The Relationship between Lean and Performance Measurement in Service and Manufacturing Organisations in New Zealand

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Abstract

This thesis examines the relationship between lean and performance measurement systems (PMSs) in New Zealand private and public organisations. There is a dearth of research on lean and PMSs, despite the importance of understanding this relationship. To provide insights and an understanding of this relationship, this study identifies and examines lean techniques and the corresponding performance measures applied to measure lean performance. The research data were analysed using Searcy's (2004) framework of lean performance dimensions and the findings were informed by contingency theory. The research conclusions were drawn from qualitative interpretations of the data through thematic analysis.

The research findings show that lean is still in an emergent state in New Zealand and that managers associate lean with reducing waste to reduce costs, promote continuous improvement, improve quality, and deliver customer value. This differs from the global perspective of providing customer value through continuous improvement (Thornton et al., 2019; Albzeirat et al., 2018). The lean techniques implemented by the lean organisations reflect the managers' association of lean with reducing cost and promoting continuous improvement, with a marginal focus on improving customer value.

Organisations that successfully use lean techniques remain in a 'black hole' between measuring lean performance and the inclusion of lean performance dimensions in the PMS. Less than half of the organisations adapted their PMSs to include lean performance, nor did they implement specific lean KPIs to measure and evaluate lean performance. In those organisations where managers had identified, implemented, and used critical lean success factors, they had concurrently modified their PMS to include lean KPIs. Nonetheless, dollars

saved are still recognised as the most important lean contribution, subsequently, once dollar-related goals were reached, organisations restored their traditional PMSs. As such, lean performance was neglected, and the existing lean practices were not associated with PMS. Ultimately, most organisations did not adapt their PMSs sufficiently to accommodate lean, and consequently, the organisations' PMSs did not adequately capture lean outcomes.

The implications for organisations and CEOs are that they need to shift focus from cost savings and profits to lean techniques and map the correct key performance indicators to the PMS to fully measure and evaluate lean outcomes.

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List of Abbreviations

ABC:	Activity Based Costing
AS/NZS ISO:	Australian and New Zealand International Standard Organisation
CEO:	Chief Executive Officer
CFO:	Chief Financial Officer
CI:	Continuous Improvement
CLSF:	Critical Lean Success Factor
COO:	Chief Operating Office
CT:	Contingency Theory
DC:	District Council
DHB:	District Health Board
ED:	Emergency Department
GAAP:	Generally Accepted Accounting Principles
GDP:	Gross Domestic Product
IFRS:	International Financial Reporting Standards
IMVP:	International Motor Vehicle Programme
JIT:	Just-in-Time
KPI:	Key Performance Index
LG:	Local Government
LPDs:	Lean Performance Dimensions
LSS:	Lean Six Sigma
MIT:	Massachusetts Institute of Technology
NZTE:	New Zealand Trade and Enterprise
OEE:	Overall Equipment Effectiveness

PMS: Performance Measurement System

PY: Poka-Yoke

ROA: Return on Assets

ROI: Return on Investment

SMEs: Small and Medium Enterprises

SMED: Single-Minute-Exchange-of-Die

SS: Six Sigma

TPM: Total Productive Maintenance

TQC: Total Quality Control

TQM: Total Quality Management

VM: Visual Management

VSC: Value Stream Costing

VSM: Value Stream Mapping

CHAPTER 1 INTRODUCTION

1.1 Introduction

Lean is a philosophy based on waste reduction techniques that maximises the value of the product and services, as perceived by the customer, through minimization of waste (Sundar et al., 2014). This is achieved by aligning production flow with customer pull and through continuous improvement to eliminate waste. Lean has been identified as best practice for manufacturing organisations (Agarwal et al., 2013) and is implemented to achieve world-class performance levels. Many techniques have been proposed and developed to assist with this process in relation to the philosophy of lean, such as continuous improvement, waste reduction, quality products and services and optimum customer value.

One of the requirements for the successful implementation of lean has been identified as the need for an effective communication system (Stevanović & Čečević, 2018), in the form of an appropriate performance measurement system (PMS). The PMS organises the process of collecting, analysing, and reporting information regarding the performance of an organisation. Traditional PMSs have been shown to be inappropriate to use in lean organisations, because lean organisations do not fit traditional mass-production aimed at a push system of production at the lowest cost (Kennedy & Brewer, 2006). Lean organisations, therefore, require an appropriate PMS that can adequately assess whether lean outcomes align with the strategic aims of the organisation.

This study examines the relationship between the lean techniques implemented and the performance measures applied to measure the outcomes of lean in service and manufacturing organisations in a New Zealand context. The study draws on qualitative analysis to interpret the collected data and inform the research findings using contingency theory.

The remainder of this chapter is structured as follows: section 1.2 discusses the background and context of the study and section 1.3 the research problem. Section 1.4 sets the aims, objectives, and research questions, section 1.5 presents the significance of the study, and section 1.6 introduces the theoretical framework applied. This is followed by section 1.7 that explains the research methodology and methods, and finally, section 1.8 sets out the structure of the thesis.

1.2 Background of the study

Lean was first developed in the automotive sector but has progressed into many other manufacturing sectors and the service sector (Bhamu & Sangwan, 2014). Most studies on lean focus on either the manufacturing sector or the service sector, with minimal studies set in both sectors (Danese et al., 2018). As lean evolved, the number of lean techniques grew rapidly (Repenning & Sterman, 2001) and accordingly, lean took on different meanings and different settings which has led to its implementation fluctuating between organisations (Hines et al., 2004).

Organisations implement lean for a variety of reasons with a focus on positively influencing operational performance and assisting organisations to achieve world-class performance levels (Negrão, et al., 2017; Fullerton et al., 2014). Regardless, organisations are not always successful in the implementation of lean, with several obstacles that complicate and prevent the successful implementation of lean, such as the cost of implementing lean and employee resistance to the implementation. The lean literature has proposed critical success factors for lean, which are those aspects of an organisation that must be focused on to ensure the successful implementation of lean. Correct performance measurement is a critical success factor of lean, which can play an important role in the effective implementation of new production methods based on the lean philosophy (Samuel et al., 2015).

Performance measurement is critical to support managers in achieving organisational performances (Marchand & Raymond, 2018; Bititci et al., 2011). Performance measurement essentially focus on ensuring and maintaining the effectiveness of the production process by optimising available organisational resources, technical as well as human (Bellisario & Pavlov, 2018). Lean organisation still shows a bias towards operational analysis, but strategic level analysis needs to be explored (Bellisario & Pavlov, 2018). Organisations focus mainly on evaluating the operational side of the business but as lean is viewed as an organisation-wide philosophy, the strategic side of the business is also important. Traditional performance measurement, which is based on mass-production, is not suitable for lean organisations, which is based on the opposite of mass-production (Bhamu & Sangwan, 2014; Luo & Brozovsky, 2013). Accordingly, performance measurement must change substantially to adapt to lean (Kroll, 2004), and it is important to determine what performance measures lean organisations implement to determine its suitability for a lean organisation.

Searcy’s (2004) lean performance dimensions (LPDs) have been proposed by lean literature as appropriate to measure lean outcomes. Searcy expanded the four balanced scorecard principles (Kaplan & Norton, 1992) to six lean performance dimensions and aligned them specifically to lean.

New Zealand provides a unique setting to undertake this study because there is evidence that in New Zealand, the government, unlike the governments of developed economies, initiated the adoption and implementation of lean philosophy by New Zealand organisations. Additionally, New Zealand has a much smaller economy and population, high labour costs due to strict labour laws, and a relatively open economy leading to high levels of global competition (Agarwal et al., 2013). Besides, most organisations in New Zealand fall into the Small and Medium Enterprise (SME) category (Thornton et al., 2019) making up 97% of all New Zealand firms, and form an important driving force behind the New Zealand economy (Ministry of Economic Development, 2011). Research that addresses lean in SMEs is scarce (Alkhoraif, et al., 2019; Hu et al., 2015) and as such, setting this study in New Zealand, where organisations are predominately SMEs, will contribute to the current limited knowledge on lean in SMEs.

Table 1.1 provides a summary of prior studies identified from a review of the extant literature undertaken for this study. These studies set the precedent for this research. They provide an understanding of the lean techniques applied by organisations, globally, the underlying differences between lean and traditional production processes that necessitate different PMSs, an understanding of Searcy's LPDs, and the role organisational strategy plays in lean.

Table 1.1: Prior Research on Lean Informing this Study

Research Areas	Main Ideas	References
What lean applications/techniques have organisations implemented?	• Discuss the first two components of lean: JIT production and 'respect-for-human.	Sugimori et al. (1997)
	• Identified lean tools: VSM, Kanban, JIT, TPM, 5S, Cellular Manufacturing, Continuous Improvement, TQM, Kaizen, SMED, Visual control, Supplier relationship, Poka-Yoke, Standardised work, simulation. • The different tools are not implemented in isolation but are used in combination with each other.	Bhamu and Sangwan (2014)
	• Identified lean tools: TPM, OEE, TQM, Cellular manufacturing, SMED systems and Error, Poka-Yoke, VSM, JIT, Kanban, VSM, Kaizen, 5S, Visual Management, • Industries are adopting only some of the lean tools instead of deploying the tools 'holistically, integrated, and comprehensively sustainable'.	De Oliveira et al. (2019) (p.982).
What performance measurements have organisations implemented as part of their performance measurement to accommodate lean implementation? What type of relationship exists between the current performance measures used and lean tools/techniques?	• Traditional performance measurement is based on organisations that use mass production. • Lean accounting provides performance information for management control.	Luo & Brozovsky (2013)
	• Lean is based on the opposite of mass-production. • Lean avoids inventory build-up. • Lean manufactures to customer demand.	Bhamu and Sangwan (2014)
	• Identifies the difference between traditional and lean accounting.	Lin & Qingmin (2009)
	• Traditional performance measurement measures the wrong costs in terms of lean. • Accounting control and measurement methods must change substantially to adapt to lean.	Kroll (2004)
	• Three key aspects of lean accounting; Visual Management, Value Stream Management, Continuous Improvement.	Maskell & Baggaley (2006)
Do the performance measurements implemented relate to Searcy's (2004) lean performance dimensions, and if so, how?	• Identified the six lean performance dimensions: Financial, Customer, Operating Performance, Learning & Growth, Safety & Quality.	Searcy (2004)
	• Alignment of Kaplan and Norton's (1992) balanced scorecard with Searcy's (2004) lean performance dimensions.	Baroma et al. (2013) Stevanović and Čečević (2018) Longoni et al. (2013)
	• New Zealand managers have limited awareness and understanding of the lean performance dimensions. • They focus on the operating performance dimension. • Limited focus on customer value, quality, employee satisfaction, and safety dimensions.	Thornton et al. (2019)
Do organisations' managers view lean as part of their organisational strategic aims, and if so, how?	• Major barrier to lean implementation is that it is seen as an operational activity. • Lean should be viewed as an organisation wide philosophy or strategy. • Lean must be a way of thinking that influences all aspects of an organisation.	Bhasin and Burcher (2006)
	• Lean should be implemented at a strategic level.	Bellisario and Pavlov (2018)

1.3 Research Problem

A comparison between New Zealand and global lean research, as presented in Table 2.6, has shown that both New Zealand and global lean research have extensively researched the implementation of lean and the discovery of the outcomes of lean. Global research has also focused on conceptualising lean and on the relationship between lean and other disciplines. New Zealand research has also focused on lean emergence and the relationship between lean and accounting systems. However, neither global nor New Zealand research has investigated the relationship between lean and performance measures. This has also been highlighted in lean research that claims that research has been slow at aligning performance measurement with a lean strategy (Castellano & Burrows, 2011; Haskin, 2010).

Although New Zealand's lean literature has investigated lean in terms of accounting systems and management accounting systems, the literature does not cover the PMS of lean organisations and how it relates to Searcy's (2004) LPDs. Thornton and Nath (2015) examined the current level of understanding and use of lean in New Zealand and noted that organisations adjust their accounting processes to align to their lean strategy. However, the authors did not relate the organisations' understanding of lean back to the LPDs. Thornton et al. (2019) investigated lean in terms of the LPDs and indicated that New Zealand managers note efficiency, elimination of waste, cost reduction, and meeting customer demands based on secondary sources as prevalent dimensions of lean in New Zealand, and that managers do not understand the importance of customer value and product quality. The study, however, failed to fully relate the adaptions organisations made to their PMSs to Searcy's LPDs, in terms of measuring the outcomes of lean.

Merchant & Van der Stede (2016) claim that an adequate PMS increases the probability that organisations can monitor their activities thus increasing their capability of meeting their stated objectives. Research has not investigated the relationship between lean and performance measures or linked the performance measures implemented by lean organisations to Searcy's LPDs to form an adequate lean PMS that will appropriately measure the outcomes of lean.

1.4 Aims, Objectives and Research Questions

Given the lack of research on lean performance measures appropriate for a lean organisation and the relationship between lean performance indicators and PMSs, this study aims to establish the relationship between lean and the performance measures in service and manufacturing organisations in a New Zealand context.

The general objectives of the study are to:

- Reveal the current understanding and use of lean in New Zealand in terms of lean techniques implemented in manufacturing companies, service companies, wholesale and retail companies, DHBs, and LGs.
- Provide insights into the current understanding and use of performance measurement in New Zealand in terms of what current measures are used, what the relationship between the performance measures and the lean techniques implemented is, and if these relate to Searcy's LPDs in manufacturing companies, service companies, wholesale and retail companies, DHBs, and LGs.

- Establish if the organisations' PMSs were aligned with their strategic objectives of implementing lean organisational policies in manufacturing companies, service companies, wholesale and retail companies, DHBs, and LGs.

To address the general aim and objectives of this research, the study will attempt to answer the following six research questions:

- *RQ1: What lean techniques have organisations implemented?*
- *RQ2: What performance measures have organisations implemented as part of their performance measurement to accommodate lean implementation?*
- *RQ3: What type of relationship exists between the current performance measures used and the lean techniques?*
- *RQ4: Do the performance measures implemented relate to the lean performance dimensions, and if so, how?*
- *RQ5: Do organisations' managers view lean as part of their organisational strategic aims, and if so, how?*
- *RQ6: What factors drive the implementation of lean techniques, the application of performance measures to measure lean outcomes, and the relationship between the lean techniques and the current performance measures?*

1.5 Significance of the Study

The research findings will have implications for practitioners, academics, and policymakers. The term ‘practitioners’ is applied in this study to refer to all the participants who took part in the study via the online survey and face to face interviewees, these participants were associated with the practice and implementation of lean in various organisations, thereby representing the different sectors. They comprised of the CEOs, CFOs, COOs, and managers. This research makes three significant contributions. First, the findings add to the literature on lean in a New Zealand setting. There is a large body of research on lean directly related to the evaluation process and applications of lean principles (Albzeirat et al., 2018), and also the dissemination of the knowledge on lean (Samuel et al., 2015) but, research in a New Zealand context is minimal (Deakins & Bensemann, 2019; Grigg et al., 2018; Wilson et al., 2018; Doevendans et al., 2015; Vilasini et al., 2014; Agarwal et al., 2013; Basnet et al., 2006; Dyer, 1998). With New Zealand being so different from the global market, as discussed above, this research can provide New Zealand firms with valuable insights and assist them in growing their business and becoming more competitive, nationally, and internationally.

Second, the research will provide information regarding the relationship between lean management and performance measurement. It has been established that lean implementation promotes improved performance (Fullerton et al., 2014), and that management commitment is crucial for successful implementation (Sharma & Thakar, 2017). This can provide valuable information to managers at the strategic and operational level of manufacturing and service firms, policymakers, and practitioners, about which aspects of performance measurement promote the successful implementation of lean.

Third, the study also has implications for academics. Tertiary education institutes can enhance their curriculum with research-based data, and so provide students with contemporary skills regarding lean techniques and appropriate performance measures that they can apply in practice. Managers engaged in policymaking within an organisation and at industry level can use the findings to develop organisational and industry level policy to ensure that measurement of lean performance is included in a generic performance evaluation system. Policymakers with Ministry of Business and Innovation can ask for Organisations to incorporate the significance of identification and inclusion of lean critical success factors, lean performance indicators and the use of lean targets in Organisational Corporate Plans.

1.6 Theoretical Framework

This research will be grounded in the assumptions of contingency theory (CT).

CT states that because organisations are not closed systems and are persistently open to contingency factors, no general set of approaches can be applied to every business situation (Otley, 1980). Accordingly, organisations with different organisational strategies will require different PMSs, and therefore organisations with a lean strategy will require a PMS aligned to lean to adequately measure lean outcomes. Furthermore, the central focus of this theory is contextual factors within which organisations operate, which would impact on the lean techniques used, the adaption of LPDs and its consequent impact on the PMS.

Furthermore, the literature shows that CT is the most used theoretical perspective in global lean research. However, there are very few lean studies in a New Zealand context that have used CT. This provides further motivation for the application of CT in this study.

1.7 Research Methodology and Methods

This study is primarily qualitative in nature as it aims to illuminate the relationship between lean and lean performance measures in service and manufacturing organisations in New Zealand.

Data collection will consist firstly of the perusal of web-based archival publicly available documents and webpages, secondly through an online survey, and lastly by using semi-structured interviews. The semi-structured interviews will augment the data collected from public archival documents, webpages, and the online survey. The survey consists of closed-ended and open-ended questions, with the semi-structured interviews consisting of open-ended questions. The open-ended questions provided context to close-ended questions and provided a deeper understand of the topics.

A thematic analysis of the data collected through web-based search, survey, and semi-structured interviews, will be conducted based on Miles, Huberman, and Saldana's (2020) data analysis. This method will draw out the relevant interpretations, meaning, and contextual insights provided by the data to elucidate the relationship between lean and performance measures. The assumptions of CT are applied to inform the findings of the study.

1.8 Structure of the Thesis

This thesis consists of eight inter-related chapters.

1.8.1 Chapter 1: Introduction

Chapter one introduces the study by providing the nature and background of the research. This chapter elaborates on the research aim and objectives and the importance of the study. It also presents the contribution of the thesis to the lean and performance measures literature and the importance of the relationship between these two concepts.

1.8.2 Chapter 2: Literature Review

This chapter provides a review of the literature on lean and performance measurement. This will provide a basis for analysing the relationship between lean and performance measurement in service and manufacturing organisations in the context of New Zealand.

1.8.3 Chapter 3: Theoretical Framework

Chapter 3 introduces and discusses the theoretical framework of contingency theory (CT), which will be applied in this study to inform the findings. This chapter illuminates the development of the theory and provides arguments as to why CT serves the purpose of this research.

1.8.4 Chapter 4: Research Methodology and Methods

This chapter presents the methods employed to collect and analyse the data on the relationship between lean and performance measures.

1.8.5 Chapter 5: Lean Emergence and Techniques

This chapter consists of the analysis and interpretation of the collected data to establish the timeline on lean implementation in New Zealand, the meanings attributed by New Zealand managers to lean, and the specific lean techniques implemented.

1.8.6 Chapter 6: Lean Performance Measurement Practices

Chapter 6 explains how organisations adapted their PMSs to measure the outcomes of the lean techniques they implemented.

1.8.7 Chapter 7: The Relationship Between Lean and Performance Measurement

This chapter presents and discusses findings regarding the relationship between the lean techniques and the PMSs implemented by the organisations.

1.8.8 Chapter 8: Conclusion

This chapter presents insights into how lean organisations measure the performance of the lean techniques implemented, seen in the context of contingency theory. The contributions and limitations of the study are also highlighted, followed by suggestions for future research.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

Chapter 2 reviews the current literature on lean and performance measurement systems (PMSs) to provide the basis for examining the relationship between lean and performance measurement in service and manufacturing organisations in New Zealand.

New Zealand offers a unique setting for research on lean. New Zealand organisations are non-typical, with around 97% falling in the Small and Medium Enterprises (SMEs) category (Ministry of Economic Development, 2011). Further, the New Zealand government promotes lean implementation. However, there is limited research on lean and performance measurement, both globally and in New Zealand. Lean originated in the manufacturing sector but over time has disseminated to the service sector. Most lean research is focused on manufacturing organisations only, with some studies focussed on service organisations only. Few studies have examined both sectors for comparison.

Lean has developed from being aimed at reducing costs while remaining competitive, to being focused on optimal customer value and delivering quality products and services through continuous improvement and waste reduction. Numerous lean techniques have developed to emulate these concepts of lean, which lean organisations implemented in different combinations. There are several barriers to successful lean implementation. Most can be overcome by viewing lean as an organisation-wide philosophy and embracing lean at the management and operational levels of an organisation.

Traditional PMSs are basically different from those PMSs adapting lean performance dimensions (Thornton et al., 2019; Baroma et al., 2013). The lean literature suggests that Searcy's (2004) lean performance dimensions (LPDs) are specifically aligned to lean concepts. This study therefore proposes LPDs as a fitting basis for a PMS to appropriately measure lean outcomes.

The remainder of this chapter is structured as follows: section 2.2 traces the global development of lean to establish the concepts associated with lean, and section 2.3 combines the identified concepts in a proposed definition of lean to apply in this study. Section 2.4 discusses and analyses the most prominent global lean techniques that developed from the lean concepts, with section 2.5 delving deeper into the implementation of lean, highlighting the reasons for and the major barriers to implementing lean, and the requirements for successful lean implementation. This is followed by section 2.6 which highlights the difference between traditional and lean systems to demonstrate the unsuitability of traditional PMSs for a lean organisation. Section 2.7 discusses Searcy's (2004) LPDs as an appropriate basis for a lean PMS, and section 2.8 discusses New Zealand as a unique setting for this research and compares New Zealand and global lean research to establish a gap in the lean literature. Finally, section 2.9 summarises the main points of this chapter.

2.2 Development of Lean

This section traces the development of lean to establish a globally accepted definition of lean. Furthermore, in tracing the development, the concepts associated with lean will be highlighted to provide insight into what constitutes lean and why it is generally accepted as a philosophy rather than a set of tools to be implemented at the operational level.

It is generally accepted that lean can be traced to the Toyota Production System, pioneered by the Japanese engineers Taiichi Ohno and Shigeo Shingo in the early 1970s (Cusumano, 1988). The Toyota Production System was popularised by the Womack et al. (1990) book, *The Machine that Changed the World*. Lean can be traced back to 1948, when Taiichi Ohno started laying the groundwork for lean. Despite its early origins, the meanings attributed to lean only noticeably expanded from 1970. Table 2.1 provides a snapshot of the development of lean prior to 1970 to the present, as lean is applied today. The table illustrates how lean started as a simple concept focusing on the reduction of waste through Just-in-Time (JIT) and Kanban being applied in the automotive sector. It then developed into a philosophy of lean focusing on the customer, applying numerous different lean applications and techniques in the automotive, manufacturing and service sectors. With lean being implemented in different sectors, the CT factor of sector, as discussed in section 3.5.5, will be applied in this study to ground the findings. The sectors are manufacturing, service, wholesale and retail, private, and public.

After WWII, in the period prior to 1970, Japan had to find optimal ways to use expensive raw materials to be able to compete with Western countries with many resources (Bhamu & Sangwan, 2014; Sugimori et al., 1977). Toyota, under the direction of Taiichi Ohno, adopted 'innovation in production management' (p. 30), which formed a vital part of Toyota's competitive strategy (Cusumano, 1988). This helped Toyota to keep costs low and be competitive at the same time. During this timeframe, the term lean was not yet used to refer to Toyota's manufacturing processes and the application of lean was limited to the automotive sector, specifically vehicle assembly. This groundwork for lean introduced the organisation wide pull-system, small-batch production, JIT, and a mutual beneficial relationship with suppliers.

Table 2.1: Lean Development from 1970 – Present Day
(Adapted from Bhamu and Sangwan, 2014; Alves et al., 2012; Hines et al., 2004; Womack et al., 1990)

Time frame	Themes	Focus	Industry sector
Prior to 1970	Diffusion of lean concepts and focusing on cost	• JIT • Kanban	• Automotive – vehicle assembly
1970 – 1989	Awareness of lean developing & focusing on cost and quality	• JIT • Kanban • TQM	• Automotive – vehicle assembly and component assembly
1990 – 1999	Quality, cost, and delivery	• JIT • Kanban • TQM	• Manufacturing - focusing on repetitive processes
2000 – 2009	Customer value	• JIT • TQM • TPM	• Manufacturing in general – high and low volume processes • Service related
2010 - presently	Meeting customer demand through continuous improvement	• JIT • TQM • TPM • VSM • LSS	• Manufacturing in general – high and low volume processes • Service related

During the period between 1970 and 1989, the Toyota Production System was further developed by Taiichi Ohno and Shigeo Shingo. It consisted of two main components: the JIT production system and a 'respect-for-human' system (Sugimori et al., 1977). Another concept that emerged during this time was Total Quality Control (TQC) or Total Quality Management (TQM) (Chase, 1988; Chan et al., 1990). In 1988, John Krafcik, a researcher from the Massachusetts Institute of Technology (MIT), working on their International Motor Vehicle Programme (IMVP), published his article, '*Triumph of the Lean Production System'.* Krafcik introduced the term 'lean' to describe the Toyota Production System. Since then, the term lean has been made popular by many other authors (Samuel et al., 2015). During this period, the application of lean was still limited to the automotive sector but now included vehicle assembly as well as component assembly, and lean had also disseminated from

Japan to other Western countries. The application of lean did not eventuate in other sectors until the next decade (Hines et al., 2004). The period from 1970 to 1989 can be summarised as a focus on an awareness of lean developing (Hines et al., 2004).

During the period between 1990 and 1999, Western organisations became more aware of lean as it was propagated by Womack et al. (1990) in their formative work on lean production, '*The Machine that Changed the World'*. The authors suggested that lean production can be applied in manufacturing sectors other than the automobile sector. This time frame saw the diffusion of lean into manufacturing sectors other than the automotive sector, and the diffusion of 'value' and 'value stream' as core elements of lean. With the identification of gaps in lean, a conflicting view of lean appeared, which lead to the further development of lean, as seen in the following decades.

The 2000 to 2009 period can be summarised as a movement from quality, cost, and delivery to customer value (Hines et al., 2004). Lean has continued to diffuse to a greater diversity of manufacturing sectors. Other areas are military aerospace (Comm & Mathaisel, 2000) and electronics manufacturers (Doolen & Hacker, 2005). Lean has also successfully moved to the service sector (Portioli-Staudacher, 2010; Piercy & Rich, 2009; Kim et al., 2006; Allway & Corbett, 2002; Swank, 2003). The number of lean applications and techniques also expanded, e.g., Total Quality Control (TQC), and Total Productive Maintenance (TPM) (Shah & Ward, 2007, 2003).

After 2010, researchers added to the concept of lean. Lean is seen as a business philosophy that encourages efficiency and the elimination of waste, and at the same time, there is a focus on the needs of customers (Alkhoraif et al., 2019). Another dimension added is continuous improvement that gives organisations agility in meeting customers' demands (Alves et al., 2012). More lean applications and techniques developed, e.g., Visual Management (De Oliveira et al., 2019). Six Sigma developed separately to lean, but now the two appear to be fully integrated, with researchers referring to Lean Six Sigma (LSS) (Gnanaraj et al., 2012; Gupta et al., 2012). Lean is now also linked to green concepts (Chugani, et al., 2017; Fercoq et al., 2016; Govindan et al., 2015; Mollenkop et al., 2011) and Supply Chain Management (SCM) (Chen, 2017; Agus & Hajinoor, 2012). This time frame can be summarised as focusing on customer value with the added element of implementing techniques aimed at continuous improvement that will lead to optimum customer value (Alves et al., 2012).

