The research will build on previous work from various authors in the form of doctoral studies and publications, notably the work of Marshall (2012) and Seddon (2008), specifically in the area of sustaining business improvement interventions through strategic leadership, these works will be applied to the supply chain.

3. Provide an outline of your study design and methods.

The research will adopt a multi-method strategy, including survey and case study methods leading to abductive research (Saunders et al, 2013) Surveys and questionnaires will reflect quantitative data collection and analysis strategies, semi – structured interviews will reflect qualitative research methods and strategies, including qualitative data for generating information such as opinion and discussion outcomes.

If deemed appropriate additional methods of data collection will be also be used, these include:

Focus groups - Aimed at discussing specific issues or scenarios, a focus group could include people across a range of different levels within the organisation.

Observational Research - With permission from the respondents and the organisation, observational study could take place in various forms. For example - attendance of meetings, observing operational activities, attendance in training sessions.

Analysis of company data - With full permission from the organisation, company data could be used for specific quantitative analysis of performance measurement data.

The research design will be informed and influenced by relevant theory and research. For example, adaptation of a Systems Thinking approach developed by Seddon (2008) and the empirical research conducted by Marshall (2012). Such research will help underpin and support rationale in areas such as the design of research questions and identification of respondent type.

Whilst in-depth secondary research will identify inter-relationships with regard to business improvement, strategy and leadership, initial exploratory research with sample organisations will be inductive and inform the main research, including initial perceptions of the challenges of sustaining business improvement methods. The exploratory research will also inform further empirical research, which will be undertaken within a range of organisations (Circa.2-5).

The research will primarily focus at management level, however, if deemed appropriate research at front line levels will also be undertaken (e.g. process engineers, planners, quality team members).

The analysis of the data will be used to formulate and build the model (objective 3), fill potential gaps in current literature and identify opportunities for further research. Upon completion of the model the researched organisations will have the opportunity to give peer review, data collection for analysis of such review will be in the form of one or more of the methods discussed above.

The following table highlights the data collection methods to be undertaken within the organisations:

	Data Collection Method				
Company	Semi – Structured Interview	Survey - Questionnaire	Use of company data	Observational	Focus groups
Exploratory research companies	**x**	**x**	**x**		**x**
Main Research companies	**X**	**x**	**x**	**x**	**x**

4. If appropriate, please provide a detailed description of the study sample, covering selection, sample profile, recruitment and inclusion and exclusion criteria.

Respondents will reflect a range of positions within live organisations. The majority of respondents will currently be working within the live organisations, however, a small number of respondents may no longer be working (e.g. retired, between jobs). Research undertaken with such respondents will not be part of any case study research and will reflect general market research, for example: Establishing generic supply chain challenges as part of the exploratory research.

The following table highlights the respondent types with regard to position in the organisations**:**

	Position in Organisation				
Company	Senior Manager or Exec level	Divisional Management	Departmental Management	First line Management	Frontline staff
Exploratory research companies	**x**	**x**	**x**	**x**	
Main Research companies	**x**	**x**	**x**	**x**	**x**

The sample sizes for the interviews will be relatively small (circa 1-3 people per company), interviews will be conducted mainly with Senior and Divisional management and will be used to collect data about the broader business, for example: Strategy development, long term goals, business impact measures.

It is anticipated that sample sizes for surveys will be circa 20-50 people per company, surveys will potentially cover the whole range of positions and will be used to collect data about perception, opinions and knowledge across many subject areas.

Focus groups and observational research will be conducted in relatively small numbers each time (circa 3-10 people) but could take place with multiple groups depending on the size of the organisation(s). Focus groups could be undertaken with representatives from most positions, or with people within one specific area depending on the area being studied. Observational research could also include people from most positions, but is most likely to be undertaken with front line operational staff. These methods will be used to explore subject areas to a deeper level, for example: How certain concepts are operationalised, understanding actual operational impact of business strategy, or debating current use of KPI measures.

Sample question types:

Until the final research design is complete it is not possible to append a complete list of questions.

However, the questions can be categorised into 3 main areas, with sample question types as below:

Perception

Relative to your position\dept, what is the level of impact of current process improvement initiatives?
Are current departmental targets aligned to the overall business strategy?
Does the organisation communicate with staff effectively?

Knowledge
Do you know what the long-term strategy is for business improvement?
What are the current quality conformance measures used by the organisation?
How are KPI's measured?