2.3 Defining Lean

Researchers noted that there is a lack of a clear definition of lean (Bhamu & Sangwan, 2014; Bayou & Korvin, 2008). There is no consensus on how lean is defined, or a specific meaning attributed to it. There have been various attempts to define lean to incorporate some universal concepts associated with it. Table 2.2 presents a summary of definitions of lean over the time frames discussed in the previous section.

Four universal concepts of lean, drawn from lean philosophy and used in the current literature, have been identified by this researcher. These are visually presented in Figure 2.1 to reflect the relationship between the four concepts. The processes of eliminating waste and continuous improvement work alongside each other to deliver quality products and services to provide optimum value to customers.

Table 2.2: Lean Defined: 1988 to 2018

(Adapted from Albzeirat et al., 2018; Bhamu and Sangwan, 2014)

Author(s)	**Year of publication**	**Key words**
Krafcik	1988	Compared to mass production it uses less of everything.
Hayes and Pisano	1996	It uses less of everything required to produce a product.
Naylor et al.	1999	Leanness means developing a value stream to eliminate all waste, including time, and to ensure a level schedule.
Howell	1999	Optimize performance of the production system against a standard of perfection to meet unique customer requirements.
Comm and Mathaisel	2000	A philosophy intended to significantly reduce cost and cycle time throughout the entire value chain while continuing to improve product performance.
Shah and Ward	2003	An approach to deliver the upmost value to the customer by eliminating waste through process and human design elements.
Simpson and Power	2005	A practice with the objective to generate a system that is efficient and well organized and devoted to continuous improvement and the elimination of all forms of waste.
Taj and Berro	2006	The lean approach is focussed on systematically reducing waste (Muda) in the value stream.
Shah and Ward	2007	A management philosophy focussed on identifying and eliminating waste throughout a product’s entire value stream.
Alves et al.	2012	A model where persons assume the role of thinkers and their involvement promotes the continuous improvement and gives companies the ability to face the market demands.
Bon and Kee	2015	A unified system that entailed with a set of philosophies, rules, guidelines, applications, and techniques which are imposed to eliminate significant waste in all business processes for continuous improvement.
Shakoor et al.	2017	Lean is defined as a continuous improvement methodology, focusing on eliminating non-added value activities.
Albzeirat et al.	2018	Lean is a manufacturing philosophy that shortens the time between the customer’s order and the product build/ shipment by eliminating the sources of waste.

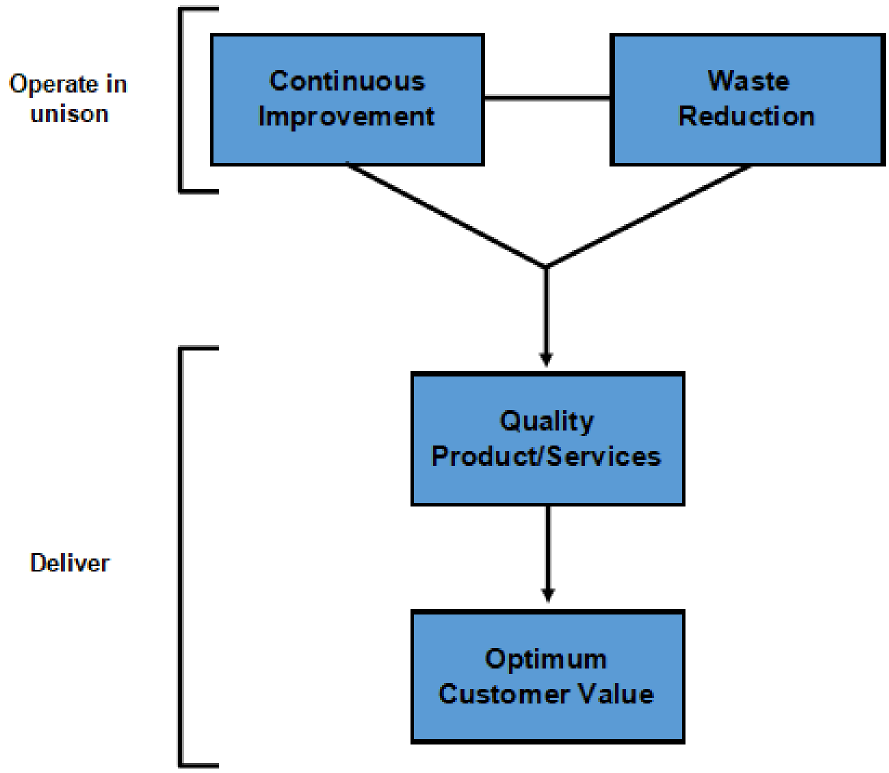

Figure 2.1: Proposed Definition of Lean
(Adapted from global lean literature)

This leads to the following definition that will be applied for the purpose of this study:

> 'Business practices focused on continuous improvement through the reduction of waste and non-value-added activities, to provide quality products/ services that will result in optimum customer value.'

The next section will discuss the main lean techniques developed from the lean concepts, as applied in practice.

2.4 Lean Techniques

For organisations to become lean, many techniques have been proposed and developed to assist with this process. There is an excess of different techniques for different purposes and waste elimination. Many of the techniques are not applied in isolation but rather used in conjunction with each other (Bhamu & Sangwan, 2014).

The techniques were developed in relation to the concepts of lean as depicted in Figure 2.1, and the following section will illustrate how each technique developed in terms of the lean concepts. The current and most prominent techniques, as identified from the lean literature, are discussed.

2.4.1 Just-in-Time (JIT)

JIT emerged to reduce costs in holding inventory, with an intention to remove the waste in material flow and the waiting time for inventory. JIT also simplifies the production process, ensures continuous flow, reduces inventory and storage space, and enhances output time (Alcaraz et al., 2016; White et al., 1999; Clode, 1993). JIT is based on the pull-system where products are manufactured as per customers' demand, and raw material is therefore procured as and when production is required. This reduces inventory levels of raw material and finished products. JIT ensures the delivery of the correct quantity of material required at the right time for production. This method has a positive effect on the upstream and downstream supply chain (Calvasina et al., 1989).

JIT was one of the two original systems that the Toyota Production System, and therefore lean, consisted of. It originated in the automotive sector but today it is applied in various manufacturing sectors (Mannai & Suliman, 2017; Madanhire & Mbohwa, 2016), healthcare (Berg, 2018; Goolsby et al., 2016), and construction (Vardhana & Venugopal, 2019), to name just a few.

2.4.2 Kanban/Pull

Kanban is a visual system for managing work as it moves through a process. It visualises both the process and the actual work passing through that process. The goal of Kanban is to identify potential bottlenecks and fix them for work to flow through the process cost-effectively at an optimal speed or throughput. The Kanban process manages the flow of production, assists in minimizing the handling of waste and storage, and guarantees products are delivered to customers on time (Wang et al., 2011). Kanban relates to the elimination and reduction of waste and continuous improvement by identifying and fixing bottlenecks and by working on a pull system for raw materials and products required.

2.4.3 Total Quality Management (TQM)

TQM is a continuously evolving management system that consists of values, applications, and techniques. Its aim is to increase external and internal customer satisfaction with a reduced number of resources (Martinez-Lorente et al., 1998; Chan et al., 1990, p. 41). It is important to view TQM as a system in which values are supported by applications and techniques to form a whole. To establish a culture based on core values, TQM starts with first choosing core values, then the techniques which support the values, and finally, the applications that are suitable for each technique (Hellsten & Klefsjo, 2000). TQM is related to the lean concepts in terms of reduction of waste, continuous improvement and delivering quality products.

2.4.4 Total Productive Maintenance (TPM)

TPM concentrates on the effective identification and elimination of waste, unproductive cycle time and rework in the manufacturing process (McCarthy & Rich, 2004). It is a holistic approach to equipment maintenance aimed at an almost perfect production process (Agustiady & Cudney, 2018). This technique is based on employee teamwork and participation to attain global level of effective maintenance. TPM is a method of communication and maintaining a partnership between the production and maintenance teams to enhance quality, eliminate waste, minimise operation cost, ensure availability of equipment and enhance the organisation’s culture towards maintenance (Rhyne, 1990). TPM is related to the lean concept of continuous improvement and eliminating waste to ensure quality.

2.4.5 Continuous Improvement (CI)/Kaizen

CI/Kaizen is a strategy where employees at all levels of a company work together proactively to achieve consistent, incremental improvements to the manufacturing process. It combines the collective talents within a company to create a powerful engine for improvement. Kaizen is a Japanese term which means Kai (continuous) zen (improvements) (Brunet & New, 2003).

CI/Kaizen is part action plan and part philosophy (Alemán Rentas, 2019). As an action plan, CI/Kaizen is about projects focused on improving specific areas within the organisation. These projects involve teams of employees at all levels, with an especially strong emphasis on involving plant floor employees. As a philosophy, CI/Kaizen is about building a culture where all employees are actively engaged in suggesting and implementing improvements to the organisation and it is directly related to the lean concepts as per Figure 2.1. CI/Kaizen works together with standardised work, which is discussed further in section 2.4.9. Standardised work captures the current best practices for a process, and Kaizen aims to find improvements for those processes.

2.4.6 5S

5S is an acronym for sort, set in order, shine, standardise, and sustain (Omogbai & Salonitis, 2017). These are sometimes given different names – seiri, seiton, seiso, seiketsu and shitsuke – but they have the same meaning (Hodge et al., 2011). The 5S lean technique can be summarized as follows (Omogbai & Salonitis, 2017; Al-Aomar, 2011):

1. Sort: Organise things in order, for ease of storing and retrieval.
2. Set: Designate and clearly label where everything should be stored.
3. Shine: Keep everything clean and tidy.
4. Standardise: Document work methods and make 5S part of organisational culture.
5. Sustain: Form a habit of continuous improvement procedures.

5S helps to reduce non-value adding time, increase productivity and improve quality (Bayo-Moriones et al., 2010), therefore 5S is directly related to the lean concepts of eliminating waste and non-value-added activities to deliver a quality product/service to customers.

2.4.7 Value Stream Mapping (VSM)

VSM is the process of visually summarising the flow of information and material in the organisation, and then envisioning a better performing future. Value stream refers to those areas of the organisation that add value to the product or service (Singh & Sharma, 2009). VSM aims to identify and categorise waste in each independent value stream and to find the best way to remove this waste (Gosling et al., 2013). VSM requires the in-depth analysis of waste followed by analysing and choosing different applications or sets of applications to be adopted to eliminate the waste (Ramesh & Kodali, 2012). This tool directly relates to waste elimination through continuous improvement, two components of lean.

2.4.8 Visual Management (VM)

VM is the concept of creating an effective workplace by depicting the current condition of a workplace visually. It enhances the smooth flow of information by using visual and audio signals instead of written instructions. It includes a set of techniques that makes operation standards visible so that people can follow them more easily. These techniques expose waste so that it can be prevented and eliminated (Rother & Shook, 2003; Womack et al., 1990), which is why it is seen as a lean tool.

2.4.9 Standardisation

Standardisation involves documented procedures for manufacturing that capture best practices, which includes the time to complete each task. It must be a dynamic document that is easy to change. Standardisation includes procedures, job instructions and operating procedures (Miller et al., 2010). As mentioned in a previous section, standardised work is linked to CI/Kaizen, where there is a constant aim to identify continuous improvements by the employees. With the use of standardised work and CI/Kaizen, employees are motivated to identify opportunities for improvements (Marksberry et al., 2011), which in turn will help eliminate waste in the organisation.

2.4.10 Single-Minute-Exchange of Die (SMED)

SMED is used by manufacturing organisations to reduce the time wasted during equipment changeover. It provides for the rapid interchangeability of machinery between different products. The technique ensures that both employees and machinery stay productive by decreasing stoppage time. SMED ensures training for all the operators regarding exchange of die, which results in faster changeovers (Dave & Sohani, 2015). This tool is linked to the lean concepts in that it assists in eliminating waste and non-value-adding activities.

2.4.11 Poka-Yoke (PY)

Poka-Yoke is a Japanese term that means ‘mistake-proofing’ and its purpose is to eliminate product defects by preventing and correcting human errors to attain zero defects and ultimately reduce inspections for quality control (Pötters et al., 2018). The concept behind this technique is to reduce the worker’s physical and thinking time to make them involved in additional activities that add value. Simply put, this is a fool-proofing technique to prevent errors, consecutive damages, breakdowns, and process shutdowns (Kumar et al., 2019). This technique is linked to the lean concepts of eliminating waste and non-value-adding activities.

2.4.12 Six Sigma (SS)

Six Sigma is a rigorous, focused and highly effective implementation of proven quality principles and techniques with the aim of virtually error free business performance (Akkucuk, 2014). This technique comprises values of engineering, statistics, and business to attain real outcomes. It is employed to enhance the quality of the product to meet global standards and is applicable in different streams including design, planning, production, marketing, sales, administration, and services (Wang et al., 2011). Six Sigma developed separately to lean but has been fully integrated with lean and is referred to as Lean Six Sigma (LSS) (Gnanaraj et al., 2012; Gupta et al., 2012), which is discussed in section 2.4.13.

2.4.13 Lean Six Sigma (LSS)

LSS is the combined principles and practices of lean manufacturing and Six Sigma, which are both independent methods used in the industry for quality improvement. LSS delivers an integrated enhancement method which improves quality by minimising discrepancies, reworks, and costs (De Koning et al., 2006). It is directly related to the lean concepts of waste elimination and continuous improvement.

2.4.14 Summary

The preceding section has briefly discussed the mainstream lean techniques applied in organisations with the aim of becoming lean. These lean techniques were developed to emulate some or all the concepts of lean, as depicted in Figure 2.1, the elimination of waste and non-value-added activities, continuous improvement, quality products and services, and optimum customer value. As shown in Figure 2.1, there are many different techniques and organisations do not apply them in isolation but rather use them in conjunction with each other (Bhamu & Sangwan, 2014). This study will elicit which lean techniques New Zealand organisations have implemented, distinguishing between manufacturing, service, wholesale and retail companies, DHBs and LGs.

The next section will illustrate issues relating to the implementation of lean, highlighting the reasons lean is implemented, the barriers to lean, and the critical success factors required.

2.5 Implementation of Lean

This section will discuss the driving force for the implementation of lean, the barriers against the successful implementation of lean, and the critical success factors required for the successful implementation of lean, as proposed in the current lean literature.

2.5.1 Driving Force for Implementation

As previously noted, after WWII the Japanese had to find optimal ways of using expensive raw materials and to rebuild their decimated manufacturing facilities. Lean principles were developed to streamline activities, reduce waste and non-value-added activities, and deliver quality products (Bhamu & Sangwan, 2014; Cusumano, 1988; Sugimori et al., 1977).

Motivated by the productivity and cost reduction successes of Japanese automotive manufacturers and to stay competitive, Western manufacturing organisations also started implementing lean tools from 1970 to 1989 (Chan et al., 1990). Lean noticeably expanded from 1970 and the reasons for implementing lean increased from simply endeavouring to reduce waste. Researchers noted a strong, positive relationship between the implementation of lean practices and operational performance (Negrão et al., 2017; Hong et al., 2014; Fullerton et al., 2014; Nawanir et al., 2013; Inman et al., 2011; Fullerton & Wempe, 2009; Swink et al., 2005). Other reasons behind organisations' decisions to adopt lean are to improve performance, competitive pressures (Parker, 2003), customer pressure, and the creation of a team spirit (Bhasin, 2012b). Lean has also been identified as best practice for process improvement (Samuel et al., 2015), and is often regarded as the most important strategy for manufacturing firms desiring to achieve world-class performance (Rinehart et al., 1997). The effectiveness of an organisation depends on managers identifying opportunities like lean, which are linked to improved performance (Negrão et al., 2017). Managers can therefore choose to include lean as part of organisational strategy, ensuring that lean is implemented at both the management level and operational level of an organisation. Lean will then be part of the overall strategy of the organisation. Accordingly, strategy, as further discussed in section 3.5.1, is one of the CT factors applied in this study, to ground the findings. Clearly, lean provides the opportunity for organisations to reduce waste, improve performance, and be competitive in their field, whether it is the manufacturing or service sector.

Although lean has been implemented in various types of organisations, it has not always been successfully implemented (Chan et al., 1990). The barriers to implement lean are discussed in the following section.

2.5.2 Major Barriers

Research has shown that there are many obstacles preventing and complicating the implementation of lean in an organisation. Bhasin (2012a) indicated the following obstacles: cost (topmost concern for small organisations), insufficient supervision, culture (reasonably important), insufficient management time, and employee attitudes/resistance to change. Narayanamurthy et al. (2018) researched lean implementation in healthcare institutions and identified the reasons for the failure to successfully implement lean as the lack of readiness, a lack of systemic approach, and the absence of adaptation. Organisations need to be adaptable to enable them to implement lean techniques successfully. Organisations also need to be adaptable to implement appropriate performance measures to adequately measure lean outcomes. Accordingly, systems' adaptability will be included in this study as a CT factor, as described in section 3.5.3, to ground the findings. Sim and Rogers (2009) identified specific barriers as an aging and high seniority workforce, a lack of committed leadership, employees feeling under-valued, and management not providing adequate support.

Bhasin and Burcher (2006) noted that organisations view lean as a process instead of embracing it as an organisation wide philosophy. The lack of management commitment together with this barrier of not viewing lean as an organisation wide philosophy, indicates that management commitment should be a major driving force in the implementation of lean. The organisational level at which organisations make the decision to implement lean is related to management commitment. If the decision to implement lean is mad at the managerial level, it can be an indication of management commitment to lean. Accordingly, organisational decision style, as discussed in section 3.5.2, will be applied in this study as a CT factor to ground the findings.

2.5.3 Requirements for Successful Lean Implementation

The elements required for the successful implementation of lean can be derived from the barriers discussed in the previous section. Bhasin and Burcher (2006, also see Bhasin, 2012a), specified a combination of general requirements as crucial for the successful implementation of lean. This includes making numerous cultural changes and viewing lean as a long-term journey (strategic decision and implementation) to instil a continuous improvement viewpoint. The researchers also indicated the importance of embracing empowerment, training staff, and managers delegating responsibilities appropriately. They further noted that every firm is unique, and that lean should not be viewed in the narrow sense of a set of tools, techniques, and practices, but rather needs to be observed as a philosophy.

Critical success factors for successful lean implementation have also been suggested by several researchers and consultants (Netland, 2016; Bortolotti et al., 2015; Manville et al., 2012). Critical success factors can be defined as:

> *Those few things that must go well to ensure success for a manager or an organisation, and, therefore, they represent those managerial or enterprise areas that must be given special and continual attention to bring about high performance. (Boynton & Zmud, 1984, p. 17)*

Organisations often view lean as a process, whereas they should embrace it as a philosophy (Bhasin & Burcher, 2006). Liker (1996) includes the word ‘philosophy’ in the definition of lean. Repenning and Sterman (2001, p. 65) advocate that companies use new initiatives almost as a whim and assent that:

> *Whilst the number of tools, techniques, and technologies available to improve operational performance is growing rapidly, on the other hand, despite dramatic successes in a few companies most efforts to use them fail to produce significant results.*

Bhasin and Burcher (2006) note that when lean is perceived as a philosophy, it is not just seen as another tool or technique, but it becomes a way of thinking that will influence all aspects of the organisation. They note that lean is also about changing corporate culture, as reiterated in lean viewed as a philosophy that influences all aspects of an organisation. Implementing lean is an approach that involves all levels of the firm, and both the strategic and tactical managers will play important roles in successful implementation. Lean as an organisation wide philosophy will be reflected in lean being included in an organisation’s strategy. This further substantiates the inclusion of strategy, as discussed in section 3.5.1, as a CT factor examined in this study.

2.5.4 Summary

The previous section showed that lean has developed into best practice for process improvement, and that the implementation of lean is positively linked to the operational and financial performance of an organisation. It was also shown that managers play an important role in the successful implementation of lean and that lean should be seen as an organisation-wide philosophy to ensure lean is successfully implemented.

2.6 Traditional Performance Measurement Systems and Lean

In new business conditions, measuring performance efficiently is one of the requirements for successful business (Stevanović & Čečević, 2018). CT proposes that there is no single correct accounting system that applies to all organisations in all conditions (Emmanual et al., 1190) and accordingly, the theory proposes that organisations that implement lean will require a performance measurement system that is appropriate to measure lean outcomes. There has been limited research on adapting PMSs to better serve lean organisations, and there is still an emphasis on traditional absorption costing with little attention given to techniques specifically needed for lean (Carnes & Hedin, 2005). Accounting professionals have not generally accepted the set of methods aimed to adjust accounting information to lean. Maskell and Baggaley (2006) stated that traditional accounting systems are seen as 'anti-lean'. The traditional systems do not have the ability to identify the positive financial impact of successful lean implementation and may even report that 'bad' things are happening despite 'good' lean progress being made. One of the main assumptions regarding the operating nature of the organisations on which the systems are built, is that organisations use mass-production technology (Luo & Brozovsky, 2013; Kennedy & Brewer, 2006; Kroll, 2004). This is not true for organisations that adopted lean processes to minimise waste. Lean is the opposite of mass-production, where organisations avoid inventory build-up and only manufacture what customers demand (Bhamu & Sangwan, 2014). Table 2.3 illustrates the differences between lean and mass-production. The table indicates that lean contrasts mass-production on many levels. Lean is focused on meeting customer demand

and works on a pull system for production, whereas mass-production is focused on being as productive as possible at the lowest cost, working on a push system for production. Another important difference is that where mass-production aligns resources to achieve high volume and repetitive production, lean aligns resources to value streams.

Table 2.3: Lean Production vs Mass-production
(Adapted from Kennedy and Brewer, 2006)

	Lean Production	**Mass-Production**
The goal	• Meet customer demand	• Lowest possible cost with highest productivity of employees and equipment
Organising resources	• Align resources to the value streams	• Align resources to achieve goal of high-volume repetitive production
Flow	• Cellular-based one-piece flow	• Batch-and-queue; prefer larger batches
Trigger	• Customer orders (pull system)	• Forecast from budgets (push system)
Human Element	• Empowered employees and long-term supplier relationships	• Intense supervision and oppositional supplier relationship

The traditional accounting systems of GAAP and IFRS report organisations' information in statements and journals. The benefits from minimising waste in lean production, however, are not covered in GAAP and IFRS (Luo & Brozovsky, 2013; Maskell & Baggaley, 2006). Managers wait for lean improvements in the organisation to be visible in the bottom-line of their financial reports, but traditional accounting is harmful to lean implementation and is seen as 'pushing back' against it (Maskell & Kennedy, 2007). Accounting control and measurement methods must change to adapt substantially to lean (Kroll, 2004).

Table 2.4 summarises the differences between traditional systems and systems appropriate for lean. Measures for labour efficiency and overhead absorption, which are part of traditional systems, lead to over production and large batch sizes, both of which lead to an increase in inventory (Luo & Brozovsky, 2013; Chiarini, 2012; Maskell & Kennedy, 2007).

Mass-production assumes that maximising profit is derived from maximised use of resources, which conflicts with lean. Lean proposes that profit is maximised by augmenting the flow of products as based on customer demand.

Table 2.4: Traditional Systems vs Systems for Lean
(Adapted from Lin and Qingmin, 2009; Maskell and Kennedy, 2007)

	Traditional Systems	**Systems for Lean**
Cost Object	• Product	• Value Stream
Employees responsible for cost	• Accountants	• Employees controlling the Value Stream
Cost Analysis Emphasis	• Variance Analysis	• Continuous Improvement Analysis
Organisational Culture	• Command and Control	• Equality and Cooperation
Manufacturing Expense Allocation (Cost Driver)	• Based on Employee Workload (e.g., Direct Labour Hours)	• Based on Value Stream
Communication of Information	• Upward to Managers	• Upward, Downward and/or Parallel
Performance Emphasis	• Financial	• Financial and Operational

It is argued that a traditional PMS usually uses inappropriate and at times inaccurate costs to evaluate performance (Chiarini, 2012; Maskell & Kennedy, 2007). For example, the costs used from a traditional system to calculate productivity and profitability will be based on product costs calculated using standard costing or activity-based costing from static budgets, which would not have been adjusted for cost fluctuations (Chiarini, 2012; Maskell & Kennedy, 2007; Kroll, 2004). Furthermore, these costs are then used for making decisions on price and inventory valuation and for performance measurement. These types of costs are useless in lean manufacturing, which is more concerned with the costs of whole value streams (Lin & Qingmin, 2009; Maskell & Kennedy, 2007; Kroll, 2004;). Researchers have argued that traditional systems use standard costs for costing products, decision-making of products, and customer profitability and pricing. This argument has been extended to include bid quotation and sourcing raw material customer rationalisation. In terms of lean, it is treacherous to base decisions on fully absorbed product costs (Maskell & Kennedy, 2007).

Traditional systems work on the basis that excess capacity is undesirable and machines must be worked to their full capacity. Lean, on the other hand, creates additional capacity through eliminating waste, which is then utilised to grow the business (Seth et al., 2008; Maskell & Baggaley, 2006). Labour or machine hours are the principal cost drivers in traditional systems, whereas lean organisations base the cost of products on the rate of flow through the value stream (Maskell & Kennedy, 2007).

Traditional systems focus on cost, share prices, and earnings, which indicates that the focus is on the value created for the owners of the organisation. Lean organisations focus on the value created for customers (Lin & Qingmin, 2009: Maskell & Kennedy, 2007). Lean organisations not only emphasise the value that their products and services create for customers but use this information to drive continuous improvement in products, services, and operations. The focus on creating value for customers will in turn lead to creating value for owners.

Traditional accounting systems, and therefore traditional PMSs, are not appropriate for lean organisations. It is therefore important to align the PMS of a lean organisation to the attributes of lean as represented in Table 2.4. The present study suggests that Searcy’s (2004) LPDs should be incorporated into the PMS of a lean organisation because it is aligned with the lean attributes.

The next section will discuss the development of the LPDs and illustrate how they relate to lean attributes.

2.7 Searcy's (2004) Lean Performance Dimensions (LPDs)

Searcy's (2004) LPDs are specifically aligned to lean attributes. The LPDs are an adaptation and expansion of the balanced scorecard, introduced by Kaplan and Norton (1992), which is the most widespread method for measuring performance. This balanced scorecard attempts to create an equilibrium between operational goals and strategic goals, inputs and outputs, internal and external performance factors, and financial and non-financial measures (Zizlavzky, 2014).

The balanced scorecard method entails that not everything is measured in an organisation, but only those elements that are directly related to the organisation's strategy (Kaplan & Norton, 2001, 1992). It promotes the theory that strategy must be used as a basis for measuring performance. The implementation of lean is an organisational strategy; therefore, the balanced scorecard can form an ideal basis for developing a lean PMS. Searcy (2004) stated that the balanced scorecard offers a good framework to develop a PMS for a lean organisation, and accordingly adapted and expanded on the four existing balanced scorecard perspectives to develop the six LPDs.

Womack and Jones (1996) stated that to make full use of lean, managers need to understand the principles of lean and integrate them together. The principles are identified from the proposed definition set out in section 2.3. These are: continuous improvement, reduction of waste and non-value-added activities, quality products/services, and optimum customer value. The adaptation Searcy suggested for the balanced scorecard to align with lean is directly linked to these principles (Searcy, 2004, p. 2).