Opinion
Do you think quality management accreditations are of value?
Should people be rewarded for exceeding targets?
Should organisations always use technology when possible?

The research will not seek to ask questions of a personal nature, for example - age, religion, gender.
No staff members will be named within any question type.

5. Are payments or rewards/incentives going to be made to the participants? Yes ☐ No ☐
If so, please give details.

6. Please indicate how you intend to address each of the following ethical considerations in your study. If you consider that they do not relate to your study please say so.
Guidance to completing this section of the form is provided at the end of the document.

l. **Consent –** Covered by Participant Briefing and Consent Letter (Appendix 1)
m. **Deception -** This research does not use a covert or deceptive approach
n. Debriefing – Covered by Participant Debriefing and Withdrawal Letter (Appendix 2)
o. **Withdrawal from the investigation -** Covered by Participant Briefing and Consent Letter and the Participant Debriefing and Withdrawal Letter.
p. **Confidentiality -** Covered by Participant Briefing and Consent Letter and the Participant Debriefing and Withdrawal Letter. Research with organisations and individuals will comply with the Data Protection Act and the University's Good Scientific Practice.
q. **Protection of participants -** The participants are not at risk of physical, psychological or emotional harm greater than encountered ordinary life
r. **Observation research -** No observational research will be conducted without prior managerial consent**.** Any observational research undertaken will be business process related not be measuring the behaviour of individuals.
s. **Giving advice -** No advice will be given and in all cases I will refer participants to suitably qualified and appropriate professionals.
t. Research undertaken in public places – No research to be undertaken in a public place
u. **Data protection** - Covered by Participant Briefing and Consent Letter and the Participant Debriefing and Withdrawal Letter. Encryption will be used to protect all data.
v. Animal Rights - No animals are being used in this research

w. **Environmental protection -** The research is compliant to current legislations, and any negative impacts of the research on the natural environment and animal welfare will be minimised – for example: travel, use of paper.

Are there other ethical implications that are additional to this list? Yes ☐ No ☒

7. Have / do you intend to request ethical approval from any other body/organisation? Yes ☐ No ☒

If 'Yes' – please give details

8. Do you intend to publish your research? Yes ☒ No ☐.

If 'Yes', what are your publication plans?

Research will be publications will be in the form of:

- A book
- Conference papers
- Journal articles**.**

Appropriate permission will be obtained from the relevant organisation prior to compiling any research that may publish an organisations name.

9. Have you secured access and permissions to use any resources that you may require? (e.g. psychometric scales, equipment, software, laboratory space). Yes ☒ No ☐.

If Yes, please provide details.

SPSS
Excel
Word
MS project
Mendely

10. Have the activities associated with this research project been risk-assessed? Yes ☒ No ☐

The requirements of any risk assessments will be undertaken in-line with University and company procedures appropriate to the relevant company (for example; specific H&S requirements on site).

Which of the following have you appended to this application?

❑ Focus group questions

❑ Psychometric scales

❑ Self-completion questionnaire

❑ Interview questions

❒ Other debriefing material

Chapter 10 ❒ Covering letter for participants

❑ Information sheet about your research study	Chapter 11 ❑ Informed consent forms for participants
❑ Location consent form	❑ Other (please describe) Sample question types included in section 4

PLEASE SUBMIT THIS APPLICATION WITH ALL APPROPRIATE DOCUMENTATION

Dear Participant,

PhD – Participant Briefing and Consent Letter

I am Simon Smith and I would like to collect information from you which will be used in my Thesis for the **name of organisation to be inserted where appropriate**, as part of my PhD at the University of Derby.

The aim of the dissertation research is to investigate and make recommendations for sustaining business improvement within a supply chain context. The information you will be asked to provide will be used to help to provide insights to achieve this objective.

The data you provide will only be used for the Thesis, will be held securely and your name will be anonymised. Your data will not be disclosed to any third party, except as part of the dissertation findings, or as part of the supervisory or assessment processes of the University of Derby.

The data you provide will be kept until March 2025, so that it is available for scrutiny by the University of Derby as part of the assessment process.

If you feel uncomfortable with any of the questions being asked, you may decline to answer specific questions. You may also withdraw from the study completely, and your answers will not be used.

And, if you later decide that you wish to withdraw from the study, please email me at s.smith@derby.ac.uk within 1 month of completing the questionnaire\interview and I will be able to remove your response from my analysis and findings, and destroy your response.

I have read and understood the contents of this consent and briefing form, and freely and voluntarily agree to participate in this research.