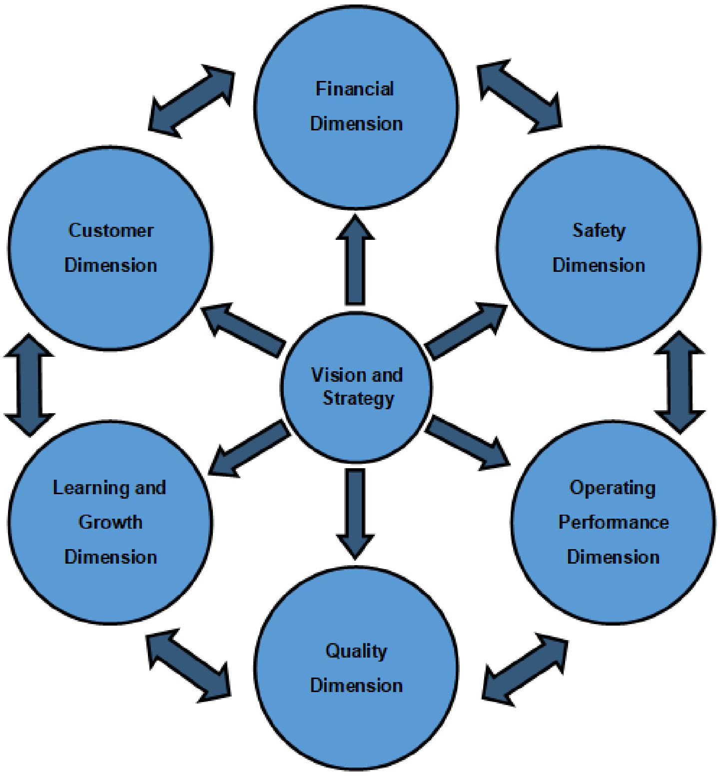

Figure 2.2: Lean Performance Dimensions of Searcy

(Adapted from Searcy, 2004; Kaplan and Norton, 2006; and Baroma et al., 2013)

This balanced scorecard is based in four perspectives (Kaplan & Norton, 1996), namely the financial perspective, the customer perspective, the internal business process perspective, and the learning and growth perspective. Searcy (2004) split the internal business process perspective into three separate perspectives. This resulted in a new balanced scorecard framework consisting of six perspectives, which is referred to as the lean performance dimensions. The dimensions are financial, customer, learning and growth, operating performance, quality, and safety. The LPDs as proposed by Searcy (2004) are illustrated in

Figure 2.2. Figure 2.2 shows how each of the performance dimensions directly relate to the vision and strategy of the organisation, and how the dimensions interact with each other.

Table 2.5: Lean Performance Dimensions
(Adapted from: Baroma et al., 2013; Stevanović and Čečević, 2018; Searcy, 2004; Tamimi and Sebastianelli, 1996; Longoli et al., 2013; and Ingalls, 1999)

FINANCIAL *Eliminating waste* *LESS WASTE = LESS COSTS* • Increasing level of financial returns • Increasing level of sales • Higher profit • Financial ratios improvement • Better self-financing activities • Apply Value Stream Costing	**CUSTOMER** *Value to customers* *MORE VALUE TO CUSTOMERS* • Minimise scraps and errors in production process to offer value to customers • Market share • Customer retention • Customer acquisition • Customer satisfaction • Customer profitability
OPERATING *Eliminating waste and continuous improvement* *LESS TIME WASTED and NO EXCESS CAPACITY* • Lower throughput time • Decrease in inventory • More effective decision-making process • Apply Value Stream Mapping • What processes needs to be excelled at?	**EMPLOYEE** *Continuous improvement* *MORE LABOUR PRODUCTIVITY = HIGHER LEARNING CURVE* • Improved employee monitoring activities • Reliable information systems • Improved implementation of strategy at all levels • Learning at individual, function (group), and company levels. • Ensure employee commitment
SAFETY *Eliminating waste & continuous improvement* *SAVE PRACTICES AND PROCEDURES = LESS WASTE AND COST* • Eliminate unsafe practices and procedures • Improve unsafe practices and procedures • Create a high-quality work environment • Improve health and safety of employees • Managers set an example • Monitor behaviour and actions of employees • Safety program • Continuous training	**QUALITY** *Continuous improvement* *CONTINUOUS IMPROVEMENT = QUALITY TO CONSUMERS* • Best practice procedures • Product or service to customers' specifications and requirements • Monitor level of customer satisfaction • Control and improve the process • Quantify quality

Table 2.5 presents the alignment of LPDS to the lean principles, identified from the proposed lean definition. In recent research, authors have started referring to the learning and growth dimension as the employee dimension (Thornton et al., 2019), which will be used

accordingly for the remainder of this study. The operating performance dimension will also just be referred to as the operating dimension.

The next sections will discuss the LPDs in detail and will illustrate how each is aligned with the principles of lean and with each other.

2.7.1 Financial Dimension

Stevanović and Čečević (2018) proposed that value stream costing can serve as a basis for measuring financial improvement. It provides relevant, accurate and understandable cost information that is valuable for assisting managers in making decisions. VSC can be used by lean organisations to determine the real cost of products and services to ultimately improve financial performance indicators (Almusawi et al., 2019). Self-financing generated through lean facilitated cost reductions (Baroma et al., 2013), can also form an important measure in this dimension. Baroma et al. (2013) note that this perspective can be linked to eliminating waste and decreasing variable costs, which will lead to financial returns in the future.

2.7.2 Customer Dimension

It is important to create products and services that offer value to customers. Stevanović and Čečević (2018) noted that the performance measures in this perspective must be set for a target customer sector on which the organisation's future growth depends. Measuring the market share in a target sector will provide the necessary financial indications on the strategy for accomplishing results. Another key measurement is value to customers. This indicates the way to achieve customer satisfaction, retain customers, attract new customers, and achieve the desired market share. Value is a key principle of lean (Baroma et al., 2013).

2.7.3 Operating Dimension

Lean applications and techniques are applied to improve the processes to eliminate waste and continuous improvement (Stevanović & Čečević, 2018; Baroma et al., 2013). The operating performance perspective is linked to the business processes in which the organisation must excel to function in a safe environment and to deliver a quality product or service to customers (Searcy, 2004). In terms of this perspective, organisations must apply value stream mapping to create a picture of all processes in the organisation and to show the flow of the product through the organisation. It shows how value is created for customers and guides managers towards required enhancements in processes. The operating performance perspective puts the focus on goals (Stevanović & Čečević, 2018; Baroma et al., 2013).

2.7.4 Employee Dimension

This perspective can be linked to continuous improvement (Baroma et al., 2013). This perspective pinpoints aspects essential for the current and future success of the organisation. The financial, customer, and internal business process objectives will reveal the gaps between the existing and the required competences of employees, systems, and procedures. On the individual level, attention is paid to the needs of individuals and what motivates them to learn and progress. The success of the lean organisation depends on employees being fully committed to the value stream to which they are assigned. On the group level, multi-functional teams are created to ensure close cooperation within the organisation (Womack & Jones, 1994). The process of institutionalisation and the construction of a new organisational structure is learning at an organisational level (Tortorella et al., 2015).

2.7.5 Safety Dimension

The safety perspective is linked to whether the organisation is operating within a safe environment, which affects all areas of the organisation (Searcy, 2004). Thornton and Nath (2015) note that organisations must provide a safe work environment for employees and must deliver a safe product or service to customers.

Longoni et al. (2013) suggest that the lean concepts of continuous improvement and process focus seem to be related to the safety climate. The researchers also note that the relationship between safety climate and worker behaviours is critical and that when lean is done right, it not only improves operational outcomes but also the health and safety of the workers who run the system. The literature generally suggests that quality and safety are collaborative in nature and that by integrating quality and safety into management systems it is possible to increase worker health and safety, assuring operational performance (Herrero et al., 2002; Del Brio et al., 2001). There is also a link between managers creating a high-quality work environment and improvement in the health and safety of employees (Barling et al., 2003).

2.7.6 Quality Dimension

The quality perspective is linked to lean in terms of measuring whether the organisation is delivering a quality product or service to its customers. Supplying a quality product or service to customers is fundamental in the success of lean (Thornton & Nath, 2015). Quality measures can be divided into four major categories: consumer-based, detection-based, process-based, and financial-based measures (Tamimi & Sebastianelli, 1996). Consumer-based measures attempt to monitor the level of customer satisfaction and include customer surveys, number of customer complaints, and repeat business by customers. Ensuring that products or services conform to design specifications of customer requirements is one part of detection-based measures and includes number of defects, number of errors, spoilage, auditing, inspection, after-sales service, and rework. On the other hand, process-based measures strive to control and improve the process rather than monitoring the end product. This category includes work-in-process inventory, statistical process control, histograms, pareto analysis, ongoing employee training, benchmarking, and flowcharting. The fourth category of financial-based measures attempts to quantify quality, including sales and non-conformance costs (e.g., audit costs, inspection costs).

2.7.7 Summary

Implementing lean has been shown to be a specific strategy that a business may follow. The balanced scorecard method only includes performance measures that are directly related to an organisation's strategy. The six LPDs as proposed by Searcy (2004) were therefore based on the balanced scorecard. Searcy (2004) further aligned the LPDs to the lean principles emerging from the proposed lean definition.

Searcy's (2004) LPDs are the financial dimension, the customer dimension, the operating dimension, the employee dimensions, the quality dimension, and the safety dimension. The LPDs now provide six perspectives on which an organisation can focus their performance measures, to assist them in successfully implementing lean.

Accordingly, the six LPDs will be applied in this study to evaluate the performance measures organisations have implemented.

2.8 Lean in New Zealand

This study is set in the New Zealand context. It is therefore important to analyse lean research in New Zealand and compare it to global lean research. The reasons for setting this study in New Zealand are twofold. First, lean implementation in New Zealand was government-directed to boost productivity (Goodyer et al., 2011; Callaghan Innovation, 2017). This is not the case in other comparable developed countries, such as Australia, the US, and the UK, and developing countries such as India (Danese et al., 2018; Albzeirat et al., 2018). Second, New Zealand is atypical in that around 97% of organisations fall in the Small and Medium Enterprises (SMEs) category (Ministry of Economic Development, 2011). Further, studies that examine SMEs are scarce (Alkhoraif, et al., 2019; Hu et al., 2015), therefore setting the present study in New Zealand will add to the limited research in this area. These two aspects make New Zealand a unique setting for this study.

Furthermore, the fact that New Zealand organisations are mostly SMEs, relates to organisational size as a CT factor applied in this study to ground the findings. As discussed in section 3.5.4, organisational size has been studied as an influential contextual CT factor.

Most global studies are based in large organisations, and as New Zealand's organisations are mostly SMEs, inclusion of the CT factor of organisational size, will add a new context for research on this CT factor.

The lean research literature in New Zealand has increased since 1996. In the few years before 2000, only three studies were published, with 13 studies in the period from 2000 to 2009, and 39 studies from 2010 to 2019. This shows an increase in lean research in New Zealand over the last few years. However, there is still wide scope for further studies.

Table 2.6 presents current lean issues as researched in the global and New Zealand contexts, with representative references. This table indicates that the four global research themes are exploring the implementation of lean, discovering the outcomes of lean, investigating the relationship between lean and other disciplines/approaches, and conceptualising and defining lean. Table 2.6 further indicates that the four New Zealand research themes are the implementation of lean, discovering the outcomes of lean, the emergence of lean, and exploring the relationship between lean and accounting systems.

The following sections will elaborate on each of these identified themes, and ultimately identify the gap in the research literature.

Table 2.6: Lean Research Themes: New Zealand and Global

New Zealand	Research	Global	Research
Implementation of lean	MacDonald et al. (2013); D'Young et al. (2014); Akmal (2019); Rees, (2010); Gunawan (2009); Neyogi (2009); Chen (2017); Sullivan-Taylor et al. (1996); Xiao (2016); Elias (2016); Richards (2017); Kobus et al. (2018); Doevendans (2014); Doevendans et al. (2012); Deakins & Bensemann (2019); Alagundagi (2015); Ardagh (2006); Ardagh (2010); Doevendans et al. (2015); Vilasini et al. (2014); Krotov & Mathrani (2017); Wilson (2017)	Implementation of lean	Hines et al. (2004); Holweg (2007); Hoss & Caten (2013); Moyano-Fuentes & Sacristan-D´ıaz (2012); New (2007); Shah & Ward, (2007); Samuel et al. (2015); Bhamu & Sangwan (2014); Jasti & Kodali (2014, 2015b); Dabhilkar & Ahlstrom (2013); Liker & Morgan (2006); Reichhart & Holweg (2007); Hadid & Mansouri (2014)
Discover the outcomes of lean	Alagundagi (2015); Corbett (2011); El-Kafafi (2006); Donovan et al. (2017); Sterling et al. (2013); Baines, et al. (2014); Winstone (2017); Cochrane at al. (2005)	Discover the outcomes of lean	Bortolotti & Romano (2012); LaGanga (2011); Papadopoulos et al. (2011), Vagnoni (2015); Bortolotti et al. (2015); Browning & Sanders (2012); Radnor et al. (2012); Amin & Karim (2013); Pullan et al. (2013); Liu et al. (2013); Azadegan et al. (2013); Shah & Ward (2003); So & Sun (2010); Wiengarten et al. (2015)
Relationship between lean and accounting systems	Hoque & Alam, (1999); Moazzam et al., (2018); Thornton & Nath, (2015); Thornton et al. (2019)	Investigating the relationship between lean and other disciplines/approaches	Narasimhan et al. (2006); Qrunfleh & Tarafdar (2013); Soni & Kodali (2012); Rahimnia & Moghadasian (2010); Hallgren & Olhager (2009); Mehrsai et al. (2014); Prince & Kay (2003); Krishnamurthy & Yauch (2007), Bruce & Daly (2011); Purvis et al. (2014); Naim & Gosling (2011); Shah et al. (2008); Vinodh et al. (2011); Longoni & Cagliano (2015); Fahimnia et al. (2015); Simpson & Power (2005);
Lean emergence	Agarwal et al. (2013); Donovan et al. (2017); Fuemana et al. (2013); Poshdar et al. (2019); Doevendans (2014); Doevendans et al. (2012); Doevendans et al. (2015); Alagundagi (2015); Thornton & Nath (2015)	Conceptualising and defining lean	Shah & Ward (2003); Ward & Zhou (2006); Fullerton & Wempe (2009); Jayaram et al. (2008); Aronsson et al. (2011); Bruce & Daly (2011); Eriksson (2010); Parker (2003); Longoni et al. (2013); De Treville & Antonakis (2006); Alves & Alves (2015); Piercy & Rich (2015); Bortolotti et al. (2013

2.8.1 Global Lean Research

Four global lean themes were identified, namely, exploring the implementation of lean, discovering the outcomes of lean, investigating the relationship between lean and other disciplines/ approaches, and conceptualising and defining lean.

Globally, the most researched theme is the exploration of lean implementation (Danese et al., 2018). The main issues researched under this theme are the implementation of lean in manufacturing in general terms, the implementation of lean in service in general terms, developing models/ guidelines to implement lean in a manufacturing setting, and investigating specific factors that impact lean in manufacturing. In section 2.8.2.1, it will be shown that this is also the most prevalent researched theme in New Zealand and that although there are similar issues covered, there are marked differences. The diffusion of lean is included under this theme in global research, but it is identified as a separate theme in the New Zealand context and noted as an emergence of lean, rather than as a diffusion of lean.

The second largest global theme identified in Danese et al.'s (2018) literature review is discovering the outcomes of lean. The lean aspects researched were technical outcomes, with operational and financial performance the most prevalent, and social outcomes, with employees' personal and work outcomes and social sustainability the most prevalent. Other aspects researched to a lesser extent were organisational performance, supply chain performance and marketing performance under technical outcomes, working environment, health and safety, and human cost under social outcomes. This is similar to New Zealand, being the second largest research theme with similar aspects covered. This is further discussed in section 2.8.2.2.

The third largest global theme identified is investigating the relationship between lean and other disciplines/ approaches, where lean was related to agile, IT, environmental management, and risk management. The fourth theme of conceptualising and defining lean covers the historical evolution of lean and defining and conceptualising lean manufacturing and lean service. Neither of these themes is identified in New Zealand lean research.

An analysis of the four themes and the different issues identified under each of the four themes indicates that the relationship between lean and performance measurement has not been researched in a global context. This study will therefore attempt to fill this identified gap in the lean and performance measurement literature in the New Zealand context.

2.8.2 New Zealand Lean Research

Analysis of the lean research in New Zealand revealed four main themes, namely the implementation of lean, discovering the outcomes of lean, the emergence of lean, and exploring the relationship between lean and accounting systems. The next sections will discuss each of the New Zealand themes with a comparison to the global themes identified in section 2.8.1.

2.8.2.1 Implementation of Lean

This theme is the most researched in New Zealand and it is the most researched theme globally. Both the global and New Zealand literature include some of the same topics, for example, the general aspects of lean implementation in manufacturing and service (Akmal, 2019; Deakins & Bensemann, 2019; Kobus et al., 2018; Chen, 2017; Richards, 2017; Elias, 2016; Xiao, 2016; Alagundagi, 2015; D'Young et al., 2014; Doevendans, 2014; MacDonald et al., 2013; Doevendans et al., 2012; Rees, 2010; Gunawan, 2009; Neyogi, 2009; Sullivan-Taylor et al., 1996), and developing models/ frameworks to implement lean (Krotov & Mathrani, 2017; Wilson, 2017; Doevendans et al., 2015; Vilasini et al., 2014; Ardagh, 2010, 2006).

There are, however, areas that are not present in both New Zealand and global research. The global literature includes the diffusion of lean under the implementation theme, while in the New Zealand literature, it is recognised as a separate theme and referred to an emergence instead of a diffusion. The emergence of lean as a New Zealand theme is discussed further in section 2.8.2.3.

The initiatives of the New Zealand government to promote the implementation of lean in manufacturing organisations is another topic included under the implementation theme in New Zealand research (Goodyer et al., 2011; Murti, 2009; Wilson et al., 2008). This is not a topic in the global literature, as other developed countries’ governments did not follow New Zealand’s example. This unique feature of New Zealand is one of the major motivations for setting this study on lean in New Zealand.

2.8.2.2 Discovering the Outcomes of Lean

This theme is the second most researched in the New Zealand and global literature. The topics included under this theme are very similar for the New Zealand and global literature and can be divided into operational outcomes and social outcomes. In terms of New Zealand, operational outcomes is the biggest topic (Donovan et al., 2017; Alagundagi, 2015; Corbett, 2011; El-Kafafi, 2006), and this is the same for the global literature. For New Zealand, the social outcomes topics cover issues relating to employees, job quality, and health and safety (Winstone, 2017; Baines, et al., 2014; Sterling et al., 2013; Cochrane at al., 2005), which is also comparable to the global literature. For this theme, there is no discernible difference between New Zealand topics and global topics.

2.8.2.3 Lean Emergence

The emergence of lean in organisations is recognised as a separate theme in New Zealand. In the global literature, it is included as the diffusion of lean under the theme of implementation of lean. Researchers examined the emergence of lean in manufacturing (Donovan et al., 2017; Agarwal et al., 2013), construction (Poshdar et al., 2019; Fuemana et al., 2013), the fruit industry (Doevendans et al., 2015; Doevendans, 2014; Doevendans et al., 2012), and some compared manufacturing and service organisations (Alagundagi, 2015; Thornton & Nath, 2015).

The emergence of lean is identified as a separate theme in New Zealand because lean has not spread as far in New Zealand as it has globally and therefore this issue still requires research in a New Zealand context.

2.8.2.4 The Relationship between Lean and Accounting Systems

Research on lean and accounting systems is identified as a theme in New Zealand, but not the global, literature, which sets New Zealand apart. It is important to analyse each of the articles further in terms of what aspects of the accounting system they cover, to determine how the present study will add to this theme.

Five studies focused on the theme of research on lean and accounting systems. Two studies focused on the effect of lean on the management accounting system. Hoque and Alam (1999) noted that implementing TQM does change the management accounting system, but the authors did not relate this back to the balanced scorecard of Kaplan and Norton (1992). This is important because this study applies the LPDs of Searcy (2004), which are based on Kaplan and Norton's balance scorecard. Searcy's (2004) LPDs are discussed in detail in section 2.7. Hoque's (2000) research activity based costing and lean manufacturing did not cover the balanced scorecard or the LPDs.

Moazzam et al. (2018) evaluated different PMSs in terms of the agricultural sector, including the balanced scorecard. They applied the Supply Chain Operations Reference as a framework for the performance management system. Again, the LPDs were not investigated in this study. Thornton and Nath (2015) examined the current level of understanding and use of lean in New Zealand and noted that organisations adjust their accounting processes to align to their lean strategy. The authors did not relate the organisations' understanding of lean back to the LPDs.

The last study identified under this theme investigated lean in terms of the LPDs (Thornton et al., 2019). The authors indicated that New Zealand managers note efficiency, elimination of waste, cost reduction, and meeting customer demands based on secondary sources as the current prevalent dimensions of lean in New Zealand, and that managers do not understand the importance of customer value and product quality. The authors used Searcy's (2004) LPDs and Saaty's (1980) analytical hierarchy process (AHP) model to establish the relative importance of the LPDs.

Although the studies included in this theme did consider lean in relation to areas of the accounting system and management accounting system, only one investigated the PMS of the lean organisations in terms of Searcy's (2004) LPDs. The present study will aim to expand this research by applying Searcy's (2004) LPDs and contingency theory to determine the relationship between lean and performance measures.

2.8.2.5 Global Themes Not Present in New Zealand

Two themes identified under the global literature, namely conceptualising and defining lean and understanding the relationship between lean and other disciplines/ approaches, were not identified as themes in New Zealand.

Studies included under the theme of conceptualising and defining lean have explored the historical evolution of lean and attempted to define and conceptualise lean in different settings. The evolution of lean in New Zealand, compared to its global evolution, is at a different pace. New Zealand researchers are more concerned about the actual implementation of lean and what the outcomes will be for organisations. They are less concerned with the history and conceptualisation of lean as they accept that these factors have already been established in the literature.

The theme of understanding the relationship between lean and other disciplines/ approaches included studies that explored lean in terms of relatable disciplines e.g., agile and Six Sigma, and other disciplines lean could influence e.g., green management and information systems. This was not a theme in New Zealand as the level of implementation is low compared with the rest of the world. One New Zealand study was identified as fitting under this theme. Gamage (2015) investigated how the zero-waste proposition of lean and Taguchi's Quality Philosophy, which allows engineers to identify optimum design parameter settings, complement each other.

This demonstrates that New Zealand is not yet at a level where there is a wider consideration of lean in terms of other disciplines, but it is slowly getting to that stage which will motivate research in this area.

2.8.2.6 Research Gap

Table 2.7 presents a comparison of New Zealand and global research themes. The implementation of lean and the discovering of the outcomes of lean are the two most prevalent areas of research for both sectors. The two other global themes of understanding the relationship between lean and other disciplines and conceptualising and defining lean are not identified as themes in New Zealand. Rather, the relationship between lean and accounting systems and lean emergence were identified as lean themes for New Zealand. The table also indicates that the gap in both areas is investigating the relationship between lean and performance measurement. Although the New Zealand lean literature did investigate lean in terms of the accounting system and management accounting system, the literature did not cover the PMSs of the lean organisations and how they relate to Searcy's (2004) LPDs. Further, the current global literature indicates that there is no or very limited research on lean and performance measurement.

Table 2.7: Research Gap in Lean Literature
(Adapted from Danese et al., 2018; and the research literature)

New Zealand	Gap in both sectors	Global
• Implementation of lean • Discover the outcomes of lean • Relationship between lean and accounting systems • Lean emergence	• Relationship between lean and performance measurement	• Implementation of lean • Discover the outcomes of lean • Investigating the relationship between lean and other disciplines / approaches • Conceptualising and defining lean

Accordingly, this study will aim to fill this gap in the lean and performance measurement literature by investigating how the PMSs of the lean organisations relate to the LPDs, which are discussed in section 2.7.

2.8.3 Summary

This section analysed lean research in New Zealand and compared the findings to current global lean research. This was done in terms of the lean themes identified, theoretical approaches applied, the context in which studies were set, and the methodologies applied to collect data.

There is a gap in the lean New Zealand and global literature in terms of lean and performance measurement, and this study will therefore aim to fill this gap. This will be accomplished by investigating the incorporation of Searcy's (2004) LPDs into PMSs for the successful diffusion of lean concepts. See section 2.6 for a more detailed discussion.

The next section will elaborate on the development of lean in a global context.

2.9 Chapter Summary

This chapter has reviewed the literature on lean and performance measurements applicable to lean organisations to provide a basis for examining the relationship between lean and performance measures.

The development of lean was discussed which culminated in a proposed lean definition for application in this study. The numerous lean techniques currently applied in organisations were discussed to illustrate the link to the proposed lean definition. The implementation of lean was also discussed to illustrate the reasons lean is implemented, the barriers to implementation, and the requirements for successful implementation of lean.

The efficient measurement of performance is one of the requirements for successful business. Traditional accounting methods were shown to be not applicable to lean organisations, and a PMS based on Searcy's (2004) LPDs is proposed. The literature indicated that Searcy's (2004) LPDs can be successfully linked to lean.

The study is set in a New Zealand context due its unique characteristics, with the New Zealand government attempting to boost lean in companies, and the country's large proportion of SMEs. The literature showed that in terms of New Zealand and global lean research, there is limited research on the relationship between lean and performance measurement. This provides an ideal opportunity for the present study to attempt to fill this gap. The business sectors that this study will investigate are manufacturing, service, wholesale and retail, DHB and LG, to fill the identified gap in studies comparing these sectors.

Contingency theory will be applied to ground the findings of this study, which states that because organisations are continuously open to contingency factors, no general set of approaches can be applied to every business situation. Further, this theory has been successfully applied in global research and in one identified New Zealand research study.

The following chapter will discuss contingency theory as the theoretical premise this study will be based on.

CHAPTER 3 THEORETICAL FRAMEWORK

3.1 Introduction

Chapter 3 introduces and discusses the research's theoretical framework, explaining contingency theory (CT) and analysing how this theory will be used in the present study to inform the findings.

The cornerstone of empirical research is its theoretical framework, as it informs the researcher's perception of reality and guides the method of data collection and analysis (Aldredge et al., 2017; Beattie, 2014; Lukka, 2010; Chua, 1986; Tomkins & Groves, 1983). The present study is grounded in the CT perspective in which lean techniques are implemented in different sectors and lean performance techniques are incorporated into the organisations' performance management systems.

This chapter is structured as follows. Section 3.2 defines CT, while section 3.3 provides an in-depth illustration of its evolution. This is followed by section 3.4 which presents recent management accounting studies that applied CT as the theoretical framework. Section 3.5 discusses the contingency factors relevant to this research, and finally, section 3.6 summarises the main points of the chapter.

3.2 Defining Contingency Theory

CT is based on the premise that there is no universally appropriate accounting system that applies equally to all organisations in all circumstances (Emmanuel et al., 1990). The theory denotes those particular features of an appropriate accounting system that depend upon the specific circumstances in which an organisation finds itself. Otley (1980) specifies that:

> … a contingency theory must identify specific aspects of an accounting system which are associated with certain defined circumstances and demonstrate an appropriate matching. (p. 413)

At the heart of CT is the notion that an organisation must maintain a fit between its structure and its contextual factors to achieve high performance levels (Taylor & Taylor, 2014; Sousa & Voss 2008; Donaldson 2001). Chenhall (2007) noted that when one or more of these relative factors change, another type of organisational configuration may constitute the best fit with the relative factors and become the best organisational configuration for the organisation at that period. Furthermore, for an organisation to perform well, organisations must adapt their structure to contingencies such as the environment, organisational size and business strategy (Thornton & Nath, 2015; Fullerton et al., 2013; Gong & Tse, 2009; Gerdin & Greve, 2008, p. 996; Chenhall, 2007,2003).

3.3 Evolution of Contingency Theory in Management Research

Otley (1980) originally proposed a view of CT to explain the variety of management accounting practices and forms of organisational structure that were most appropriate to specific circumstances.

This theory is heavily based on the CT of organisational structure (Otley, 2016). Figure 3.1 illustrates the proposed relationship between contingent variables, organisational control packages, intervening variables, and organisational effectiveness. The figure illustrates that this version of CT does not identify any specific contingency variables.

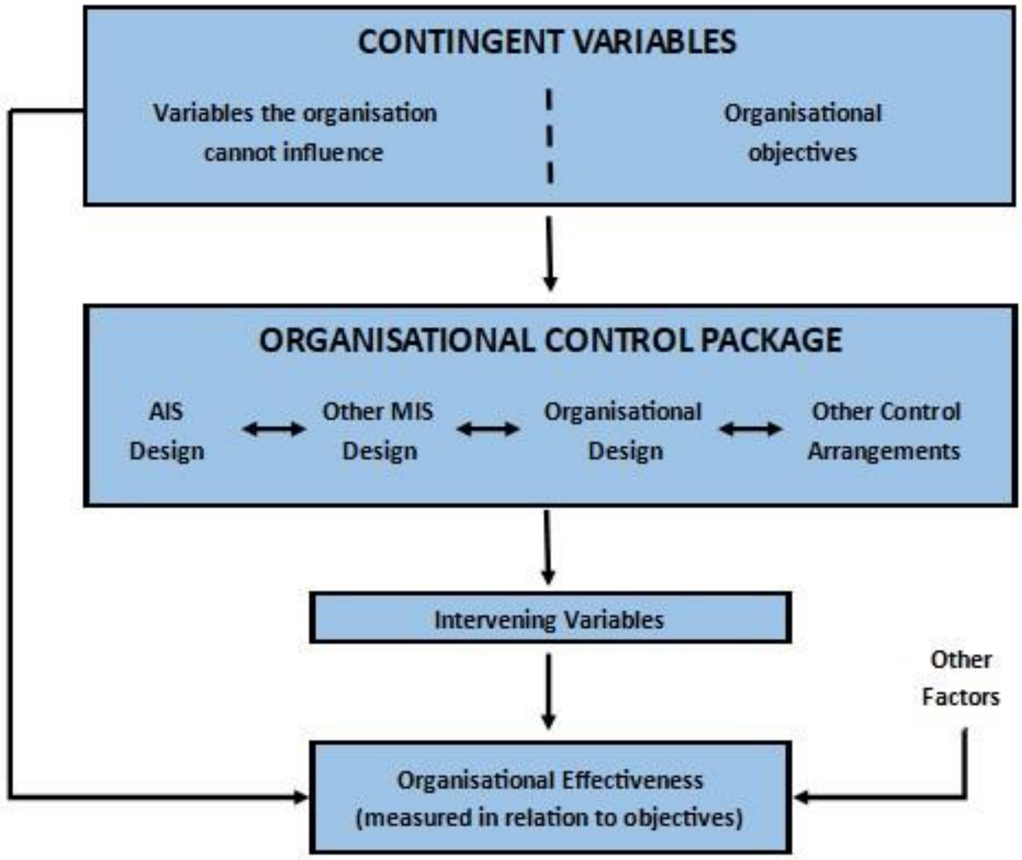

Figure 3.1: Otley's (1980, p.421) Contingency Theory Framework

Tiessen and Waterhouse (1983) provided an expanded view of CT in which the structure of an organisation depends on the organisation's technology and environment. They propose that the effectiveness of the management accounting system is contingent on the organisational structure. Figure 3.2 illustrates Tiessen and Waterhouse's (1983) CT of organisations where technology and environment affect organisational structure and in turn the management accounting system. The major development in this version of CT is that two contingency variables are identified, namely an organisation's technology and environment, where none were identified by Otley (1980).

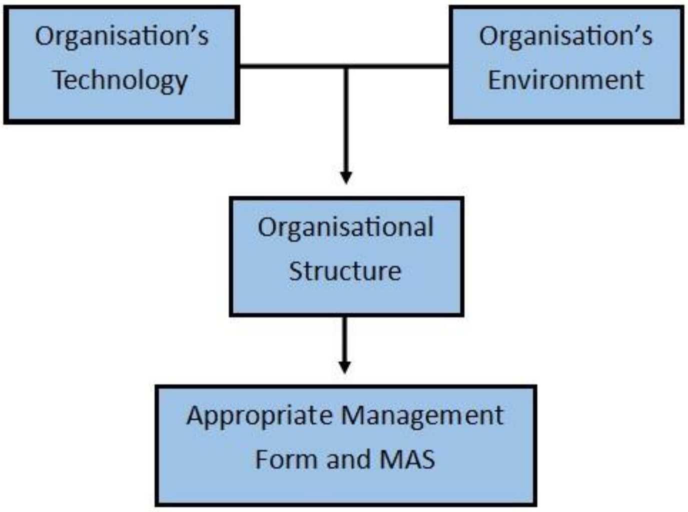

Figure 3.2: An Expanded View of Contingency Theory (Martin, n.d.)

In 2003, Chenhall (2007, 2003) discussed CT from a functionalist perspective which assumes that management control systems are developed or adopted to aid in achieving goals and outcomes. This is illustrated in Figure 3.3. Chenhall (2007, 2003) claims that the contingency factors affecting the design of the management accounting system are: external environment, technology, organisational structure, organisational size, organisational strategy, and national culture.

The Chenhall (2003) version of CT is different from Macy and Arunachalam's (1995) version in adding two new factors, namely organisational size, and national culture. It excludes decision style, organisational decision style and system adaptability as contingency factors, as previously acknowledged by Macy and Arunachalam (1995).

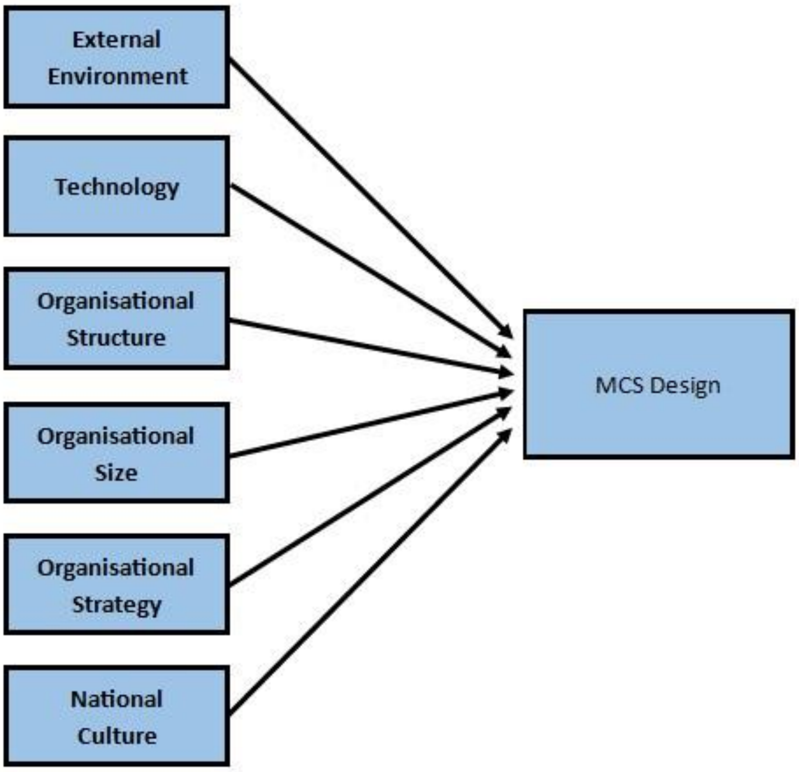

Figure 3.3: The Functionalist View of Contingency Theory (Taylor, 2004)

Figure 3.4 illustrates CT as updated by Macy and Arunachalam (1995) and highlights the functionalist factors identified through research. The figure also notes where relationships between factors and systems effectiveness have been established or not established. It is also notable that the authors have moved from the usage of 'variables' to 'factors'. Accordingly, factors will be used in the present study.

As previously noted, CT has been an important approach to the study of the role of management accounting within organisations and a variety of contingency factors have been examined, not all of which have been depicted in the figures above. In some cases, the research literature concluded that a relationship between sector and management accounting practices does exist (Contiero et al., 2016), and in other cases, no relationship was found (Nimtrakoon & Tayles, 2015).

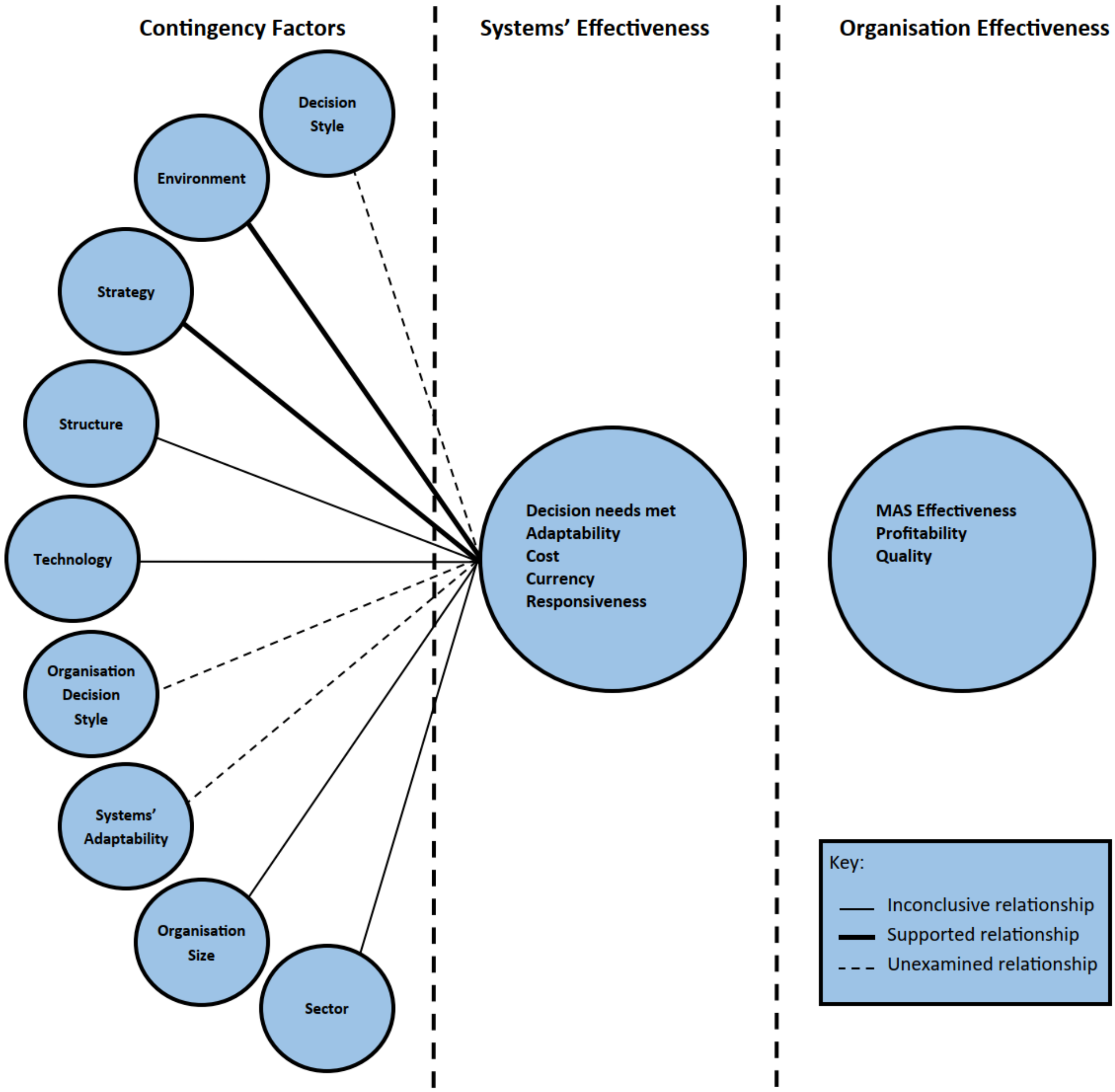

Figure 3.4: Updated Contingency Theory

Adapted from Macy & Arunachalam (1995, p.74).

3.4 Prior Studies of Contingency Theory in Lean and Management Accounting

CT has been an important approach to the study of the role of management accounting within organisations (Otley, 2016, 1980; Elgharbawy & Abdel-Kader, 2013; Chenhall, 2007, 2003). In an Australian study, Chenhall and Langfield-Smith (1998) used CT to investigate the adoption and benefits of management accounting practices, whereas Abdel-Kader and Luther (2008) researched firm characteristics and management accounting practices in the United Kingdom by applying CT. Fullerton and Wempe (2009) conducted a study on American organisations, examining how the use of non-financial manufacturing performance measures impacts the lean manufacturing/ financial performance relationship, through a CT lens.

Nimtrakoon and Tayles (2015) applied CT to explain the adoption of contemporary management accounting practices. Taylor and Taylor (2014) applied CT to research the effect of organisation size on the effective implementation of PMSs in UK based organisations. Thornton and Nath (2015) applied CT to establish the current level of the understanding and use of lean in New Zealand. Netland's (2016) study comprised international companies and investigated how contingency variables influence what practitioners see as success factors for implementing lean.

McAdam et al. (2019) successfully applied the interpretive approach using CT in exploring the role of quality management in enabling strategic alignment. In Brazil, Negrão et al. (2020) used CT to explore how contextual variables and scarce resources influence the adoption of lean practices. Costa et al. (2020) studied Brazilian and American organisations and examined how the food industry sector's characteristics affect its adoption of Lean Six Sigma (LSS) practices and performance improvement through a CT lens.

3.5 Contingency Factors Applied in this Study

As noted in the previous section, many contingency factors have been identified in prior research and were found to be relevant (Sila, 2007; Koufteros et al., 2005; Shah & Ward, 2003). While it is possible that all the factors identified in section 3.3 play an important role, this research will particularly focus on some of the factors as identified by Macy and Arunachalam (1995), Chenhall (2003), and other management accounting research. The factors were chosen for their ability to create new knowledge in terms of this research.

The CT factor of sector is of particular interest in the present study covering manufacturing companies, service companies, wholesale and retail companies from the private sector, and DHBs and LGs from the public sector. Accordingly, the factor of sector was added to the Macy and Arunachalam (1995) CT adaptation, as illustrated in Figure 3.4. Furthermore, the CT factor of organisational size as identified by Chenhall (2003), was also added.

Figure 3.4 indicates whether current research has established relationships with the CT factors. Research has supported a relationship with environment and strategy (Otley, 2016; Chenhall, 2007). The relationship with organisational size is also inconclusive as most of the research focuses on large organisations and limited research exists on SMEs. Most research based on CT has been on manufacturing organisations (Nimtrakoon & Tayles, 2015) and has not included service organisations. Accordingly, the relationship with sector is inconclusive. Furthermore, the relationship with decision style, organisation decision style, and systems' adaptability is still unexamined. It is believed that this adapted version of CT by Macy and Arunachalam (1995) will best suit this research, as it identifies the factors most applicable to the context of this study.

The CT factors this study will apply, are strategy, organisational decision style, system adaptability, organisational size, and sector.

3.5.1 Strategy

Strategy and systems' effectiveness have been shown to have a relationship (Otley, 2016; Chenhall, 2003 & 2007; Macy & Arunachalam,1995). Strategy has been shown to be of particular importance in terms of successful lean implementation (Bhasin & Burcher, 2006; Castellano & Burrows, 2011; Bhasin, 2012a) and is therefore included in this study. According to Chenhall (2003, 2007), strategy is not an element of context, but a means for managers to influence the nature of the external environment, the technologies of the organisation, and the structural arrangements of the organisation. Managers can therefore position their organisation in environments, through strategy. The present study will illustrate to what level lean is included in the organisation's strategy in relation to incorporation of lean techniques and appropriate lean performance measures.

3.5.2 Organisational Decision Style

Organisational decision style is a contingency factor that has not been fully researched in terms of the factor's relationship with systems' effectiveness (Macy & Arunachalam,1995). Organisational decision style is concerned with how organisations make decisions, what information is needed to make decisions, and how those needs are supported. Management commitment and leadership is of importance in successful lean implementation (Sim & Rogers, 2009), and the organisational level the decision to implement lean is made on, reflects management commitment.

The value of this perspective has been discussed in the information systems literature but has not been examined in the contingency literature with respect to PMS design. For this research, organisational decision style will be presented by the level at which the organisation decided to implement lean and whether it was on the strategic/management level or operational/production level.

3.5.3 Systems' Adaptability

Systems' adaptability is the ability of the management accounting system to adapt to changes in the organisation's internal and external environment. It is viewed as a process in the CT framework (Macy & Arunachalam, 1995). Organisations' lack of adaptability was shown as a major barrier in the successful implementation of lean (Narayanamurthy et al. 2018). The system changes include structural changes, information processing changes, external changes, and procedural changes. These changes have an impact on the organisation's technology, people, policies, and procedures. This research will examine the adaptation of the organisation's systems to incorporate lean techniques and the implementations of new performance measures that measure lean outcomes. This will illustrate the adaptability of the organisation's operational systems and PMS.

3.5.4 Organisational Size

Organisational size has been studied as an influential contextual factor. As an organisation increases in size, the need for accounting information increases (Edwards & Boyns, 2012). However, many studies are limited because they only examine large organisations (Chenhall, 2003). Most organisations in New Zealand fall into the Small and Medium Enterprise (SME) category (Thornton et al., 2019). SMEs are different from large organisations in that they are typically privately owned (Thornton et al., 2019) with limited resources, but have a flat structure and simple systems (Pearce et al., 2018). Research that addresses lean in SMEs is scarce (Alkhoraif, et al., 2019; Hu et al., 2015). If size is included as a contingency factor in this research, it will add knowledge about SMEs. Chenhall (2003, p. 149) gives a useful analysis of possible ways to measure size, including the number of employees, net assets, sales, and profits. For this research, size will be measured in terms of the number of employees.

3.5.5 Sector

Lean originated in the automotive sector and moved into other manufacturing sectors as well as the service sector (Bhamu and Sangwan, 2014; Alves et al., 2012; Hines et al., 2004; Womack et al., 1990). The majority of management accounting research based on CT has focused on manufacturing organisations (Nimtrakoon & Tayles, 2010). Further, most studies on lean focus on either the manufacturing sector or the service sector, with minimal studies set in both sectors (Danese et al., 2018). Several studies have included sector as a CT with conflicting results. The present study's aim is to expand the knowledge of lean by comparing manufacturing, service, wholesale and retail, DHBs, and LGs. In addition, a comparison of privately owned and publicly owned organisations will be included.

3.6 Chapter Summary

This chapter introduced and discussed the theoretical framework applied in this study to inform the findings. CT was discussed in terms of suitability and what it offers for grounding the findings of the present study.

As previously established, CT identifies specific aspects of an accounting system that are associated with certain defined circumstances and demonstrate an appropriate matching. This theory can be applied to establish the relationship between lean and the performance measurement system by evaluating contingency factors. Relationships are best studied in context and not in isolation. CT is therefore an appropriate underlying theory for the present study, to fill this gap in the research by studying the relationship between lean and performance measurements, within a contextual setting.

The contingency factors that will be examined in the present study are strategy, organisational decision style, systems' adaptability, organisational size, and sector. These factors were chosen for their ability to be applied to the study and for their potential to add new knowledge.

Chapter 4 will present the present study's research design.

CHAPTER 4 RESEARCH METHODOLOGY AND METHODS

4.1 Introduction

This research is primarily qualitative in nature as it aims to illuminate the relationship between lean and performance measurement in lean service and manufacturing organisations in New Zealand. The study is qualitative in nature due to the assumptions of reality and knowledge, where I look at socially constructed contextual meaning.

This study utilised several different methods to collect data to enhance the application of contingency theory (CT), which will inform the findings of this study. The data collected in the present study is primarily from web-based public archival documents, webpages, and an online survey. The archival documents consisted of Annual Reports from 2001 to 2021 and other relevant reports. The data is further augmented through semi-structured interviews.

All the ethical requirements of the Massey University Code of Responsible Research Conduct as promulgated by Massey University's Research Ethics Office were met. The data collection was conducted via online surveys and interviews in full compliance with the approved Massey University Code of Responsible Research Conduct procedures and guidelines.

This chapter is structured as follows: section 4.2 discusses the methodological approach of interpretivist qualitative research. This is followed by section 4.3 which revisits the research objective and presents the development of the research from relevant literature, and section

4.4 which presents and discusses the data collection approach of web-based research, online surveys, and semi-structured interviews. Section 4.5 provides details on the research participants, consisting of New Zealand companies, district health boards, and local governments, and finally, section 4.6 summarises the main points of the chapter.

4.2 Methodological Approach

The research is qualitative in nature and is grounded in an adapted version of CT as proposed by Macy and Arunachalam (1995), to reveal insights for an understanding of the relationship between lean and performance measurement in lean organisations, reveal the reasoning behind which lean techniques were used, how lean was incorporated into the existing PMSs, and how Searcy's (2004) LPDs fit into the adapted PMSs. Furthermore, these are used in a context and because the context is human, technological, and environmental, it is socially constructed. Accordingly, the approach is interpretive in nature.

The research conclusions of the present study are drawn from qualitative interpretations of the data through thematic analysis. To achieve this aim, this study adopts a broad interpretive paradigm. The interpretive approach can introduce new perspectives and assist in identifying meaningful evaluative criteria. This leads to language and communication, and accordingly the identification of themes. The themes denote meaning within the socially constructed context.

Researchers have called for accounting research to expand from its traditional style (Lukka, 2010; Burchell et al., 1980). In response to this call, accounting researchers have attempted to view accounting in varied forms (Maroun, 2012; Ahrens et al., 2008; Quattrone & Hopper, 2005; Macintosh & Scapens, 1990; Chua, 1988; Tomkins & Groves, 1983). For the critical and interpretivist researcher, accounting research is socially constructed within the environment in which the activity takes place. Critical research expands the research using power and interest as it exists in an organisation and remains a technical discipline. These 'alternative' approaches to accounting research have a rich description-generating ability, permitting accounting issues to be explored in more detail (Ahrens et al., 2008; Davila & Oyon, 2008).

The interpretive paradigm is common in management accounting (van der Meer-Kooistra & Vosselman, 2012; Abdul-Khalid, 2009; Lye et al., 2006; Chua, 1988; Tomkins & Groves, 1983). Alsharari and Al-Shboul (2019) state that the interpretive approach is useful in introducing new perspectives of accounting. Interpretive management accounting research has the potential to generate clarifications of transformation in which more meaningful, evaluative criteria may be identified (Lukka & Modell, 2010).

4.3 Research Objectives and Research Questions

The overall aim of this study was to establish the relationship between lean and the performance measurement system. This was achieved by applying CT to fill this gap in the research within a contextual setting. To achieve this, research questions were developed from relevant literature, as presented in Table 1.1.

The primary research objective of this study is to examine the relationship between lean and performance measurements in organisations that have implemented lean. This objective is addressed by research question RQ3. It is anticipated that this examination of the relationship will yield results that can improve the effectiveness of lean implementation.

The first subsidiary objective of this study is to examine and document what lean techniques organisations have implemented. This objective is addressed by research question RQ1. The intention is to provide a clear image of what lean techniques are implemented in New Zealand organisations, and furthermore, the knowledgeability of managers concerning lean techniques. This contextual information will assist in answering research questions RQ3 and RQ6.

The second subsidiary objective is to examine what performance measurements lean organisations have implemented to accommodate lean. This objective is addressed by research question RQ2. This will give a clear image of the knowledgeability of managers of lean performance measurements and will provide further contextual information to assist in answering research questions RQ3, RQ4 and RQ6, alongside RQ1.

The third subsidiary objective of this study is to evaluate the implemented lean performance measurements in terms of the lean performance dimensions framework as proposed by Searcy (2004). This objective is addressed by research question RQ4. It is expected that the results of this evaluation will further add to the improvement of the effectiveness of lean implementation as per the primary objective.

The fourth subsidiary objective is to examine managers' view of lean as part of their strategic aims. This objective is addressed by RQ5. This will give an indication of whether lean is included in strategic aims and provide further contextual information to answer research questions RQ3 and RQ6.

The fifth subsidiary objective is applying CT to explain the implementation of lean techniques, the usage of performance measures, and the relationship between these two concepts. This objective is addressed by RQ6. This will give a clear explanation of the CT factors that drive lean implementation and measuring lean outcomes.

The following sections will set out the research design to establish the different methods of data collection and how the data were analysed.

4.4 The Data Collection Approach

Figure 4.1 provides a summary of the specific methods of data collection. This figure shows that data was collected using three methods: a web-based search, a survey, and semi-structured interviews. The use of these three methods provides a rich contextual basis for interpreting results (Patton, 2002). Insight and understanding that might be missed when only a single method is used, can be used to increase the generalisability of the results and produce the more complete knowledge necessary to inform theory and practice (Migiro & Magangi, 2011). These methods of collecting data will further enhance the successful application of CT in this study.

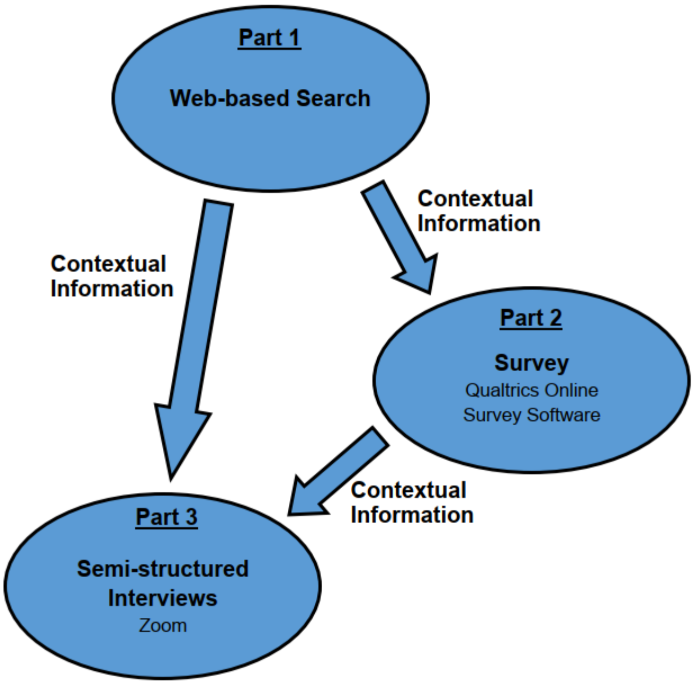

Figure 4.1: Data Collection Approach

The first part of the data collection approach consisted of a web-based search on each company from the Callaghan Innovation list, DHBs, and LGs. This search was aimed at collecting crucial data, such as contact details, mentions of lean implementation on the respective websites, and the mention of lean in annual reports.

The second part of the data collection approach consisted of an online survey that was sent out to each DHB and each LG, and to companies whose online presence and telephonic confirmation noted that they implemented lean. Accordingly, surveys were sent out to 79 companies, 20 DHBs, and 76 LGs. This resulted in 45 usable responses from the companies, 11 from DHBs, and 31 from LGs. See section 4.5 for more information on the research participants.

The questions of the survey were developed based on the literature, the preliminary web-based investigation, the annual report investigation, and CT. For example, RQ1 was based on Bhamu and Sangwan (2014) and De Oliveira et al. (2019), which indicated the different lean techniques that exist and determined that only some tools are implemented by organisations. In addition, the web-based and annual report investigations indicated that lean was implemented, but the lean techniques were not identified. RQ4 was based on Bellisario and Pavlov (2018) who note that lean should be viewed as an organisation wide philosophy or strategy, and Bhasin and Burcher (2006) who state that lean should be implemented on a strategic level. Further, the web-based and annual report investigations indicated that lean was not mentioned by all the organisations as being part of their strategy. Strategy is a contingency factor that will be investigated in the present study. The collected survey data not only provided insight into the current state of lean and lean performance measurement practices, but also provided essential contextual information for developing the questions for the semi-structured interviews.