I am happy to be identified as a participant in the research by my position at work (eg as a member of the executive committee).

Signed

Date…….

Please print name

Dear Participant,

Participant Debriefing and Withdrawal Letter PhD

Thank you for agreeing to participate in my research, your help was much appreciated and I can confirm the following:

- The information I collected from you will be used in my Thesis as part of my PhD at the University of Derby.

- The aim of the PhD research is to investigate and make recommendations for sustaining business improvement within a supply chain context. The data you provided will be used to help to provide insights to achieve this aim.

- The individual data you provided will only be used for the PhD thesis, and will not be disclosed to any third party, except as part of the PhD findings, or as part of the supervisory or assessment processes of the University of Derby.

- The data you provided will be kept until March 2025 so that it is available for scrutiny by the University of Derby as part of the assessment process.

- If you later decide that you wish to withdraw from the study, please email me at s.smith@derby.ac.uk within 1 month of completing the questionnaire\interview and I will be able to remove your response from my analysis and findings, and destroy your response.

Debriefing will be possible post data analysis, if you would like to be debriefed with regard to aspects\progress of the study please do not hesitate to contact me via email (s.smith@derby.ac.uk) and a summary will be provided. A more detailed debriefing will be available upon request post full completion of the study.

Kind Regards

Simon Smith
Date:

Survey 1 - Sample invitation to complete letter communication

Dear xxxx
Thank you so much for agreeing to participate with my PhD survey, it should only take approx. 20 – 25mins.
I am currently working on developing a method (using a model) to sustain operational improvements within supply chain related organisations.
The survey is a multi-stage survey (Delphi study), in a few months' time I would like to invite you again to undertake a revised version which will incorporate modifications built from the results of this survey – There will only be 2 stages.
Your support is very much appreciated, please click the link below to start the survey (I have attached an additional PDF of the model and general survey information to this mail should you need it).

https://forms.gle/hWQQsRR8MTk72Pkm6

Once again, many thanks

Best wishes

Simon

Survey 2 Sample invitation to complete letter communication

Dear xxxxx
I hope this message finds you well.
Thank you so much for helping with my previous PhD survey (model to sustain operational improvements in supply chain); I have analysed the results from the survey and have updated the model based on the results.
I would be very grateful if you could spare the time (approx. 15-20mins) to complete the 2nd and final survey, I am at a crucial point in my PhD research and your continued support would be very helpful and most welcome. If you are able to complete over the next week or at your earliest convenience that would be really great.

I have attached an additional PDF of the model (it is quite small in the survey) and general survey information to this mail should you need it.

Please click the link below to start the survey.

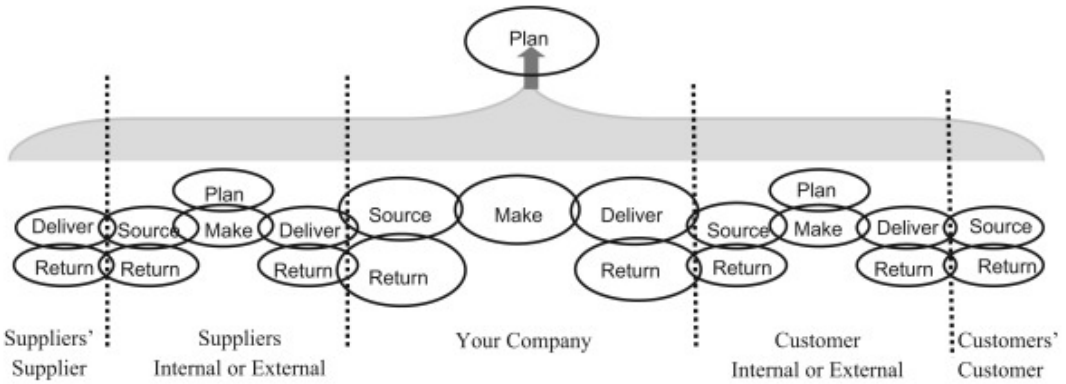
https://forms.gle/p8dUVzQGF3m43fsDA

Once again, many thanks

Simon

Appendix F – SCOR Model

An adapted Schematic representation of SCOR management processes (Ntabe et al ,2015)



According to Ntabe et al (2015) , the SCOR model is structured around 5 processes of Plan, Source, Make Deliver and Return, highlighting that application of SCOR is an enabler for organisations to examine their supply chains, giving a process architecture to define how the processes interact and perform.