The third part of the data collection approach used inquiry by semi-structured interviews. It has been asserted that interviews are the most common type of data collection method used in qualitative research, whether they are used alone or in combination with other data collection methods (Doody & Noonan, 2015). The present study used semi-structured interviews undertaken with a focus group of five individual respondents, as identified from the respondents of the survey. The interviewees were chosen to be representative of and to reflect the same proportion as respondents from each identified sector. The questions for the interviews were developed from the gaps in data identified through analysis of the survey data. For example, to further enhance the data collected on the relationship between lean techniques and performance measurements, organisations were asked to reflect on any specific performance measures they implemented to measure the outcomes of the lean techniques they implemented. Some organisations indicated that they value the input of lean experts and therefore interviewees were asked if they had made use of lean consultants or lean experts and to reflect further on why they did or did not. The questions were open-ended questions to allow interviewees to provide contextual feedback. Open-ended questions allow researchers to better understand the respondent's true feelings and attitudes about the concepts. The interview data provided further insight into the current state of lean and lean performance measurement practices and provided vital contextual data for thematic analysis.

The next subsections will further describe each of the research methods used.

4.4.1 Web-based Search

The first part of the data collection approach consisted of a web-based search. This search aimed to collect crucial contact information on each potential participant. Due to privacy laws in New Zealand, Callaghan Innovation could only provide the researcher with a list of company names. This necessitated a web-based search for each company to ascertain if they were still operating and for their contact details. The contact information of DHBs and LGs were readily available on government websites. Annual reports, where available, were also scrutinised.

4.4.1.1 Planning and Data Gathering

The data collected consisted of crucial items such as contact details and any mention of lean. The following data were collected:

- Website links
- Physical addresses
- Email addresses
- Phone numbers
- Names of CEOs, CFOs, COOs, and operation/production managers (where applicable)
- Any mention of lean or lean-related aspects on websites
- Any mention of lean or lean-related aspects on annual reports (if available for the period 2001 to 2021)
- Public documents from Callaghan Innovation
- Public documents from the Ministry of Health.

The collected data was collated using Microsoft Office Excel.

4.4.1.2 Data Analysis

Relevant data collected on participants mentioning lean, through the web-based search, were analysed in conjunction with the analysis of the survey-collected data. This is discussed in section 4.4.2.2.

4.4.2 Survey

Data was collected by utilising an online survey. Surveys allow for broader research questions to be studied (Speklé & Widener, 2018; Jansen, 2010), and can be used to establish more meaningful inferences in terms of the population. Surveys have been successfully used in management accounting research for many years and they are one of the most used researched methods (Herschung et al., 2017; Hopper & Bui, 2016).

In the last three decades, web-based surveys have become the predominant method of obtaining participation in academic research for its ease, quick response, and low cost (Saleh & Bista, 2017). Web-based survey tools are mostly selected based on their many advantages over other tools, such as email and post. The advantages of web-based tools include good cost-benefit ratio, time efficiency, quality of responses, human error reduction, broader distribution, higher response rate, a smaller turnaround, and ease of follow-up (Hayslett & Wildemuth, 2004). Web-based surveys are also streamlined in terms of distribution, collection, and analysis (Peytchev & Crawford, 2005). Accordingly, the survey was created, distributed, and managed through the Qualtrics Online Survey Software.

4.4.2.1 Planning and Data Gathering

The survey instrument was designed specifically to gather data to answer the research questions of this study. The full survey can be seen in Appendix 1. Data collected consisted of information on the lean techniques implemented, lean performance measures applied, and managers' views on lean and strategy. Some general questions regarding the organisation were also included to add further value to the data. The questions also aimed to collect data relating to the CT factors applied in the study, for example, the sector the organisation belonged to, the organisational level the decision to implement lean was made on, and whether lean was incorporated in the organisational strategy.

The following areas were covered:

- Date the organisation was established
- Business sector
- Business ownership
- Why lean was implemented
- When lean was implemented
- Organisation level at which it was decided lean should be implemented
- Organisation level lean at which lean was implemented
- Lean features implemented
- Lean techniques implemented
- Lean performance measures applied
- Managers' views on lean and strategy
- Inclusion of lean in corporate documents.

There were 25 questions in the survey, consisting of a mix of open-ended and closed-ended questions. The open-ended questions allowed free text input. The closed-ended questions were one of the following applied types:

- Multiple choice questions
- Multiple choice questions with one or more options allowing respondents to add choices not mentioned
- Matrix table with three different options per choice.

A pilot study of the survey was done as a control measure for the efficiency and effectiveness of the survey questions. As part of the pilot, five respondents completed the survey. The respondents were chosen for their knowledge and practical experience in lean and performance measurement in their respective organisations. The researcher checked each response and discussed the responses and survey with each of the respondents, regarding any issues found in the survey and possible changes required.

Dependability, credibility, and transferability are considered yardsticks of trustworthiness in survey research. Dependability refers to the survey and its application being trustworthy and reliable, credibility refers to the survey results being able to be trusted, and transferability refers to the results of the survey being generalised to other contexts. To meet these attributes, the following steps were taken:

- Each respondent was provided with a personalised link to the web-based survey, that was linked to their email address. This was to address the potential lack of security and the inherently unrestricted access to the World Wide Web (Crawford et al., 2001).
- During the data-gathering process, survey notifications, reminder emails, and telephone follow-ups were planned and carried out (Witmer et al., 1999), to mitigate the potential limiting factor of a low response rate.
- The survey was designed to facilitate ease of use (Crawford et al., 2001).

As previously noted, the Qualtrics Online Survey Software was used to facilitate the survey. This program was chosen for its ease of use and flexible functionalities of data creation, distribution, and analysis.

4.4.2.2 Data Analysis

After collection, the survey data was analysed and presented in an aggregated format. Relevant data, collected through the web-based search, was analysed in conjunction with the survey data. The Qualtrics Online Survey Software built-in analysis and reporting capabilities as well as the functionalities of Microsoft Office Excel and Microsoft Office Word were used to aggregate and categorise the survey data. The Qualtrics Online Survey Software and Microsoft Excel were also used to process raw data into tables and appropriate charts. The Miles, Huberman, and Saldana (2020) data analysis process was used to thematically analyse the data. This method draws out the relevant interpretations, meaning, and contexts in the data. The process includes revisiting and refining the identified patterns and themes, which can lead to the emergence of new patterns.

The following key thematic analysis steps were taken:

1. To create familiarisation with the complete response of each participant, each of the responses was read repeatedly. This assisted the researcher in looking for meaning in the data.
2. Categories and sub-categories were identified by examining the data to identify themes and patterns with common or new meanings.
3. The ‘text iQ’ feature of the Qualtrics Online Survey Software was applied to collate themes and patterns. The list of themes and patterns was constantly compiled and recompiled and analysed for relationships. This process was repeated until no more categorisations were possible.
4. Steps 1 to 3 were repeated on each response up to the point where categorisations did not change due to new data being incorporated.

During this analysis phase, the data collected from the web-based search, was also incorporated.

The tables, charts, and thematic analysis were used to examine and analyse the lean techniques implemented, the lean performance measures applied, and managers' views on strategy and lean. The analysis included identifying possible gaps in the data and areas that warranted further investigation. These were used to develop the semi-structured interview questions with the aim to collect relevant data to fill the gaps.

4.4.3 Semi-structured Interview

The semi-structured interview was designed specifically to gather data that would fill the gaps identified from analysing the data collected from the web-based search and the survey data, and to collect further data on the areas that were identified as warranting further investigation. Two of the gaps identified were the reasons the specific lean techniques were chosen, and what objectives the participants wanted to achieve in implementing lean. The semi-structured interview questions can be seen in Appendix 2.

Interview-based management accounting studies are perceived to be a more accepted and commonly employed research paradigm (Tucker & Parker, 2014). Semi-structured interview techniques are widely used in management accounting research. Examples include the exploration of management accounting systems in the advanced manufacturing environment (Ismail & Isa, 2011), the analysis of factors affecting resistance to changes in management accounting systems (Angonese & Lavarda, 2014), and the analysis of the role of management accounting towards a carbon-constrained organisation (Kumarasiri & Jubb, 2016).

Research by semi-structured interview focuses both on what transpired and on the meaning behind what transpired. It is an approach that facilitates the understanding of what and how individuals make meaning of their experiences, and it is generally qualitative in nature (Kallio et al., 2016; Cridland et al., 2015). The interviews were conducted through the virtual conferencing software, Zoom. This allowed the researcher to conduct the interviews with interviewees situated in different areas of New Zealand, without the need to travel. The software also allows for the meeting to be recorded and the creation of an automatic, online transcript of the meeting. As a back-up to the recorded meetings, each meeting was also recorded in mp3 format.

4.4.3.1 Planning and Data Gathering

To provide this study with a streamlined instrument of inquiry that was efficient and productive, Adams' (2015) semi-structured interview guide was adopted. In line with its characteristics, the questions asked were generally generic, non-directive, and introspective in nature. This technique provided a degree of structure to the interviews. The questions were constructed to fill the gaps identified in the analysed survey data. The semi-structured interview consisted of open-ended questions. Open-ended questions have the advantage of researchers obtaining answers that are unanticipated and may more closely ascribe the real views of the participants. It also allows participants to answer questions in their own words (Fowler, 2014).

The questions were designed to encourage participants to describe their individual experiences and perceptions of lean implementation, lean performance measurements applied, and the view of lean as a strategy or not, in their respective organisations. The intention was to enable managers to narrow down the ethos, stories, and interpretation of their experiences and observations. Throughout the semi-structured interview sessions, flexibility was maintained to enable participants to move the discussion in any acceptable course. This opened potential areas for expanding options, which led to the uncovering of emerging topics and themes.

The semi-structured interview consisted of several questions. To open the interview and to put the interviewees at ease, the interviewees were first asked if they had any questions before the interview commenced. This was to allow interviewees to address any concerns or questions they may have about the process or questions, and to set them at ease. Furthermore, the first lean-related question was: "How did you first become involved with lean?" After that, more direct and difficult questions were asked, for example, "Can you please elaborate on why you chose the specific lean techniques you implemented? What objectives did you attempt to meet?" During the interview, to facilitate further elaboration from interviewees on specific topics, questions like, "Would you please describe what you said in more detail?" were asked. To end the interview, the last question was, "Is there anything more you would like to add?" This gave the interviewees the chance to add things they perhaps felt were important to say but did not have the opportunity to do so before or to elaborate on previous answers.

Five semi-structured interviews were conducted. The number of interviews required in a qualitative research study is contentious. Saturation has been used to establish the number of interviews, which is when the ability to obtain additional new information has been attained and when further coding is no longer feasible (Guest et al., 2006). Marginson (2004) argues that the number of interviews undertaken will be influenced by practical considerations such as available funding, time, access, and whether interviews comprise a single or just a part of how data is collected. For the present study, this researcher concluded that five semi-structured interviews will be suitable as the semi-structured interviews are not the primary data collection tool but have the purpose of adding to the web-based and online survey data. The interviewees were chosen to be representative of the three major sectors, namely companies, DHBs, and LGs, with two from companies, one from a DHB, and two from LGs. Detail on the interviewees is presented in Table 4.1. and is further discussed in section 4.5.

This study is mindful of the concerns of error, bias, and validity that may arise in qualitative research (Norris, 1997). Adams' (2015) semi-structured interview guide supports open, unbiased investigation, through the nature of open-ended questions that allow participants to determine their responses and elaboration. Trustworthiness is vital in qualitative research (Nassaji, 2020), and to further this, the interviewees were provided with transcripts of their full interviews. This allowed them to re-examine their answers and to ensure that the transcripts were faithful representations of the interviews.

4.4.3.2 Data Analysis

The purpose of analysing the semi-structured interviews was to further enhance the data collected by web-based search and online survey and to expand the results. The qualitative data analysis method as proposed by Miles, Huberman, and Saldana (2020) was again applied to perform the thematic analysis.

The first step was to transcribe the audio narratives. According to MacLean et al. (2004), non-verbal behaviours are central to the transcription process, therefore, non-verbal behaviours like “ums” and pauses were noted. This was to ensure the validity, veracity, and reliability of the transcribed data. The researcher performed the transcription process of the interview narratives. The virtual conferencing software, Zoom, has a functionality that automatically transcribes the interviews. These transcripts were verified by the researcher by reading through the transcripts while watching the recorded interviews. The researcher amended the transcripts where they differed from the interview and added non-verbal behaviours where needed. Before starting the thematic analysis, the transcripts were sent to the relevant interviewees to allow them to verify their content and add to their answers if they felt it necessary.

The Qualtrics Online Survey Software built-in analysis and reporting capabilities as well as the functionalities of Microsoft Office Excel and Microsoft Office Word were used to aggregate and categorise the survey data. The Qualtrics Online Survey software has a functionality to import responses created outside of the software. The researcher created the interview questions as a survey in the software, converted the transcripts into a format that fit the questions, and then imported each interview into the software.

The following key thematic analysis steps were taken:

1. The first step of familiarisation was performed while editing the transcripts. After the interviewees had confirmed the correctness of the transcripts, the familiarisation process was continued and each of the interview transcripts was read repeatedly. This assisted the researcher to look for meaning in the data.

2. Categories and sub-categories were identified by examining the data to identify themes and patterns with common or new meanings.
3. The ‘text iQ’ feature of the Qualtrics Online Survey Software was applied to collate themes and patterns. The list of themes and patterns was constantly compiled and recompiled and analysed for relationships. This process was repeated until no more categorisations were possible.
4. Steps 1 to 3 were repeated on each interview transcript up to the point where categorisations did not change due to new data being incorporated.
5. The themes identified from the transcribed interviews were merged with the themes identified from the web-based search and online surveys.

This thematic analysis was used to further examine the relationship between the lean techniques implemented and the lean performance measures applied, and managers’ views on strategy and lean. It was also used to fill the gaps identified from the survey data analysis.

The complete analysis of the survey data and semi-structured interview data is collectively presented in chapters 5, 6, and 7.

4.5 Research Participants

New Zealand has a small economy and population (Gal, 2001), with high labour costs due to strict labour laws, and a relatively open economy, which leads to high levels of global competition (Agarwal et al., 2013). Furthermore, most organisations in New Zealand fall into the Small and Medium Enterprise (SME) category (Thornton et al., 2019) and form an important driving force behind the New Zealand economy (Ministry of Economic

Development, 2011). SMEs are different from large organisations in that they are typically privately owned (Thornton et al., 2019) with limited resources, but have a flat structure and simple systems (Pearce et al., 2018). Research that addresses lean in SMEs is scarce (Alkhoraif, et al., 2019; Hu et al., 2015).

Unlike the governments of other developed economies, New Zealand's government initiated the adoption and implementation of lean philosophy by New Zealand entities via New Zealand Trade and Enterprise (NZTE) in 2005 and 2007 (Goodyer et al., 2011; Murti, 2009; Wilson et al., 2008). This was continued by Callaghan Innovation, a ministerial service, as a 'Better by Lean' programme, which is still offered to companies (Callaghan Innovation, 2020). This programme targeted manufacturing, service, and supply chain companies to assist them in identifying inefficiencies and customer value-adding activities, and in improving planning, staff engagement, customer value, inventory, and production flow, to create a culture of continuous improvement. This 'Better by Lean' programme provided an opportunity to obtain a list of New Zealand organisations that may have implemented lean, from Callaghan Innovation, to form part of the study sample.

New Zealand's public sector forms a major part of the economy, and it is the biggest employer in New Zealand. A high performing public sector is therefore essential to the economy. Delivering quality services at the lowest cost is one of the most important ways the public sector can contribute. Public sector organisations comprise the state sector organisations and local governments. Local government in New Zealand consists of city councils, district councils, and regional councils. These are all also known as 'local authorities'. City councils and district councils are collectively known as territorial authorities and are the second tier of local government in New Zealand, below regional councils. DHBs, which form part of the state sector, were established to ensure the provision of health and disability services to populations within a defined geographical area. The inclusion of DHBs and LGs as participants increased the proportion of service organisations in this study.

Figure 4.2 is a flow chart presenting the research participants, indicating the selection of participants for the survey and semi-structured interviews. Forty-five companies, 11 DHBs and 31 LGs participated in the online survey. Participants for the semi-structured interviews were chosen from the survey participants in the same proportion as participants from each sector. Two companies, one DHB, and two LGs were interviewed.

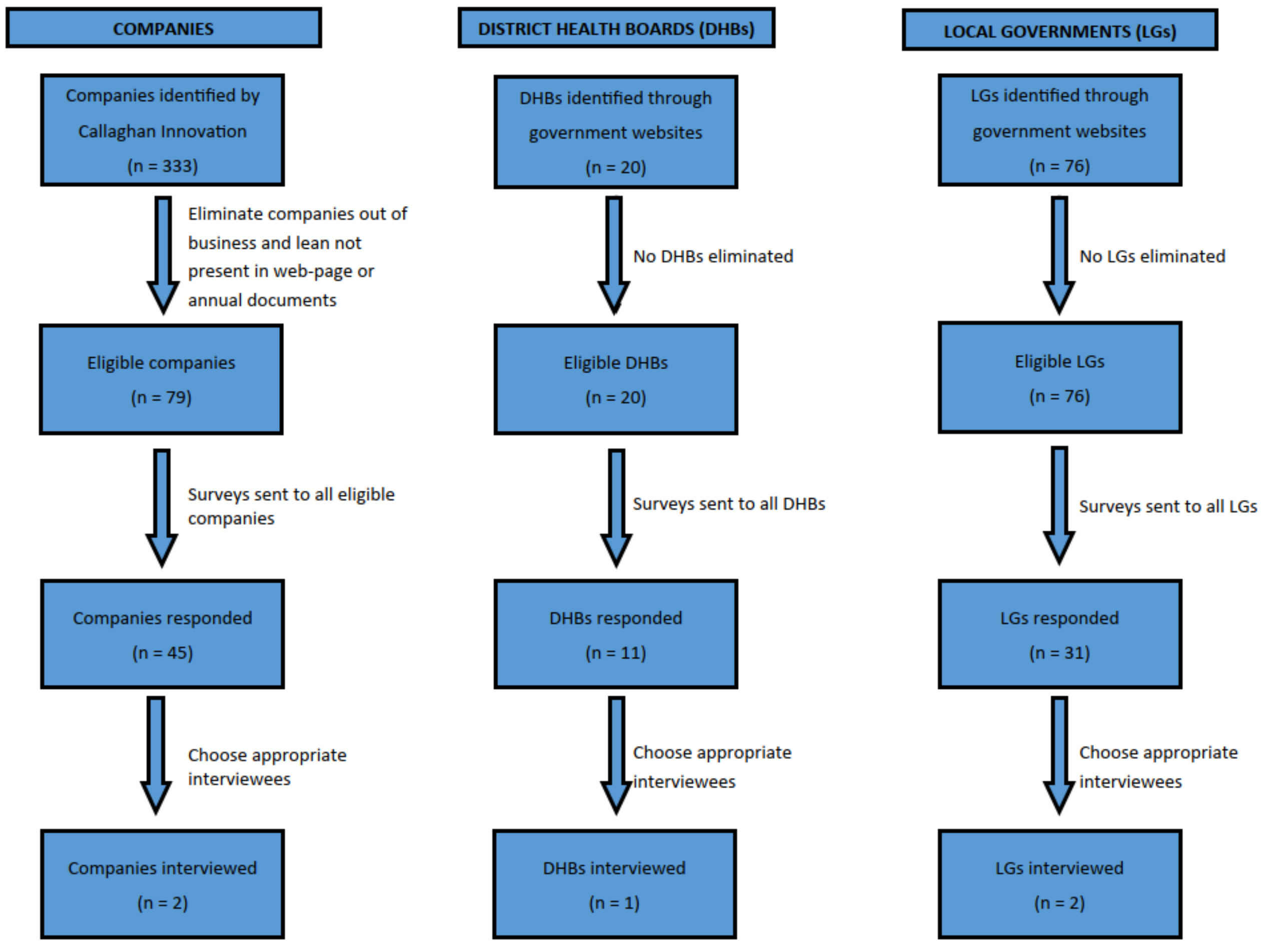

Figure 4.2: Research Participants

The first group of research participants in this study were selected from 333 New Zealand companies. A list was obtained from Callaghan Innovation, on 9 April 2020, of companies that accessed their ‘Better by Lean’ program. This provided a population of companies that offer a high degree of possibility of having implemented lean. The second group of research participants were selected from New Zealand DHBs and LGs. At the time this research was conducted, there were 20 DHBs and 76 LGs. This group was chosen to increase participants from the service sector, as only a small portion of the first group was in the service sector. This also provided an opportunity to compare organisations from the private sector (companies) to organisations from the public sector (DHBs and LGs).

The sampling method applied in this study is the non-probability method of purposive sampling. Purposeful sampling is a technique widely used in qualitative research for the identification and selection of information-rich cases for the most effective use of limited resources (Patton, 2002). This involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest (Cresswell et al., 2011). The type of purposeful sampling applied is total population sampling which involves the entire population that has a particular set of characteristics (Etikan et al., 2016). This method of sampling was chosen to ensure as many respondents as possible from a limited population.

The list of companies provided by Callaghan Innovation only gave the registered companies’ names due to New Zealand privacy laws. During the web-based search, it was ascertained that several companies had ceased operations, or were not discoverable on the world wide web, and therefore, these companies were discarded. Of the remaining companies, those that did not mention lean in their websites were contacted by telephone to ascertain whether they had implemented lean. Companies that reported not having implemented lean were discarded. The characteristic of their online presence denoting that they did implement lean or telephonic confirmation that they did implement lean, was applied to the companies to include them in the population. The elimination of unsuitable companies resulted in 79 eligible companies. The 79 companies and all the DHBs and LGs were all sent surveys as per the total population sampling technique.

The interviewee sample was determined using purposive sampling in that each group was appropriately represented. Five interviewees participated in the study. Table 4.1 provides a summary list of interviewees.

Table 4.1: Interviewees' Profile

Participant	**Senior Management**	**Middle Management**	**Position**	**Interview Duration**
Company 1	1		CEO	72 minutes
Company 2	1		Production Manager	65 minutes
LG 1		1	Lead Advisor – Reporting and Tools	58 minutes
LG 2		1	Product Manager	55 minutes
DHB 1		1	Senior Improvement Advisor	63 minutes

The interviewees consisted of two participants from privately owned companies, both of whom were from the senior management level. One of the participants was the CEO of a company and the other was the production manager of another company. Two of the interviews consisted of participants from publicly owned LGs, of which both were from the middle management level. The fifth interviewee was a participant from a DHB, who was from the middle management level. The perceptions of these interviewees of the lean techniques implemented and the performance measures applied to measure lean outcomes are important as their knowledge will reveal the corresponding drivers that influence and shape the implementation of lean and application of lean performance measures.

4.6 Chapter Summary

The chapter introduced and discussed the research design of the study. Data was collected through web searches of each participant, an online survey, and semi-structured interviews. The intent was to collect data that would ultimately provide relevant information to analyse the relationship between lean and lean performance measures.

The survey was conducted through the Qualtrics Online survey software and the participants consisted of New Zealand companies that implemented lean and New Zealand DHBs and LGs. The semi-structured interviews were conducted through the virtual conferencing software, Zoom, and the participants were selected from the survey participants. The data was thematically analysed using the method prescribed by Miles, Huberman, and Saldana (2020).

The next three chapters will present the analysis of the study findings. Chapter 5 will explain the emergence and adoption of lean and lean practices by the organisations that participated in this study. Chapter 6 will explain how participating organisations adapted their performance measurement systems to fit the lean techniques they implemented. Chapter 7 will discuss and analyse the relationship between lean and lean performance measures within the New Zealand context.

CHAPTER 5 LEAN EMERGENCE AND TECHNIQUES

5.1 Introduction

This chapter and the following two chapters present the research findings and analysis. This chapter explains the emergence and adoption of lean and lean practices by the organisations that participated in this study. Lean and lean techniques emerged in the participating organisations during the 1990s. Current New Zealand literature and the research data show that implementation was slow during the 1990s, increased during the early 2000s, and continued to increase during the 2010s (Grigg et al., 2018; Akmal, 2019; Thornton & Nath, 2015).

Current research has not yet established a timeline for lean implementation in New Zealand. Chapter 5 will therefore first provide and analyse a timeline of lean implementation by the participating organisations, in each of the different sectors, illuminating the influence of the New Zealand government on lean implementation. This is followed by a discussion and analysis of the meanings the participating organisations' managers associate with lean as emerging from the research data. Current lean research in New Zealand has not examined the lean techniques that organisations have implemented. This chapter will describe and analyse the lean techniques implemented in the participating organisations.

Chapter 5 is structured as follows: section 5.2 first presents the research sample and then discusses and analyses the emergence of lean in the participating organisations, including the meaning(s) that the senior managers of the participating organisations associate with lean. This is followed by section 5.3 that discusses and analyses lean techniques implemented by the participating organisations and the factors driving this implementation. Finally, section 5.4 draws conclusions resulting from the findings.

5.2 Emergence of Lean

This section reports, explains and analyses the findings of the survey on the emergence of lean and lean techniques in the participating New Zealand organisations. This provides an important timeline of lean implementation in the different sectors of manufacturing companies, wholesale and retail companies, service companies, DHBs and LGs, and it provides an impetus to analyse the meanings that participants associate with lean.

The study sample consists of organisations from a wide range of different sectors to allow comprehensive research. As illustrated in Figure 5.1, the study sample consists of 35 organisations from the manufacturing sector, 48 organisations from the service sector, and four organisations from the wholesale and retail sector.

The study sample can further be distinguished into privately owned or publicly owned organisations. The service sector organisations can be further distinguished into different sectors. Accordingly, Figure 5.2 illustrates that the study sample consists of 45 privately owned companies and 42 government owned public organisations. The privately owned companies consist of 35 manufacturing, six service, and four wholesale and retail companies. The public organisations consist of 31 LGs and 11 DHBs, which are further classified as service organisations.

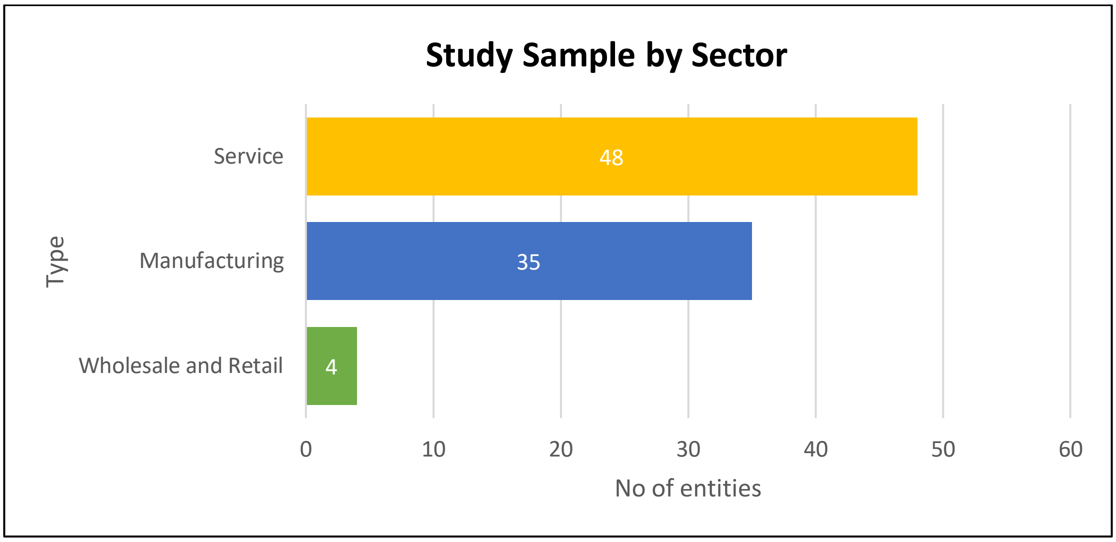

Figure 5.1: Study Sample Sectors

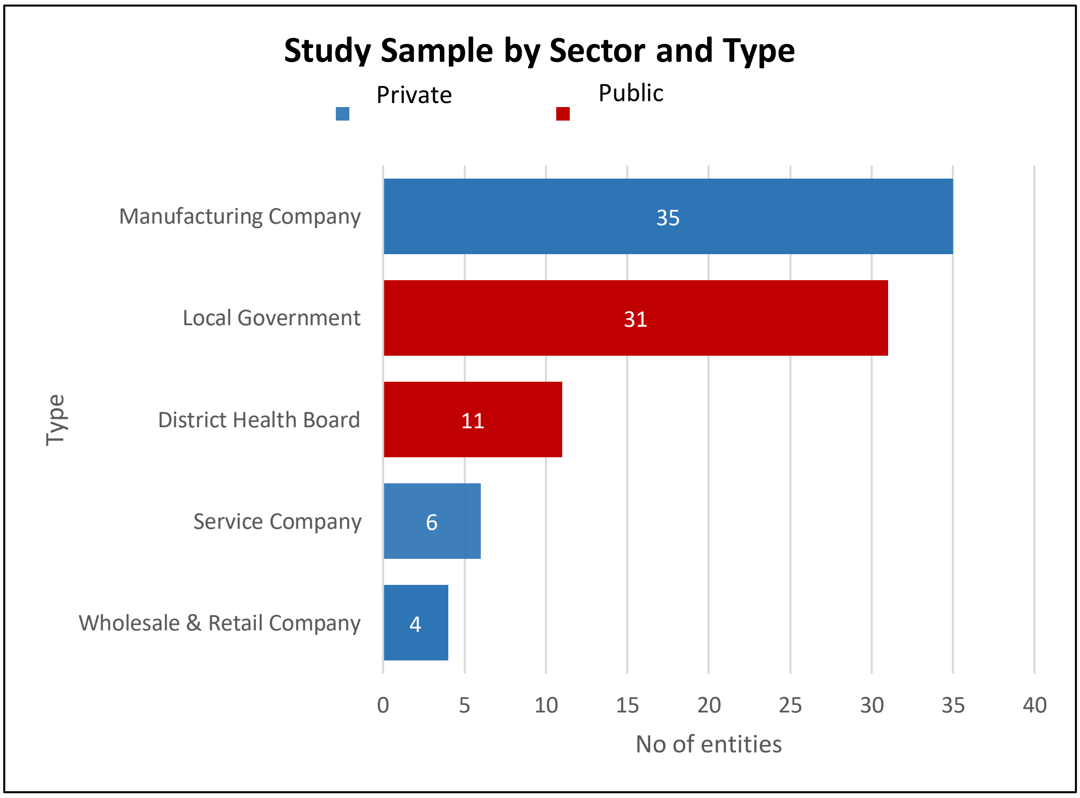

Figure 5.2: Study Sample Sectors (Private and Public) and Type

5.2.1 Implementation and Emergence of Lean

Literature on lean practice and adoption shows that global organisations started implementing lean in the manufacturing sector during the 1990s and in the service sector during the 2000s, as presented in Table 2.1 (Albzeirat et al., 2018; Bhamu & Sangwan, 2014; Hines et al., 2004). Research data shows that New Zealand is on par with lean implementation at a global level. The research data further indicates that the New Zealand government was instrumental in the implementation of lean practices to improve productivity. For example, in 2004, New Zealand Trade and Enterprise (NZTE) undertook a series of national initiatives intended to kick-start lean practices on a national level (Grigg et al., 2018; Goodyer et al., 2011). This is still an ongoing initiative with Callaghan Innovations being the current organisation running lean programmes on behalf of New Zealand Ministry of Business, Innovation & Employment (Callaghan Innovation, 2022, 2017).

Table 5.1 presents the summary research data collected on the emergence of lean in the participating organisations. It is noted that the manufacturing companies started implementing lean during the 2000s. Seven (20%) of the 35 manufacturing companies implemented lean during this period, and 27 (77%), during the 2010s. This has also been evidenced by the New Zealand research literature (Grigg et al., 2018; Feumana et al., 2013). Table 5.1 further indicates that the service companies started implementing lean during the 2010s. All six service companies implemented lean during this period. This is also evidenced by the New Zealand lean literature (Xiao, 2016; Thornton & Nath, 2015). Data summarised on the DHBs shows that lean implementation began in the 2000s. Five (46%) of the eleven DHBs implemented lean in this period and four (36%) during the 2010s. New Zealand focused research corroborates the timeline for DHBs (Akmal, 2019; Wilson, 2017; Rees, 2010). Data summarised on the LGs shows that lean implementation began in the 2000s. Four (13%) of the 31 LGs implemented lean during this period and 9 (29%) during the 2010s. It is noted that the current literature in the New Zealand context has not addressed the emergence of lean in LGs and this research is therefore filling this gap in the research literature. Table 5.1 also indicates that the wholesale and retail companies started implementing lean during the 2010s, with all four (100%) of the companies doing so. Current literature in the New Zealand context has not addressed the emergence of lean in wholesale and retail companies and this research is therefore filling this gap in the research literature. The present study therefore adds to the lean literature in providing a timeline for the emergence of lean in LGs and wholesale and retail companies. This provides an opportunity for future research on lean in these sectors in a New Zealand context.

The research data as depicted in Table 5.1 shows that when comparing the number of participants of privately owned companies (35), the service (6) and wholesale and retail (4) companies are still lagging the manufacturing companies. The New Zealand research literature has also evidenced this for service companies (Thornton & Nath, 2015; Alagundagi, 2015), but there is no corroborative literature on wholesale and retail companies. The research findings show that lean concepts were slower to emerge in privately owned companies compared to global organisations. However, research data and literature evidence indicate that lean emerged simultaneously in the publicly owned DHBs and LGs, and global service organisations. One LG reported implementing lean as early as 1989. There is scant evidence of research on lean in New Zealand LGs and wholesale and retail companies.

Table 5.1: Lean Implementation Year

(Adapted from the Danese et al., 2018 and the research data)

Year lean implemented	Manufacturing Companies		Service Companies		Wholesale and Retail Companies		District Health Board		Local Government		Total		Private		Public		Themes	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	Survey Sample	Global
Before 1990									1	3%	1	1%			1	2%		Awareness of lean developing and focusing on cost and quality
1990 - 2000																		Quality, cost, and delivery
2000 - 2010	7	20%					5	46%	4	13%	16	18%	7	16%	9	21%	Productivity and waste management (Manufacturing), Efficiency and Quality (DHBs)	Customer value
2010 - 2021	27	77%	6	100%	4	100%	4	36%	9	29%	50	58%	37	82%	13	31%	Productivity and staff engagement (Manufacturing), Quality (DHBs)	Meeting customer demand through CI
No date	1	3%					2	18%	17	55%	20	23%	1	2%	19	45%		
	35		6		4		11		31		87		45		42			

As presented in Table 5.1, the research data shows that 17 LGs, two DHBs, and one manufacturing company self-reported in the survey that they did not implement lean. Further analysis of these organisations indicated that they did implement several lean features and techniques. These organisations were therefore included in this study.

The research findings, as presented in Table 5.1, further indicate that on a broad basis, the implementation of lean in New Zealand is on par with global organisations. However, the initiatives for implementing lean are different. Within the global context, lean implementation has spread to reduce costs and make organisations more competitive. In a New Zealand context, private sector organisations were introduced to lean by the New Zealand government to boost productivity and growth. The effect was a reduction in costs and an increase in quality, but this was not the core incentive to implement lean. Public sector organisations in New Zealand were not targeted by this New Zealand government initiative (Callaghan Innovation, 2022, 2017). Public sector organisations' reasons for implementing lean were at first more in line with those of global organisations in seeking ways to improve quality and efficiency, but in 2008, this also became a government initiative separate from the Callaghan Innovation.

Canterbury DHB has faced pressures driven by large numbers of Emergency Department (ED) presentations and the increased complexity and acuteness of conditions presenting, compounded with limited physical capacity. In 2004, the DHB began the Improving the Patient Journey Programme. This aimed to reduce bottlenecks and smooth the patient journey through the whole hospital and focused on reducing ED length of stay (Dolan, et al., 2021; Ardagh, et al., 2011). This programme, however, did not relieve ED overcrowding and the DHB had to resort to a new approach called Project RED (Rejuvenating the Emergency Department).

Canterbury DHB implemented lean techniques such as Lean Thinking and Six Sigma during 2007 to enhance their ED workstream. This initiative was called the Project RED, and was run by ED clinicians, the Chief Executive Officer, the Chief Medical Officer, the Executive Director of Nursing, the General Manager of the Hospital, the RED project manager, a project facilitator, and other clinical staff (Ardagh et al., 2011). The aim of Project RED was to improve efficiency and quality in the Christchurch Hospital ED. Further, Middlemore Hospital, driven by a strong commitment from executive leadership, also aimed to improve ED service performance and implemented a comprehensive programme for quality improvement using Lean Thinking for process improvement (Working Group for Achieving Quality in Emergency Departments, 2009). In 2008, the Working Group for Achieving Quality in Emergency Departments to the Minister of Health, made recommendations to improve quality and efficiency in New Zealand EDs. The recommendations were partly based on the success of Project RED and Middlemore Hospital that applied lean successfully to improve quality and efficiency in their EDs (Working Group for Achieving Quality in Emergency Departments, 2009). These recommendations included Lean Thinking to improve ED processes.

The research data therefore indicates that DHBs at first implemented lean due to managers' previous knowledge of lean and the results it delivers. This knowledge was derived from working experience in international EDs and as reviewers of external bodies (Ardagh, et al., 2011). From 2008, lean implementation became more government initiated being directed by the recommendations of a government working group (Working Group for Achieving

Quality in Emergency Departments, 2009). A few of the DHB participants referred to this initiative in their survey responses. For example, a quality improvement manager stated that they implemented lean as:

> '*… directed by the Quality Improvement & Patient Safety Directorate …*' (Manager 6/Interviewee: DHB 1)

The research data, therefore, indicates that the New Zealand government influenced the initiation of lean and are still influencing the implementation of lean in both the private sector and the public DHB sector.

Furthermore, as presented in Table 5.1, lean implementation in a New Zealand context, in terms of the research participants, are still currently focused on productivity and quality, which is what the global lean organisations were focused on during the period before 1990 and between 1990 and 2000. Global organisations have moved on to focus on meeting customer demand through continuous improvement (CI). Quality is still present, as indicated by the lean techniques global organisations implement (see Table 5.2), but it seems to be more a way used to meet customer demand and to provide information for CI than being a core focus. This further indicates that New Zealand organisations are lagging global organisations.

Accordingly, the survey asked participants to identify lean techniques they implemented and those not implement but have knowledge of, from a list of the main-stream lean techniques. The list was compiled from the global research literature (Danese et al., 2018; Bhamu & Sangwan, 2014) to identify the most implemented and researched lean techniques, globally.

This list was corroborated and enhanced with lean techniques identified from the New Zealand lean research literature (Pearce & Pons, 2018; Wilson, 2017).

Table 5.2 presents the summary research data survey participants' use and awareness of mainstream lean techniques. The summary shows the ranking of the techniques in terms of the most to the least implemented and most knowledge of the lean techniques. The findings indicate that the lean techniques most participants have either implemented and/or have knowledge of were standardisation, JIT, and CI/Kaizen. This was followed by VM, TQM, VSM, and 5S. The most implemented and researched lean techniques as identified in the global lean literature, ranked from most to the least as being VSM, Kanban, JIT, CI/Kaizen, and TPM. These findings indicate a marked difference between the research sample of this study and global literature. The research participants are still focused on the reduction of cost and waste, which is reflected in the lean techniques ranked the highest, while the global literature is more focused on creating customer value through CI. The research findings show that the implementation of lean techniques is still very much in the emergence phase and lean is yet to mature in the New Zealand context when compared globally.

The participants ranked standardising work as the top lean technique, while it is only ranked as 10th in global terms. Furthermore, the research data indicated that 73 (84%) of the 87 participants have knowledge of JIT, but only 22 (25%) implemented JIT. JIT was mainly implemented by manufacturing company participants who purchase and carry inventories for production and produced products. This makes sense as JIT is aimed at cost reduction of holding inventories and streamlining production processes (Mannai & Suliman, 2017; Madanhire & Mbohwa, 2016). Only one (25%) of the four wholesale and retail company

Table 5.2: Lean Techniques Implemented and Knowledge of Lean

Lean Techniques (Ranked from most to least Implemented and knowledge of)	Manufacturing Companies				Service Companies				Wholesale & Retail Companies				District Health Board				Local Government				Total				Global Lean
	Implemented	%	Knowledge of	%	Implemented	%	Knowledge of	%	Implemented	%	Knowledge of	%	Implemented	%	Knowledge of	%	Implemented	%	Knowledge of	%	Implemented	%	Knowledge of	%	
Standardising	31	89%	2	6%	4	67%			2	50%			11	100%			16	52%	10	32%	64	74%	12	14%	10
Just-in-Time (JIT)	18	51%	16	46%	1	17%	4	67%	2	50%	1	25%	3	27%	5	45%			25	81%	24	28%	51	59%	3
Continuous Improvement (CI)/ Kaizen	33	94%			5	83%	1	17%	2	50%			8	73%	2	18%	14	45%	8	26%	62	71%	11	13%	4
Visual Management (VM)	26	74%	5	14%	2	33%	4	67%	2	5%			7	64%	2	18%	5	16%	12	39%	40	46%	23	26%	13
Total Quality Management (TQM)	17	49%	12	34%			5	83%	1	25%	1	25%	6	55%	1	9%	5	16%	18	58%	29	33%	37	43%	7
Value Stream Mapping (VSM)	19	54%	11	31%	3	50%	2	33%	2	50%			8	73%	2	18%	6	19%	9	29%	44	51%	24	28%	1
5S	30	86%	3	9%	4	67%			8	73%			2	18%	1	9%	1	3%	11	35%	45	52%	15	17%	6
Six Sigma (SS)	3	19%	23	66%			5	83%			1	25%	6	55%	3	27%	3	10%	15	48%	12	14%	47	54%	8
Kanban	23	66%	9	26%	3	50%	2	33%					4	36%	5	45%	6	19%	8	26%	36	41%	24	28%	2
Lean Six Sigma (LSS)	1	3%	24	69%			3	50%			1	25%	7	64%	2	18%	4	13%	14	45%	12	14%	44	51%	9
Total Productive Maintenance (TPM)	10	29%	17	49%			4	67%	1	25%	1	25%	1	9%	1	9%	5	16%	6	19%	17	20%	29	33%	5
Poka-Yoke (PY)	8	23%	7	20%			1	17%	1	25%			4	36%	3	27%			1	3%	13	15%	12	14%	12
Single-Minute-Exchange of Die (SMED)	4	11%	8	23%											5	45%			1	3%	4	5%	14	16%	11

participants implemented JIT. This type of company also buys and carries inventory and therefore it would be beneficial to implement JIT.

The participants are still very much focused on the reduction of waste to reduce cost, and therefore highly rank techniques such as standardised work. Global organisations have moved from reduction of cost to customer value through CI, with quality still of some importance, but less so, as illustrated in Table 5.1. This can be seen in the high global ranking of VSM, Kanban, and CI/Kaizen being used. Quality is not one of the main aims of the techniques, but still a result of the technique and a way to deliver CI and value to customers. Other quality related techniques such as TQM and SS are also ranked slightly lower. Both the research participants and the global literature ranked CI high, which shows that the research participants are catching up to global practices. The participants still have a way to go with ranking VSM fifth, while global research ranked VSM the most used and researched lean technique. VSM aims to add value to products and services which will lead to value to customers (Gosling et al., 2013). VSM fits perfectly with the current global view on lean of customer value but does not fit the current view of cost reduction of the research participants. It therefore makes sense that VSM is not a priority for the research participants.

Table 5.2 further indicates that, globally, Kanban is the second most implemented and researched lean technique. Kanban relates to the elimination and reduction of waste and continuous improvement by identifying and fixing bottlenecks and by working on a pull system for raw materials and products required (Wang et al., 2011). Less than 40% of the participants implemented Kanban, with manufacturing companies being the sector that used it the most. Twenty-one (60%) of the manufacturing companies implemented Kanban, with less than 50% of the other sectors' participants doing so. This indicates that most participants are still focused on a push system rather than a lean appropriate pull system that bases production of products and services on customer demand.

Based on Table 5.2, a comparison of the different sectors, all types of participants, except wholesale and retail companies, have a better perception and awareness of the different lean techniques, even though they have not implemented most of the techniques. For example, 32 (92%) of the 35 manufacturing companies have knowledge of standardising work, with 30 (86%) implementing it. A total of 22 (71%) of the 31 LGs have knowledge of CI/Kaizen, but only 14 (45%) implemented it. Wholesale and retail companies have the least knowledge of lean techniques, with only half of the participants knowing about most of the lean techniques and in many cases only one (25%) of the four companies having implemented the techniques. These findings allude to the fact that despite the expansion of knowledge and techniques amongst the participants in general, the implementation of lean techniques and practices are still lagging. This will be further discussed later in this chapter, in section 5.3.

A perusal of public documentary evidence showed that some of the research participants publicly reported or announced their lean implementation. For example, five (6%) of the participants directly referred to their implementation of lean on their websites. A service company stated the following:

> *'… started applying a LEAN management system … made us a very effective and efficient … reduced waste …'* (Phoenix Services Limited, 2022)

Documentary evidence shows that manufacturing companies devoted whole paragraphs, under their 'About Us' sections on their organisations' webpages, reporting on lean in their organisations, and noting how lean benefits their customers. For example, a participant discussed their lean implementation and noted that their key lean practices had KPIs for all departments, elimination of all types of waste, 5S workplace organisations, and Kanban on their website (North Island Forklifts, 2022).

It was noted that none of the DHB and LG participants directly mentioned 'lean' or 'lean KPIs' in their 2021 annual reports. A further examination of previous years' annual reports of DHBs and LGs, showed that some of the participants did refer to lean and some lean concepts in some of their preceding annual reports. For example, Counties Manakau DHB stated that they implemented a 'lean thinking'-based program called 'Whai Manaaki' in 2009 (Counties Manakau DHB, 2009), but this was not referred to again in subsequent annual reports. Rotorua Lakes District Council (2011) noted that they were implementing lean, and in their 2012 and 2013 annual reports devoted a whole section on their implementation of 'Lean Thinking' (Rotorua Lakes District Council, 2013, 2011), but there was no further mention of lean thinking in the council's annual reports from 2014 to 2021. Quite a few participants mentioned lean concepts such as quality, continuous improvement, and value for customers in their annual reports preceding 2021, but this was not consistent across all participants and all annual reports. For example, Western Bay of Plenty District Council (2014) noted that they implemented a continuous improvement philosophy in their 2014 annual report, but this was not referred to again in subsequent annual reports. However, some of the participants consistently mentioned lean concepts, for example, Taranaki DHB mentions lean and/or continuous improvement in many of their annual reports from 2009 to 2021 (Taranaki DHB, 2021, 2020, 2019, 2018, 2017, 2014, 2011, 2009). The research data indicates that participants implement lean concepts and find it important enough to mention in the annual reports, but then as time passes it loses importance and is left out of the annual reports. The inclusion of lean concepts in the annual reports and websites of DHBs and LGs is further discussed in the following section.

5.2.2 Meanings Associated with Lean

This section will describe and analyse the meanings associated with lean as perceived by the participants and the lean techniques they implemented. To derive the meanings that participants attribute to lean, the reasons participants implemented lean were related back to the outcomes and activities of the lean techniques they implemented. Participants seem to associate lean with specific outcomes, e.g., reduce waste, better-quality products and services, or they associate specific activities with lean, e.g., CI and standardisation. The research data indicate that these are the reasons the participants implemented lean. The outcomes and activities are what participants associate with lean, and therefore, for the purpose of this study, the reasons the participants implemented lean together with the outcomes and activities of the lean techniques, are applied as the meanings participants attach to lean.

One survey question required participants to elaborate on their reasons for implementing lean. Another survey question required the participants to indicate which general manufacturing and service lean features they implemented. A third survey question required the participants to indicate their use and knowledge of main-stream lean techniques. The research data from these three questions will be used in the following discussion to identify the meanings the participants associate with lean. This data was further enhanced by scrutinising the websites and annual reports (ARs) of the participants for references to lean.

Table 5.3 presents the summary research data collected on the meanings participants attributed to lean, ranked from most to least as identified for each sector. The findings indicate that the top meaning participants equated with lean was the reduction of waste and non-value-added activities. Reduction of cost and waste is the original reason Toyota developed lean in the period after WWII (Bhamu & Sangwan, 2014; Sugimori et al., 1977), and it is still an important philosophy of lean. This can be seen in the lean definition proposed for this study, as illustrated in Figure 2.1.

Table 5.3: Meanings of Lean

Meaning of Lean	Manufacturing Companies	Service Company	Wholesale & Retail Sectors	DHB	LG	Total
Reduction of waste and non-value-added activities	1	1	1	1	1	1
Continuous Improvement	2	2	2	2	3	2
Quality products and services	3	3	3	3	2	3
Optimum customer value	4	4	4	4	4	4
Health and safety				5		5

The participants' responses can be succinctly summarised by the commentary from a senior level operations manager from a manufacturing company, who commented that the reasons their organisation implemented lean were:

> '*To reduce waste and increase efficiency.'* (Manager 53)

Furthermore, the production manager of another manufacturing company noted their reasons for implementation as follows:

> *'… lean was implemented to help streamline the various process flows to increase efficiency throughout the business and to remove the associated waste in the system.'* (Manager 55)

Reducing waste to reduce costs was also mentioned in some of the respondent's 2021 ARs. One LG stated that they attempt to run their organisation in a *'cost-effective and efficient manner'* (Waimate DC, 2021). Several participants also noted on their websites that they implemented lean, with one manufacturing company noting that they create efficiencies by *'… reducing time, resource, and material waste … cost effective product …'* (Admark Visual Imaging Ltd, 2022). This is further evidence that the participants associate reducing waste and cost with lean.

However, the global meaning of lean moved from quality, cost, and delivery during the 1990s, to customer value during the 2000s, to the current meaning of customer value through CI in the 2010s, as illustrated in Table 5.2. As previously mentioned, quality is not one of the main aims, but it is a way to deliver CI and value to customers. The research findings of this study indicate that the participants' perception of lean is comparable to the global perception of 20 years ago which associated lean with reducing waste to reduce costs.

Table 5.3 further indicates that for all the sectors, except LGs, the second most identified meaning participants associated with lean was CI. Participants seem to understand that this is a core principle of lean and the value it offers to their organisations.

For example, a senior level manager of quality and innovation from a DHB stated in their survey response:

> *'Lean practices emerged as a result of a continuous improvement programme approach.'* (Manager 3)

Furthermore, a CEO from a service company stated that lean:

> *'… implemented continuous improvement …' (*Manager 45)

As indicated in the proposed lean definition, as illustrated in Figure 2.1, CI is one of the lean philosophies that, together with waste reduction, leads to quality products and services.

CI was also evidenced in some of the participants' websites, with one service company noting that they *'… strive for continuous improvement in everything we do'* (North Island Forklifts, 2022). Several manufacturing companies included CI, where one noted, *'... continuously looking for opportunities to improve …'* (Integrated Foods Ltd, 2022). Several DHBs included CI in their organisation's values as depicted on their website, with one noting '… *a thriving culture of improvement …'* (Hutt Valley DHB, 2022). This is further evidence of the value participants attribute to CI.

Examining the annual reports of the participants showed that several noted that they followed a CI approach. For example, Gisborne District Council (2021, 2020, 2019) noted in their 2019, 2020, and 2021 annual reports, that they follow a CI approach of procedures and internal review. Nelson & Marlborough DHB (2021, 2020, 2019, 2018, 2017, 2016) referred to applying CI in their annual reports from 2016 to 2021. This is again further evidence of the value participants attribute to CI.

The research literature indicates that the present meaning associated with lean globally is customer value through CI, as illustrated in Table 5.2. The research findings indicate that the participants associate CI as a meaning of lean, which is comparable to the current global research. However, CI is not the main meaning participants associate with lean, which further indicates that the concept of lean is still emerging in New Zealand.

As presented in Table 5.3, the third most noted meaning of lean by all the participants, was delivering quality products and services. The participants see lean as a valuable way to achieve quality products. The response of a senior manager of a private sector manufacturing company encompasses the association of quality to lean:

> *'We produce a … high quality product … viewed lean as great way to achieve it ...'* (Manager 74)

To meet quality standards in New Zealand, the Ministry of Business, Innovation and Employment has a unit, Standards New Zealand, which develops standards for all industries in New Zealand and Australia (Standards New Zealand, 2022a). The standard, AS/NZS ISO 9001:2016 (Standards New Zealand, 2022b), specifies requirements for a quality management system to demonstrate the ability to provide products and services that meet customer, statutory, and regulatory requirements, to enhance customer satisfaction.

A middle level manager on infrastructure and delivery from a LG stated that their organisation implemented:

> *'… Quality … to meet ISO …'* (Manager 35)

Further examination of the participants' websites showed that 14 (16%) of the 87 participants implemented quality management systems that were AS/NZS ISO 9001 accredited, which consisted of eight manufacturing companies and six LGs. Only four of the eight manufacturing companies and one of the six LGs implemented TQM alongside the AS/NZS ISO 9001 accreditation. Only one participant equated the ISO accreditation with lean, and it was an LG that did not implement TQM. TQM is aimed at delivering quality products and services to customers and AS/NZS ISO 9001 links quality products and services to deliver value to customers. The research data, based on the small number of participants that implemented TQM and are AS/NZS ISO:9001 accredited, indicates that most of the participants do not link delivering quality products and services to delivering value to their customers.

A perusal of the annual reports of the participants showed that several noted the value they place on quality. For example, Capital & Coast DHB (2005) noted in their 2005 annual report that they were accredited with quality Health New Zealand and, in all their annual reports from 2002 to 2021, quality is one of the DHB's core aims. Southland Regional Council (2021, 2020, 2019, 2018, 2015) referred to delivering quality service to their community in most of the annual reports from 2015 to 2021. This is again further evidence of the value participants attribute to quality.

The research findings indicate that participants' perception of lean is comparable to the global perception in the 1990s when organisations associated lean with quality, cost, and delivery, as presented in Table 5.2. This is not on par with the current global meaning associated with lean, that of customer value through CI, and it is further indication that lean is still an emerging concept in New Zealand. The participants are still very much focused on quality itself, instead of linking quality to providing value to customers.

Table 5.3 further indicates that fewer survey participants associated creating value for customers with lean than those who associated the reduction of waste, CI, and quality with lean. This is also evidenced by the New Zealand research literature (Thornton & Nath, 2015). Associating lean with customer value is partly the current global view on lean with CI, as presented in Table 5.2, and it is therefore clear that the participants are still lagging global organisations in this area. This was the fourth rated meaning of lean. A middle level manager from a LG stated the following regarding their customers:

> *'… ensure good value for money ….'* (Manager 19/ Interviewee: LG 1)

The importance of customers was reiterated by the senior level operational manager of a manufacturing company who noted:

> *'… meet customers' expectations ...'* (Manager 85)

Participants not equating customer value as the most important meaning of lean is further reflected in the lower number of participants that implemented Kanban compared to global organisations, as presented in Table 5.2. Kanban works on a pull system, basing production on customer demand, and clearly most participants do not base production on customer demand.

The examination of the participants' annual reports showed that only five LGs mentioned creating value for customers in their 2021 annual reports. For example, Ashburton DC

(2021) mentioned that they are focused on *'community outcomes'* and Chatham Island Council (2021) noted that they are focused on activities that are *'… for the greater good of the community'.* A further examination of the participants' annual reports from preceding years showed that several participants mentioned value for money in their annual reports. For example, Auckland City Council (2021, 2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011) noted that they strive to deliver value for money for their customers. Porirua City Council (2021, 2020, 2019) noted that they also aim to deliver value for money for their customers.

Creating value for customers was also noted by three participants, two LGs and one manufacturing company, on their websites. For example, the manufacturing company stated on their website that they design products *'… to customer specification'* (GDM Group Ltd, 2022). This is again evidence that some of the participants do acknowledge that they value their customers, but it is not often directly linked to the concept of lean. The research findings show that only a small number of participants associated the meaning of lean with providing value to customers, which indicates that the participants are still lagging global organisations.

Health and safety was also identified by the participants as a meaning of lean and was ranked last. The emergence of health and safety as a meaning of lean is illustrated by the manager of finance, analytics, and business advisory of a DHB as follows:

> *'… focus … improvement in … safety ….' (*Manager 11)

There were no lean features and techniques used by the participants that related to health and safety. The findings show that only two participants from the DHB sector linked health and safety to lean. The programme director: performance improvement of a DHB had noted that the health and safety related to all aspects of the organisation, including staff and service users (Manager 2). No participants of any of the other sectors identified health and safety as a meaning of lean. Three public DHBs included safety in the values and strategies on their websites, with one noting, *'… excellent service in a safe… environment'* (Taranaki DHB, 2022).

This aspect in a New Zealand context is best explained by the 2015 Health and Safety at Work Act. Health and safety is an important part of New Zealand organisations' daily operations, with health and safety being strictly regulated by the Health and Safety at Work Act of 2015. The Act aims to secure the health and safety of employees and places of employment in New Zealand. The workplace health and safety systems are further regulated by WorkSafe, which aims to transform and improve New Zealand workplace health and safety performance. Standards New Zealand (2022a) also has health and safety related standards, and some of the participants also noted on their websites that they were accredited for AS/NZS ISO 45001:2018 and AS/NZS ISO 4801:2001. With health and safety being regulated by the government, directly and indirectly, it is understandable that so few participants equated health and safety with lean. Health and safety is also not a meaning associated with lean in a global context, as illustrated in Table 5.2. Participants of this study equating health and safety with lean adds to the lean literature. This provides an opportunity for future research on lean health and safety and lean in a New Zealand and global context.

Overall, the preceding discussion indicates that the research participants connect lean only partly with the current global view on lean of value to customers through CI. The participants are still mostly focused on the reduction of waste that leads to a reduction in cost, but they are starting to embrace the current views. The participants are also starting to connect health and safety with lean, which is a new perception in the global literature.

5.3 Lean Features and Techniques Implemented

There are a wide range of lean features and techniques available (De Oliveira et al., 2019; Bhamu & Sangwan, 2014). To broaden the research study, lean features are identified separately from the lean techniques. The lean features are actions performed under the different lean techniques. For example, some of the actions or features under JIT are removing waste in inventory flow and reducing waiting times for inventory from suppliers. Under Kanban, some of the actions or features are reducing waste and CI. Some of the lean features are also applicable to more than one lean technique, for example, CI is an action under Kanban, TPM, TQM and 5s, to name a few. CI is also seen as a lean technique by itself. Furthermore, some organisations will not implement a lean technique, but they may implement some of the features of the technique. Therefore, to ensure that as much as possible relevant and applicable data were collected, the lean features were identified separately from the lean techniques in the survey.

The lean literature indicates that organisations do not implement single techniques, but that they are used in combination with each other (Bhamu & Sangwan, 2014; Hines et al., 2004). Furthermore, organisations also implement only some of the lean features and techniques available (De Oliveira et al., 2019; Fullerton et al., 2014; Gurumurthy & Kodali, 2009). This study will add new knowledge on lean, in a New Zealand context, by determining which lean features and techniques the research study's lean New Zealand participants implemented, and in what combinations, by answering the following research question:

RQ1: What lean techniques have organisations implemented?

This research question will be answered by analysing and comparing the lean features and techniques implemented by participants from each of the different sectors, consisting of manufacturing companies, wholesale and retail companies, service companies, DHBs and LGs.

Table 5.4 presents the summary research data collected on lean features and techniques implemented by the participants. The lean features are grouped under the lean techniques they are relevant to. Table 5.5 presents an excerpt of the summary research data on the combination of lean techniques implemented by the participants. This table presents the combinations of lean techniques that 16% or more of the organisations implemented. The combinations less than 16%, are at negligible levels, and are therefore not presented. In the following sections, the lean techniques will be discussed and analysed further in terms of their individual implementation and the combinations in which the participants implemented the lean techniques.

5.3.1 Standardised Work and CI

The findings, as presented in Table 5.4 (Panel A), indicate that standardisation of work is the lean technique most implemented by the participants. Sixty-four (74%) of the 87 participants implemented standardisation and 73 (84%) implemented standardisation of work by documenting best practices, instructions, and procedures. This is representative of each of the sectors. For example, of the DHBs, 100% of the DHBs implemented standardisations and 10 (91%) of the 11 DHBs implemented standardisation of work by

Table 5.4 (Panel A): Lean Features and Techniques Implemented

Lean Features and Techniques Implemented PANEL A: Standardisation and CI	Manufacturing Companies		Service Companies		Wholesale & Retail Companies		District Health Board		Local Government		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Standardisation																
Standardising	31	89%	4	67%	2	50%	11	100%	16	52%	64	74%	37	82%	27	64%
Standardising work by documenting best practices, instructions, and procedures	32	91%	5	83%	4	100%	10	91%	22	71%	73	84%	41	91%	32	76%
Continuous Improvement (CI)																
CI/ Kaizen	33	94%	5	83%	2	50%	8	73%	14	45%	62	71%	40	89%	22	52%
Achieve consistent improvements by employees on all levels	25	71%	2	33%	2	50%	9	82%	14	45%	52	60%	29	64%	23	55%

Table 5.5: Combinations of Lean Techniques Implemented

Combinations of Lean Features and Techniques	Manufacturing Companies		Service Companies		Wholesale & Retail Companies		DHB		LG		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Standardisation + CI	29	83%	4	67%	2	50%	8	73%	12	39%	55	63%	35	78%	20	48%
TQM + Standardisation	27	77%	2	33%	2	50%	11	100%	9	29%	51	59%	31	69%	20	48%
TR* + Standardisation + CI	25	71%	3	50%	2	50%	6	55%	12	39%	48	55%	30	67%	18	43%
TQM + JIT	29	83%	1	17%	1	25%	6	55%	10	32%	47	54%	31	69%	16	38%
TQM + Standardisation + CI	26	74%	2	33%	2	50%	8	73%	8	26%	46	53%	30	67%	16	38%
TR + TQM + CI	25	71%	1	17%	2	50%	6	55%	10	32%	44	51%	28	62%	16	38%
TR + TQM + Standardisation	23	66%	2	33%	2	50%	9	82%	8	26%	44	51%	27	60%	17	40%
TR + Standardisation + CI + JIT	23	66%	2	33%	1	25%	6	55%	12	39%	44	51%	26	58%	18	43%
5S + CI	30	86%	2	33%	1	25%	7	64%	1	3%	41	47%	33	73%	8	19%
TR + TQM + Standardisation + CI	21	60%	2	33%	3	75%	6	55%	8	26%	40	46%	26	58%	14	33%
Customer Related + Standardisation + CI	6	17%	3	50%	2	50%	7	64%	22	71%	40	46%	11	24%	29	69%
5S + Standardisation + CI	27	77%	3	50%	1	25%	7	64%	0	0%	38	44%	31	69%	7	17%
Customer Related + TR	5	14%	3	50%	2	50%	7	64%	21	68%	38	44%	10	22%	28	67%
VM + Standardisation + CI	25	71%	1	17%	1	25%	7	64%	3	10%	37	43%	27	60%	10	24%
Customer Related + Standardisation	6	17%	3	50%	2	50%	8	73%	16	52%	35	40%	11	24%	24	57%
Customer Related + CI	7	20%	3	50%	2	50%	7	64%	14	45%	33	38%	12	27%	21	50%
Customer Related + TQM	7	20%	2	33%	2	50%	8	73%	14	45%	33	38%	11	24%	22	52%
VM + VSM	17	49%	2	33%	2	50%	6	55%	5	16%	32	37%	21	47%	11	26%
VM + Kanban	21	60%	1	17%	0	0%	2	18%	5	16%	29	33%	22	49%	7	17%
TPM + CI	10	29%	0	0%	1	25%	1	9%	2	6%	14	16%	11	24%	3	7%

* Training of employees for skill development (TR)

documenting best practices, instructions, and procedures. LGs implemented standardisation the least, with 16 (52%) of the 31 LGs implementing standardisation and 22 (71%) implementing standardisation of work by documenting best practices, instructions, and procedures.

Comparing private and public participants, the private participants were more inclined to implement standardisation than public participants. Forty-one (91%) of the 45 private participants implemented standardisation of work by documenting best practices, instructions, and procedures, compared to 32 (76%) of the 42 public participants. The lower implementation of standardisation in the public sector is only due to the LGs. This low implementation of standardisation in LGs is also reflected in only six LGs noting that they are AS/NZS ISO 9001 accredited. Local government mandatory performance measures are limited to only a few activities, for example, stormwater drainage and water supply (Department of Internal Affairs, 2021). Standardisation is therefore not such a priority for these types of organisations.

Standardisations include documented processes for manufacturing, job instructions, and procedures (Miller et al., 2010). Accordingly, it is applicable to all the different sectors, which is reflected in the number of participants that implemented standardisation. Standardisation assists employees to identify areas to improve, which leads to the reduction of waste and cost (Marksberry et al., 2011). Reducing waste is the top meaning participants associate with lean and therefore, it makes sense that standardisation is implemented by so many participants to reduce waste and cost.

The research data as presented in Table 5.4 (Panel A) indicates that CI/Kaizen is the second most implemented lean technique. Sixty-two (71%) of the 87 participants implemented CI/Kaizen and 52 (60%) implemented consistent improvement by employees. However, this is not representative of all the sectors. For example, 33 (94%) of the 35 manufacturing company participants, five (83%) of the six service company participants, and eight (73%) of the 11 DHB participants implemented CI/Kaizen, with only two (50%) of the four wholesale and retail company participants and 14 (45%) of the 31 LG participants doing the same. Participants from the private sector were more inclined to implement CI/Kaizen than public participants, with 40 (89%) of the 45 participants and 22 (52%) of the 42 participants implementing CI/Kaizen, respectively.

CI/Kaizen is a strategy where employees at all levels of a company work together proactively to achieve consistent, incremental improvements to reduce waste and cost (Brunet & New, 2003). Furthermore, CI was the second meaning participants equated with lean. Therefore, it makes sense that CI/Kaizen is implemented by most of the participants.

Standardised work captures the current best practices for a process, while CI/Kaizen aims to find improvements for those processes (Singh & Singh, 2015). CI/Kaizen and standardised work function in harmony with each other. The two lean techniques are therefore ideal to implement in combination with each other. The research data reflects this in the analyses of the combinations of lean techniques implemented by the total participants. Table 5.5 indicates that the combination of lean techniques implemented by the largest percentage of the total participants, is standardised work and CI/Kaizen. Fifty-five (63%) of the 87 participants implemented the combination of standardised work and CI. This is not representative of all the different sectors. For example, 29 (83%) of the 35 manufacturing companies and eight (73%) of the 11 DHBs implemented this combination, but only 12 (39%) of the 31 LGs did the same. LGs were also less inclined to equate CI as a meaning of lean, compared to the other types of participants that set CI as the second meaning of lean. This further illustrates that the meanings the participants associate with lean, is related back to the reasons they implement lean and the lean techniques they implement.

5.3.2 Quality and TQM

The findings from the research data, as presented in Table 5.4 (Panel B), show that quality is the next most implemented lean feature and technique by most of the participants. Fifty-five (63%) of the 87 participants implemented proven quality principles and techniques, with 29 (33%) implementing TQM. This was not representative of all the different sectors. For example, proven quality principles and techniques were implemented by 11 (100%) of the 11 DHBs, 27 (77%) of the 35 manufacturing companies, and only two (33%) of the six service companies. Furthermore, TQM was implemented by 17 (49%) of the 35 manufacturing companies and by none of the service companies. In terms of the private and public sectors, the implementation is somewhat more comparable, with 31 (69%) of the 45 and 24 (57%) of the 42 participants, respectively, implementing proven quality principles and techniques, and 18 (40%) of the 45 and 11 (26%) of the 42 participants, respectively, implementing TQM.

This is an example of one of the lean techniques where most of the participants implemented a feature of the lean technique instead of implementing the technique itself. Almost twice as many participants noted that they implemented quality principles and techniques but not TQM itself.

Table 5.4 (Panel B): Lean Features and Techniques Implemented

Lean Features and Techniques Implemented PANEL B: Quality, visualisations, and 5S	Manufacturing Companies		Service Companies		Wholesale and Retail Companies		District Health Board		Local Government		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Quality																
TQM	17	49%			1	25%	6	55%	5	16%	29	33%	18	40%	11	26%
Implement proven quality principles and techniques	27	77%	2	33%	2	50%	11	100%	13	42%	55	63%	31	69%	24	57%
Visualisation																
Kanban	23	66%	3	50%			4	36%	6	19%	36	41%	26	58%	10	24%
VSM	19	54%	3	50%	2	50%	8	73%	7	23%	39	45%	24	53%	15	36%
VM	26	74%	2	33%	2	50%	8	73%	6	19%	44	51%	30	67%	14	33%
Create graphics (visualisations) of standards and processes	24	69%	4	67%	1	25%	8	73%	9	29%	46	53%	29	64%	17	40%
Map areas of the organisation that add value to identify waste	18	51%	2	33%	2	50%	6	55%	5	16%	33	38%	22	49%	11	26%
5S	30	86%	4	67%	8	73%	2	18%	1	3%	45	52%	35	78%	10	24%

Quality is related to the lean concepts in terms of reduction of waste, CI and delivering quality products (Chan et al., 1990, p.41; Martinez-Lorente et al., 1998). The implementation of quality relates back to the meanings participants associate with lean. Furthermore, quality relates to several of the meanings, namely reduction of waste, and CI. The implementation of quality and TQM is consistent with the meanings the participants associate with lean and the participants' relating meanings of lean with the lean techniques they implemented.

Table 5.5 indicates that participants implemented quality related techniques in many different combinations with other lean techniques. For example, 51 (59%) of the 87 participants implemented quality with standardised work, with 100% of the 11 DHBs and 27 (77%) of the 35 manufacturing companies doing the same. The significance of standards is establishing quality products and services, which leads to customer satisfaction (Cronin & Taylor, 1992). AS/NZS ISO 9001 is a standard to create quality management systems (Standards New Zealand, 2022b) and is a further indication that the use of standardisation leads to quality. It is therefore very useful for the participants to implement quality and standardisation together.

Table 5.5 further indicates that 47 (54%) of the 87 participants implemented quality with JIT, with 29 (83%) of the 35 manufacturing companies doing so. Another combination implemented by 46 (53%) of the 87 participants was TQM (quality), standardised work, and CI. Quality is important to manage cost and for creating customer value (Langfield-Smith et al., 2022). Quality is related to the lean concepts of reduction of waste, CI and delivering quality products (Hines et al., 2004; Chan et al., 1990). The link to quality is also relevant as quality is the third meaning the participants associated with lean. It is therefore appropriate for the participants to implement quality with the other lean techniques as they all aim to reduce cost and CI.

5.3.3 Visualisations

Visual Management (VM) is a visually based system for organisational improvement and waste reduction, and Kanban and VSM are seen as tools for VM (Jaca et al., 2014). For that reason, CM, VSM, and Kanban are grouped together for analysis. As presented in Table 5.4 (Panel B), the research data shows that the fourth most implemented lean features and techniques implemented by most of the participants, are visualisations.

The research data shows that about 50% of all the participants implemented Kanban, VSM, and/or VM or noted that they created visualisations of standards and processes or mapped areas of the organisations that add value to identify waste. Some of the sectors of participants were more inclined to implement visualisation techniques than others. For example, eight (73%) of the 11 DHBs implemented VSM and VM and created visualisations of standards and processes. Of the manufacturing company participants, 26 (74%) of the 35 participants that implemented VM, 24 (69%) created visualisations of standards and processes, and 23 (66%) implemented Kanban. LG participants were the least likely to implement visualisations, with 9 (29%) of the 31 participants creating visualisations of standards and processes, seven (23%) implementing VSM, and six (19%) implementing Kanban. Private sector participants were more inclined to implement visualisations, with around 27 (60%) of the 45 participants, compared to about 15 (35%) of the 42 public sector participants. This was mainly due to manufacturing companies and DHBs.

Kanban, VSM, and VM are lean techniques that use visualisations to reduce cost and for CI. Reducing cost was the topmost meaning participants associated with lean, with CI being the second meaning. The implementation of visualisations is consistent with these meanings. VSM is seen as one of the pillars of lean (Ramesh & Kodali, 2012) and Kanban is one of the first lean tools developed (Bhamu & Sangwan, 2014) to reduce waste and for CI. Therefore, it can be concerning that only 50% or less of all the participants implemented any type of visualisations.

Table 5.5 indicates that participants implemented the visualisation related techniques in different combinations with each other. The most implemented combination was VM and Kanban, for example, 21 (60%) of the 35 manufacturing companies implemented this combination, but only a small number of the other participants did the same. The other participants implemented VM and VSM together, for example, six (55%) of the 11 DHBs implemented this combination. The participants may have some confusion about what each of these techniques are, and how they fit together. This is illustrated in Table 5.4 (Panel B), where it is shown that nine (29%) of 31 LGs implemented visualisations in general, but only 6 (19%) implemented VM.

Table 5.5 further shows that the visualisation techniques were combined with several different other lean techniques. For example, 37 (43%) of the 87 participants implement VM with standardised work and CI and 33 (38%) of the 87 participants implemented either VM or VSM with quality related techniques. This was however not representative of all the respondent sectors. It was mainly manufacturing companies and DHBs that combined VM and VSM with standardisation, CI, and quality. This is because these two types were more inclined than other types to implement visualisations. The number of participants that implemented visualisations indicates that not enough of the participants recognise that visualisations are some of the best ways for reducing waste and to promote CI (Ramesh & Kodali, 2012). This is especially true for the service companies, wholesale and retail companies, and LGs which were not inclined to implement visualisation techniques.

5.3.4 5S

The findings from the research data, as presented in Table 5.4 (Panel B), show that the fifth most implemented lean technique was 5S. Forty-five (52%) of the 87 participants, implemented 5S. However, this is not representative of all sectors. For example, 30 (86%) of the 35 manufacturing companies, eight (73%) of the 11 DHBs, and four (67%) of the six service companies implemented 5S. Only one (25%) of the four wholesale and retail companies and two (6%) of 31 LGs implemented 5S. 5S is a lean technique that combines some of the other lean techniques, such as standardisations, CI, and even visualisations (Omogbai & Salonitis, 2017). These specific techniques are implemented by the participants in other ways, and therefore 5S is not required. For example, 16 (52%) of 31 LGs implemented standardisation, but only two (6%) implemented 5S, and two (50%) of the four wholesale and retail companies implemented CI/Kaizen, but only one (25%) implemented 5S. 5S is also traditionally seen as a lean manufacturing tool (Omogbai & Salonitis, 2017), so it is encouraging to see it being applied in non-manufacturing organisations like DHBs and service companies.

Private sector participants were more inclined to implement 5S with around 35 (78%) of the 45 participants implementing it, compared to 10 (24%) of 42 public sector participants. This is due to manufacturing and service companies that implement 5S, with only a few of the

LGs implementing 5S. LGs implemented other lean techniques for standardisations and CI. 5S is directly related to the lean concepts of eliminating waste and non-value-added activities to deliver a quality product/service to customers (Bayo-Moriones et al., 2010). With all three of these concepts being meanings the participants associated with lean, it makes sense that 5S is implemented. The research data as presented in Table 5.5 shows that the participants combined 5S with several other lean techniques. For example, 30 (86%) of the 35 manufacturing companies and seven (64%) of the 11 DHBs implemented 5S with CI. Twenty-seven (77%) of the 35 manufacturing companies and seven (64%) of the 11 DHBs implemented 5S with CI and standardisation. Another 25 (71%) of the 35 manufacturing companies and seven (64%) of the 11 DHBs implemented 5S with VM. This makes sense as 5S encompasses these three lean techniques.

Two other lean techniques participants combined with 5S were TQM/quality, and training of employees for skill development. Again, this was mainly by manufacturing companies and DHBs. For example, 25 (71%) of the 35 manufacturing companies combined 5S with CI and training of employees for skill development, with seven (64%) of the 11 DHBs implementing 5S with TQM and training of employees for skill development. This is again due to the lower implementation levels of 5S by the different types, that resulted in their lower levels of combining 5S with other lean techniques.

5.3.5 Production Management/TPM

The research data as presented in Table 5.4 (Panel C), indicates that lean features and techniques related to TPM is the sixth most implemented by the participants. The most important feature of TPM is regular maintenance and 49 (56%) of the 87 participants

Table 5.4 (Panel C): Lean Features and Techniques Implemented

Lean Features and Techniques Implemented PANEL C: Production Management & Customer related	Manufacturing Companies		Service companies		Wholesale and Retail Companies		District Health Board		Local Government		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Production management																
TPM	10	29%			1	25%	1	9%	5	16%	17	20%	11	24%	6	14%
Regular maintenance	22	63%	3	50%	1	25%	4	36%	19	61%	49	56%	26	58%	23	55%
Regular reports on value adding areas for control and management	14	40%	3	50%	1	25%	3	27%	6	19%	27	31%	18	40%	9	21%
Customer related																
Base service design on customer needs	3	9%	2	33%	1	25%	6	55%	21	68%	33	38%	6	13%	27	64%
Reduce waiting/idle time of customers	6	17%	3	50%	2	50%	9	82%	16	52%	36	41%	11	24%	25	60%
Remove activities in the service process not adding value to customer	4	11%	2	33%	1	25%	7	64%	15	48%	29	33%	7	16%	22	52%
Reduce time lost in transportation / movement of customers	3	9%	1	17%	2	50%	5	45%	2	6%	13	15%	6	13%	7	17%

implemented regular maintenance. Furthermore, 27 (31%) of the 87 participants prepare regular reports for control and management, with 17 (20%) implementing TPM itself. This is not representative of all the different sectors. For example, 22 (63%) of the 35 manufacturing companies, 19 (61%) of the 31 LGs, and three (50%) of the six service companies implemented regular maintenance. Only four (36%) of the 11 DHBs, and one (25%) of the four wholesale and retail companies implemented regular maintenance. A small number of the total participants implemented TPM, with 10 (29%) of the 35 manufacturing companies, one (25%) of the four wholesale and retail companies, and five (16%) of the 31 LGs. None of the service company participants implemented TPM.

This is again an example where most of the participants implemented a feature of the lean technique instead of implementing the technique itself. Almost three times as many participants noted that they implemented regular maintenance but not TPM itself. TPM concentrates on the elimination of waste in the manufacturing process (McCarthy & Rich, 2004) and is a method of communication between the production and maintenance teams to enhance quality, eliminate waste, and minimise operation cost (Rhyne, 1990). TPM is traditionally a lean manufacturing tool and therefore it makes sense that it is implemented by more manufacturing companies than by participants of the other sectors. Maintenance is a more universal lean tool, not only limited to manufacturing companies. This is illustrated by the research data showing a larger percentage of participants from other sectors also implementing maintenance. A comparison of private and public sectors did not show a notable difference. TPM is related to the lean concept of eliminating waste to ensure quality. Both these concepts are also meanings the participants associate with lean, and this is consistent with the implementation of TPM and regular maintenance.

The research data as presented in Table 5.5 shows that the participants did not really combine TPM with many other lean features and techniques. For example, only 14 (16%) of the 87 participants combined TPM with CI, and 13 (15%) of the 87 participants combined TPM with standardisation. This is not representative of the different sectors. For example, 10 (29%) of the 35 manufacturing companies combined TPM with CI, but only 2 (6%) of the 31 LGs did the same. The low rate of combining TPM with other lean features and techniques is related to the low implementation level of TPM by the participants.

5.3.6 Customer Related

There is not a specific lean technique that just relates to customers. Several of the lean features were related to customers and were therefore grouped together. The research data as presented in Table 5.4 (Panel C) shows that not many of the total participants implemented lean features related to customers. For example, 36 (41%) of the 87 participants attempted to reduce the waiting time of customers and 33 (38%) based their service design on customer needs. This is, however, not representative of all the different participating sectors. For example, 9 (82%) of the 11 DHBs reduced wating times for customers with 16 (52%) of the 31 LGs and six (17%) of the 35 manufacturing companies doing the same. Twenty-one (68%) of the 31 LGs based their service design on customer needs, with two (33%) of the six service companies and three (9%) of the 35 manufacturing companies doing so. Thornton et al. (2019) showed that New Zealand managers are more focused on operating and financial performance and less on their customers. This is further evidenced by this study's research data, with 35 (41%) or less of the 87 participants implementing customer related lean techniques. This also fits with the research data indicating that a small number of participants associated the meaning of lean with providing value to customers.

Comparing private and public sectors, participants from the public sector were more inclined to implement lean features related to customers than those from public sectors. Twenty-seven (64%) and 25 (60%) of the public participants based their service design on customer needs and reduced waiting times for customers, respectively, compared to private sector participants with six (13%) and 11 (24%), respectively. This is probably related to the fact that the public sector participants are in the service business focusing on their customers, while the largest portion of the private sector participants are from the manufacturing sector and are less focused on their customers.

The research data as presented in Table 5.5 shows that the participants combined customer related lean features with several other lean techniques. This mainly relates to the service sector participants and especially the DHB participants. For example, 8 (73%) of the 11 DHDs combined customer related lean features with either standardisation or TQM, and 7 (64%) combined standardisations with customer related lean features and techniques. Twenty-two (71%) of the 31 LGs combined standardisation and CI with customer related lean features and techniques, and a further 21 (68%) combining training of employees with combined customer related lean features and techniques. Only about 50% of service and wholesale and retail companies combined customer related lean features and techniques with either standardisation, CI, TQM, and training of employees, or in a combination of three or more. This is a reflection on the level of implementation of customer related techniques by the different sectors, where service sectors participants were more inclined to implement customer related techniques than manufacturing company participants.

5.3.7 JIT

The findings from the research data, as presented in Table 5.4 (Panel D), show that the seventh most implemented lean technique with its lean features is JIT. A much smaller percentage of the participants implemented this lean technique. Twenty-four (28%) of the 87 participants implemented JIT, with 34 39% or less of all the participants implementing some of the JIT features. For example, 29 (39%) of the 87 participants manage flow of production by identifying and fixing bottlenecks, 31 (36%) removed waste in inventory flow, and 29 (33%) managed the timely delivery of inventory to production. This is not representative of all the different participating sectors. Manufacturing companies were most inclined to implement JIT with its different features, with 18 (51%) of the 35 participants implementing JIT, 34 (97%) managing flow of production by identifying and fixing bottlenecks, and 31 (89%) removing waste in inventory flow. JIT aims to reduce cost through the reduction of holding inventory and remove the waste in material flow and simplifies the production process and enhances output time (White et al., 1999; Clode, 1993). The other sectors did not implement these features of JIT, which is most likely because these features are related directly to the production process and inventory and the other sectors do not produce products or hold inventory.

The feature that the other sectors implemented under JIT was a reduction of resources and supplies. For example, six (55%) of the 11 DHBs aimed to reduce resources and supplies. A comparison of private and public sectors shows that 21 (47%) of the 45 private sector participants implemented lean with only 3 (7%) of the 42 public sector participants doing the same.

Table 5.4 (Panel D): Lean Features and Techniques Implemented

Lean Features and Techniques Implemented PANEL D: JIT	Manufacturing Companies		Service Companies		Wholesale and Retail Companies		District Health Board		Local Government		Total		Private		Public	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
JIT																
JIT	18	51%	1	17%	2	50%	3	27%			24	28%	21	47%	3	7%
Reduction of resources	9	26%	2	33%			6	55%	9	29%	26	30%	11	24%	15	36%
Remove waste in inventory (material) flow	31	89%									31	36%	31	69%		
Reduce waiting time for inventory (material) from suppliers	23	66%									23	26%	23	51%		
Deliver the correct amount of inventory (material) to production	25	71%									25	29%	25	56%		
Timely delivery of inventory (material) to production	29	83%									29	33%	29	64%		
Manage the flow of production by identifying and fixing bottlenecks	34	97%									34	39%	34	76%		
Regular communication between the production and maintenance teams	18	51%									18	21%	18	40%		
Reduce supplies	4	11%	1	17%	1	25%	6	55%	3	10%	15	17%	6	13%	9	21%
Reduce time lost in transportation / movement of supplies	4	11%	3	50%	2	50%	5	45%	2	6%	16	18%	9	20%	7	17%

This is probably due to JIT being a traditional lean manufacturing tool dealing with inventory and production, and the public sector participants, of this study, do not carry inventory or manufacture products. JIT enhances lean values of CI and the elimination of waste which is consistent with the meanings the participants associate with lean and the participants' relating meanings of lean with the lean techniques they implemented.

JIT is another example of a lean technique where most of the participants implemented features of the lean technique instead of implementing the technique itself. For example, none of 31 LGs implemented JIT, but nine (29%) implemented the reduction of resources. One (17%) of the six service companies implemented JIT but three (50%) implemented reducing the time lost in transportation of supplies. This indicates that some of the JIT features are universally applicable to different types of organisations.

The research data as presented in Table 5.5 shows that JIT or features of JIT, were combined with several other lean techniques. This was mainly by manufacturing companies and some of the DHBs. For example, 29 (83%) of the 35 manufacturing companies and six (55%) of the 11 DHBs implemented JIT or features of JIT with TQM/quality. Six (55%) of the 11 DHBs and 23 (66%) of the 35 manufacturing companies also implemented JIT or features of JIT with standardisation, CI, and training of employees for skill development. Other lean techniques implemented with JIT by manufacturing company participants in different combinations were VSM, Kanban, 5S, and VM. For example, 21 (60%) of the 35 manufacturing companies implemented JIT with TQM, standardisation, CI, and training of employees for skill development. Service companies, wholesale and retail companies, and LGs did not really implement JIT, and therefore JIT is not most of the lean technique combinations of these participants. JIT enhances lean values of CI and the elimination of waste (Fujita et al., 1993), which fits in with lean techniques such as CI, Kanban, and VSM which have similar goals of CI and cost and waste reduction.

5.3.8 Lean Features Relevant to Many Techniques

There are quite a few lean features that are relevant to more than one lean technique or are standalone lean features. These lean features were grouped together separately from the lean techniques already discussed. The research data presented in Table 5.4 (Panel E), shows that some of these lean features were implemented by a large portion of the participants, while some were only implemented by a few. For example, 70 (80%) of the 87 participants implemented the training of employees for skill development. This is not representative of all the sectors of participants. For example, 29 (83%) of the 35 manufacturing companies implemented the training of employees for skill development with only two (50%) of the four wholesale and retail companies doing the same. Training of employees is important for ensuring quality in the organisation processes (Tamimi & Sebastianelli, 1996). Employees are also an important factor in CI (Singh & Singh, 2015) and they are a core element of TPM (McCarthy & Rich, 2004). Training employees empowers them to identify waste in the organisation processes and promote CI. This is clearly understood by most of the participants, as reflected in the level of implementation by most of the participants. This is consistent with the main meaning participants associate with lean of CI.

The research data, as presented in Table 5.4 (Panel E), further shows that 69 (79%) of the 87 participants implemented identifying and removing waste. This is a core purpose of most of the lean techniques and is therefore achieved in many ways by the participants.

Table 5.4 (Panel E): Lean Features and Techniques Implemented

Lean Features and Techniques Implemented PANEL E: General features relevant to many of the techniques	Manufacturing Companies		Service Companies		Wholesale and Retail Companies		District Health Board		Local Government		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
General features relevant to many of the techniques																
Training of employees for skill development	29	83%	4	67%	2	50%	9	82%	26	84%	70	80%	35	78%	35	83%
Identify and remove waste	33	94%	5	83%	4	100%	8	73%	19	61%	69	79%	42	93%	27	64%
Minimise errors	27	77%	5	83%	3	75%	10	91%	15	48%	60	69%	35	78%	25	60%
Minimise breakdowns	18	51%	5	83%	1	25%	4	36%	9	29%	37	43%	24	53%	13	31%
Minimise shutdowns	13	37%	4	67%	1	25%	2	18%	11	35%	31	36%	18	40%	13	31%
Minimise discrepancies in final products	30	86%									30	34%	30	67%		
Minimise correcting of faulty products	27	77%									27	31%	27	60%		
Minimise / eliminate scrap	26	74%									26	30%	26	58%		

This can be seen in their implementation of JIT, Kanban, VM, VSM, standardisation of work, TPM and TQM, to name but a few of the lean techniques aimed at reducing waste. This is consistent with the main meaning participants associate with lean of reducing waste.

Furthermore, the research data also indicates that in some sectors, participants implemented lean features not implemented by others. For example, between 26 and 30 (74% to 86%) of the 35 manufacturing companies implemented minimising discrepancies in final products, minimising correcting of faulty products, and minimising scrap. These lean features are linked to production and JIT. JIT was also more implemented by manufacturing companies than the other types, and accordingly, manufacturing companies will implement these lean features more than participants of other sectors.

Service-related lean features were implemented more by LGs and DHBs than other sectors. For example, 27 (87%) of the 31 LGs and four (67%) of the six service companies simplified the service process. Ten (91%) of the 11 DHBs made full use of service capacity. These specific types are service organisations and therefore it makes sense that they implement lean features aimed at improving their service delivery. Manufacturing company participants implemented the least service-related lean features. They were more focused on manufacturing-related lean features, e.g., JIT.

A comparison of private and public sectors shows that both sectors implemented training of employees for skill development, with 35 (78%) of the 45 private sector and 35 (83%) of the 42 public sector participants implementing this feature. The research data clearly indicates that training of employees is an important lean technique for participants of both sectors. Identifying and removing waste was more implemented by participants in the private sector, with 42 (93%) of the 45 participants implementing the lean feature, and service-related lean features were more implemented by participants from the public sector, 34 (81%) of the 42 participants implementing the lean feature. This split can be due to the nature of the participants' business operations, with private sector participants being mostly manufacturing companies and all the public sector participants being service organisations.

The research data as presented in Table 5.5 shows that the training of employees for skill development is implemented in combination with several other lean techniques, but mostly with standardisation, CI, TQM, JIT, 5S and VM. This was, however, mainly the case for manufacturing companies and DHBs, with the other sectors of participants combining training of employees less with other lean techniques. For example, 26 (74%) of the 35 manufacturing companies combined training of employees with JIT and CI and nine (82%) out of 11 DHBs combined training of employees with standardisations and TQM. These combination levels are linked to the lower level of implementation of the other lean techniques by the different types of participants, rather than to the implementation of training of employees.

5.3.9 Least Implemented Techniques

The research data, as presented in Table 5.4 (Panel F), shows that four of the lean techniques were not implemented by a large portion of the participants. These are SMED, PY, SS, and LSS. Twenty-four (28%) of the total participants implemented features of SMED, 13 (15%) implemented PY, 12 (14%) SS, and 12 (14%) LSS. This is not representative of all the participating sectors. For example, PY was implemented by four (36%) of the DHBs with none of the six service companies. Only manufacturing companies.

Table 5.4 (Panel F): Lean Features and Techniques Implemented

Lean Features and Techniques Implemented PANEL F: SMED, PY, SS, and LSS	Manufacturing Companies		Service Companies		Wholesale and Retail Companies		District Health Board		Local Government		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
SMED																
SMED	4	11%									4	5%	4	9%		
Ability to change/adapt machinery quickly to manufacture different products	24	69%									24	28%	24	53%		
PY	8	23%			1	25%	4	36%			13	15%	9	20%	4	10%
SS	3	9%					6	55%	3	10%	12	14%	3	7%	9	21%
LSS	1	3%					7	64%	4	13%	12	14%	1	2%	11	26%

implemented features of SMED. Seven (64%) of the 11 DHBs implemented LSS, with one (3%) of the manufacturing companies and none of the four wholesale and retail companies.

Comparing private and public sectors, shows that public sector participants were more inclined to implement SS and LSS than private sector participants. Nine (21%) and 11 (26%) public sector participants implemented SS and LSS respectively, compared to three (7%) and one (2%) private sector participants, respectively. PY presented the opposite, with nine (20%) private sector participants implementing PY compared to four (10%) public sector participants. The low rate of implementation by the total participants can be due to the lean techniques being lessor known or more applicable to just certain sectors. For example, SMED and PY are more applicable to manufacturing organisations than to service organisations (Dave & Sohani, 2012).

5.4 Chapter Summary

This chapter provided an explanation of the emergence and adoption of lean and lean practices in New Zealand in both the private and public sectors over the period 1990 to 2021. The chapter also discussed and analysed the meanings New Zealand managers associate with lean and which lean techniques were implemented and, in which combinations they were implemented.

The research findings show that lean is still emerging in New Zealand. Private sector manufacturing companies and private sector service companies both started implementing lean around a decade after their respective global counterparts but show signs that the implementation is expanding. The public service sector DHBs and LGs started implementing lean the same time as global service organisations and the sector is therefore ahead of private service companies. The research findings on LGs are novel as there are minimal previous lean research literature indicating the implementation of lean in LGs. Private wholesaler and retailer companies started implementing lean in the same decade as private service companies. This is also new research as there are minimal previous lean research studies indicating the implementation of lean in wholesale and retail companies. These research findings therefore provide a timeline for lean implementation in public sector LGs and private wholesale and retail companies in a New Zealand context. New Zealand managers showed extensive knowledge of the main-stream lean techniques, which is a further indication of the emergence of lean in New Zealand and that it is expanding.

As indicated by the research data, the New Zealand managers associate lean with reducing waste to ultimately reduce cost, CI, quality products and services, customer value, and health and safety, in that order of importance. This is quite different from global lean research that currently associates the meaning of lean with providing value to customers through CI. New Zealand managers still partly associate the meaning of lean with reducing cost and quality products and services which was the global meaning associated with lean in the 1990's. New Zealand managers are moving with the times as they are starting to acknowledge customer value and CI as meanings of lean, but still to a lesser extent than reducing waste, cost, and quality. This is also an indication that lean is still emerging in New Zealand and has not developed as far as global organisations. A small number of lean public sector DHBs associated health and safety with the meaning of lean. This is not associated in global lean literature as a meaning of lean. This adds to the lean literature.

The foremost lean techniques implemented by the lean New Zealand organisations in all the sectors were aimed at reducing waste and CI. Standardisation and CI/Kaizen were the two most implemented lean techniques, followed by quality and TQM. Another group of lean techniques also implemented by a large portion of the participants, were visualisation techniques, namely Kanban, VSM, and VM. 5S, a lean technique that combines reducing cost and CI was also implemented by about half of the participants, but especially by the manufacturing companies and public DHBs. JIT, one of the original lean techniques, was mainly implemented by manufacturing companies, which makes sense as it is focused on manufacturing processes and handling of inventory. The analysis of lean features that were relevant to many lean techniques, showed that the training of employees for skilled development was one of the most implemented lean features, being implemented on the same level as standardising work. The main theme running through all the different techniques is the aim to reduce waste and cost and to promote CI, which is also the main meanings the participants associated with lean. This explains the high level of implementation of these lean techniques.

The research data show that none of the lean New Zealand organisations implemented only one lean feature or lean technique but implemented a combination of techniques. Standardised work and CI were the two lean techniques most participants implemented with each other. The second highest combination was standardisation, CI/Kaizen, and training of employees for skill development. Some of the sectors added other techniques that complimented these two main techniques, namely 5S, VSM, VM, JIT, Kanban, and TQM. These techniques were combined with standardisation and CI/Kaizen in different combinations. Manufacturing company participants especially implemented 5s in combination with the other lean techniques. This was not the case with the other sectors' participants. All the lean techniques implemented in combination with each other either had the aim to reduce waste and cost or to promote CI or were aimed at both. This also fits in well with the meanings New Zealand managers associate with lean, where reducing cost and CI were the primary meanings associated with lean.

The specific combination of lean features and techniques implemented by New Zealand manufacturing, service, wholesale and retail companies, and DHBs and LGs provide new insights into lean. Little lean research so far has attempted to investigate which and in what combination New Zealand organisations implement lean techniques. These research findings answer RQ1 by establishing the lean features and techniques implemented in lean New Zealand organisations.

Chapter 6 will extend the knowledge and provide an analysis on the lean performance measures and their implementation within a New Zealand context.

CHAPTER 6 LEAN PERFORMANCE MEASUREMENT PRACTICES

6.1 Introduction

Chapter 6 explains how the organisations that participated in this study adapted their performance measurement systems (PMSs) to measure the outcomes of lean techniques they implemented. CT denotes that the features of a PMS will depend on the circumstance in which an organisation finds itself (Emmanuel et al., 1990). Implementing lean indicates a change of circumstances of an organisation, and accordingly will require an adaptation of the PMS.

Current research has not yet examined the adaptions New Zealand managers have made to their organisations' PMSs to accommodate and capture lean performance. Accordingly, Chapter 6 will first illuminate the organisations' perception of the changes they made and whether they consider performance measures aimed at lean outcomes, being an integral part of their organisations' PMSs. This is followed by a discussion and analysis of the specific measurements the organisations implemented to accommodate lean, by linking applied performance measures to the different lean techniques.

The research data indicate that most of the organisations did not adapt their PMSs to measure the outcomes of lean, and that the organisations do not perceive lean performance measures as an integral part of their PMSs. The research data further shows that some attempt was made to include performance measures aimed at the lean techniques implemented, but that this adaption was not sufficient to adequately measure lean outcomes.

This chapter is structured as follows: section 6.2 discusses and analysis the perception of the organisations on whether their PMSs were adapted to lean, whether lean forms an integral part of their PMSs. This is followed by section 6.3 that discusses and analysis performance measures implemented by the organisations to fit the specific lean techniques they implemented, and finally section 6.4 draws conclusions resulting from the findings in this chapter.

6.2 Lean Incorporation into Performance Measurement Systems

This section reports, explains and analyses the findings of the survey on the perception of the organisations on whether they adapted their PMSs to fit lean and whether lean is adequately reflected in their organisation's PMSs.

The survey asked participants to indicate whether their organisations adapted their PMSs to fit their lean strategy and whether lean formed an integral part of their current PMSs. Table 6.1 shows a summary of the responses to these questions, which indicates that 36 (41%) of the organisations have implemented changes to their PMS, while 39 (45%) did not, and 12 (14%) used existing measures. This was not representative of the different sectors. The organisations that did implement changes consisted mainly of manufacturing companies and service companies. These were also the organisations who indicated higher implementation levels of lean techniques.

As indicated by the research data, 45% of the organisations did not adapt their PMSs at all to accommodate lean. The research literature shows that traditional performance measures are not adequate for lean organisations (Maskell & Baggaley, 2006). Almost half of the

Table 6.1: Managers' Perceptions on PMS Adaptation to Lean

	Manufacturing Companies		Service Companies		Wholesale and Retail Companies		District Health Board		Local Government		Total		Private		Public	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
PMS adapted to lean?																
No	12	34%	1	17%	3	75%	3	27%	20	65%	39	45%	16	36%	23	55%
Yes	22	63%	5	83%	1	25%	2	18%	6	19%	36	41%	32	71%	8	19%
Using existing measures	1	3%					6	55%	5	16%	12	14%	1	2%	11	26%
Lean an integral part of PMS?																
No	18	51%	3	50%	3	75%	9	82%	22	71%	55	63%	24	53%	31	74%
Yes	17	49%	3	50%	1	25%	2	18%	9	29%	32	37%	21	47%	11	26%

organisations did not adapt their PMSs and will therefore not be able to measure lean outcomes adequately nor meet the organisations' objectives. Current literature in the New Zealand context has not addressed lean organisations adapting their PMSs to lean and the present study is therefore filling this gap in the research literature. This research therefore adds to the lean literature in providing an adaption level of organisations' PMSs to lean using a New Zealand sample.

The research data as presented in Table 6.1 shows that 32 (37%) of the organisations indicated that lean formed an integral part of their PMSs. Not all organisations that adapted their PMSs feel that the adaptions to include lean performance measures were adequate. Research literature indicate that organisations require an adequate PMS to meet their organisational objectives (Stevanović & Čečević, 2018). Current literature in the New Zealand context has yet to address whether New Zealand managers of lean organisations perceive lean to be an integral part of their organisations' PMSs. Thornton et al. (2019) noted that New Zealand managers have limited awareness and understanding of the lean performance dimensions, but the scope of their study did not address whether lean was an integral part of their sample's PMSs. The present study therefore adds to the lean literature on whether lean organisations perceive lean implementation to be an integral part of their organisations' PMSs.

The following section will further elucidate the performance measures implemented for each of the lean techniques.

6.3 Alignment of Performance Measures with Lean Techniques

Studies on performance management systems in a New Zealand context have so far investigated the implementation of TQM and JIT, evaluated how organisations adjust their accounting systems to align with strategy, and how New Zealand organisations prioritise Searcy's (2004) LPDs. For example, Hoque and Alam (1999) researched the implementation of TQM in a New Zealand construction organisation and included an evaluation of changes in the organisation's PMS due to TQM. The study did not identify nor expand on specific key performance indicators but referred to the changes in a general summary. Hoque (2000) researched JIT and the use of information in managerial decision making in New Zealand manufacturing organisations to indicate that the use of costing information increases automation. The focus of this study was only the costing information used in the decision-making process. Thornton and Nath (2015) researched lean and performance measurements in manufacturing and service organisations in New Zealand by evaluating how organisations adjust their accounting systems to align with a lean strategy. The authors did not identify which specific performance measures the organisations implemented. Thornton et al.'s (2019) study focussed on how manufacturing and service organisations in New Zealand prioritise Searcy's (2004) LPDs. The study did not identify the specific performance measures the organisations implemented. Subsequently, this gap in the lean literature on the incorporation of lean in the PMS, will be bridged by the present study.

Accordingly, this study attempts to answer the following:

> *RQ2: What performance measures have organisations implemented as part of their performance measurement to accommodate lean implementation?*

This question will be answered by identifying and analysing the specific lean performance measures implemented in a New Zealand context by comparing manufacturing companies, wholesale and retail companies, service companies, DHBs, and LGs. A comparison will also be made in terms of whether the organisations are privately owned or publicly owned.

To collect relevant data, the survey asked participants to indicate the lean performance measures they implemented. This data was triangulated with the lean literature (Patel & Patel, 2021; Hernandez-Matias et al., 2020; Kováks et al., 2020, Lamine, 2019), to identify the performance measures used that related to each lean technique. This analysis did not only result in the identification of performance measures but also revealed areas critical to the successful implementation of each lean technique. For example, one such area was the performance of employees, which included several areas in which employees were required to perform e.g., skill development and training, and employee participation in problem-solving on the operational level.

In the following sections, each lean technique will be discussed and analysed in terms of the performance measure implemented by organisations to monitor the performance of the different techniques, and the areas identified as critical for the successful implementation of the lean techniques.

6.3.1 Just-in-time (JIT)

The JIT philosophy is incorporated to remove waste in material flow and waiting time for inventory (Alcaraz et al., 2016; White et al., 1999). The system is based on the pull-system where products are manufactured as per customers' demand, and raw material is therefore procured as and when production is required. When JIT is implemented efficiently, it should lead to a reduction in cost. According to literature on lean, performance measures aimed at inventory levels, throughput time, and measuring scrap, are all measures appropriate for monitoring a JIT system (Meybodi, 2015). Furthermore, using JIT's pull demand method and dashboards to procure inventory and production of products are ideally suitable to monitor inventory requirements and track movement in the production process.

Table 6.2 presents the summary research data on the performance measures used by organisations that have implemented JIT and the areas identified as crucial to monitor for successful implementation of JIT. The findings indicate that 16 (67%) of the 24 organisations that implemented JIT, monitored inventory levels and the majority were manufacturing companies, with 13 (72%) of the 18 companies monitoring inventory levels. Furthermore, 13 (54%) of the 24 organisations that implemented JIT used dashboards to monitor the flow of inventory, while only around 40% measured scrap and throughput time. JIT is aimed at reducing cost, therefore VSC should be an important performance measure. The research evidence indicates, however, that only 8 (33%) of the 24 organisations used VSC to measure the outputs of JIT.

Furthermore, JIT is based on a pull demand system where inventory is requisitioned only when it is required by production. The research data shows that only 38% of the participants used a pull-demand system, which can indicate that JIT is not properly implemented or measured by the organisations. A comparison of privately and publicly owned organisations' usage of appropriate performance measures for lean, do not show a significant difference between the two sectors, which indicates that private and public organisations measure JIT similarly.

Table 6.2: KPIs and Performance Areas for JIT

Performance Measurement	MC (n=18)		SC (n=1)		WRC (n=2)		DHB (n=3)		LG (n=0)		Total		Private		Public	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Inventory levels	13	72%			1	50%	2	67%			16	67%	14	67%	2	67%
Use a dashboard	9	50%			2	100%	2	67%			13	54%	11	52%	2	67%
Measuring scrap	10	56%									10	42%	10	48%		
Throughput time	7	39%					2	67%			9	38%	7	33%	2	67%
Pull demand	8	44%					1	33%			9	38%	8	38%	1	33%
Value Stream Costing (VSC)	7	39%					1	33%			8	33%	7	33%	1	33%

Table 6.3: KPIs and Performance Areas for Kanban

Performance Measurement	MC (n=23)		SC (n=3)		WRC (n=0)		DHB (n=4)		LG (n=6)		Total		Private		Public	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Throughput time	9	39%	1	33%			3	75%	6	100%	19	53%	10	38%	9	90%
Use a dashboard	13	57%	1	33%			2	50%	2	33%	18	50%	14	54%	4	40%
Measuring breakdowns	8	35%	2	67%			1	25%	1	17%	12	33%	10	38%	2	20%
Measure machine hours	7	30%	1	33%			2	50%			10	28%	8	31%	2	20%
Pull demand	8	35%					2	50%			10	28%	8	31%	2	20%
Value Stream Costing (VSC)	4	17%					1	25%	3	50%	8	22%	4	15%	4	40%

The research data indicate that organisations mostly measured JIT by monitoring inventory levels. Some used dashboards to monitor the flow of inventory and products through production. Other appropriate JIT performance measures, e.g., measuring scrap and VSC are not used by most of the organisations. Accordingly, the organisations use limited performance measures to measure the outcomes of JIT, which can lead to JIT not being properly implemented, which can result in targets of waste and cost reduction not being met.

6.3.2 Kanban

Kanban's goal is to identify and fix potential bottlenecks for work to flow through the process cost-effectively at an optimal throughput, by visualising the work process (Wang et. al., 2011). Kanban works on a pull system for raw materials and products required. Performance measures identified from relevant research literature indicated that PMSs must measure throughput, breakdowns, shutdowns, and machine hours to monitor the implementation of Kanban (Al-Baik & Miller, 2015). The aim of Kanban is also to reduce cost and therefore VSC would be an appropriate performance measure.

The summary research data on the performance measures used by organisations that have implemented Kanban, is presented in Table 6.3. The findings indicate that 19 (53%) of the 36 participants that implemented Kanban, measure throughput time. All six of the LGs that implemented Kanban also measure throughput time, with only three (75%) of the DHBs and nine (39%) of the manufacturing companies doing so. Eighteen (50%) of the 36 participants noted that they use dashboards, and less than 33% implemented any of the other relevant KPIs. Kanban is based on pull demand, and only 10 (28%) of the 36 participants noted that they use pull demand. Furthermore, only 8 (22%) applied VSC. A comparison of participants from privately and publicly owned organisation shows that almost all the publicly owned participants measured throughput, with less than 40% of the privately owned participants doing the same. Twice as many privately owned organisations measure breakdowns and machine hours compared with publicly owned participants. This may be due to the production activities of manufacturing organisations being more machine orientated than DHBs.

The evidence collected indicates that the organisations do not appropriately measure the performance of Kanban. Appropriate performance measures for Kanban are not applied to a sufficient extent to drive Kanban and therefore there can be issues involved with the successful implementation of Kanban.

6.3.3 Value Stream Mapping (VSM)

VSM is the process of visually summarising the flow of information and material in the organisation, and then envisioning a better performing future (Voelkel & Chapman, 2003). VSM aims to identify and categorise waste in each independent value stream and to find the best way to remove this waste (Gosling et al., 2013).

VSM encompasses all the organisational processes providing a wide variety of relevant performance measures. The research literature indicates operating-related measures such as measuring inventory levels, product defects, breakdowns, machine hours, and scrap, to name but a few. One area critical to the successful implementation of VSM is employee related, where certain aspects related to employees are monitored or set in place, e.g., the ability of employees to work across different operations of the organisation (cross-trained ability), employee quality performance, and employee response time to queries. Safety is also a critical area in terms of creating safe work environments, identifying unsafe practices and procedures, and monitoring if employees are following safe work practices (Antonelli & Stadnicka, 2018).

Table 6.4 presents the summary research data on the performance measures applied by organisations that have implemented VSM, and the critical areas required for successful implementation or usage of VSM. The research data indicates that in the critical are of employees, most of the organisations included the skill development and competency of employees, with 37 (74%) of the 50 organisations that implemented VSM, doing so, and 31 (62%) included the cross-trained ability of employees. In the safety criteria 33 (66%) included safe work practices, 32 (64%) ensured safe work environments, and 29 (58%) monitored if employees follow safe work practices and procedures. The only operational performance measures most of the organisations implemented was monitoring inventory levels, with 31 (62%) of the organisations doing so. The percentages were not representative of all the different sectors, with 100% of the wholesale and retail companies applying the measures, between 61% and 82% of manufacturing companies doing the same, and only 33% of the service companies doing the same. A comparison of the organisations from privately and publicly owned organisations did not show a marked difference, which indicates that both sectors measure VSM at similar levels.

Table 6.4: KPIs and Performance Areas for VSM

Performance Measurement	MC (n=28)		SC (n=3)		WRC (n=2)		DHB (n=9)		LG (n=8)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Skill development / competency	23	82%	1	33%	2	100%	6	67%	5	63%	37	74%	26	79%	11	65%
Unsafe practices and procedures identified	20	71%	1	33%	2	100%	5	56%	5	63%	33	66%	23	70%	10	59%
Safe work environment	19	68%	1	33%	2	100%	5	56%	5	63%	32	64%	22	67%	10	59%
Inventory levels	22	79%			1	50%	3	33%	5	63%	31	62%	23	70%	8	47%
Cross trained ability of employees	20	71%	1	33%	2	100%	3	33%	5	63%	31	62%	23	70%	8	47%
Use a dashboard	18	64%			2	100%	5	56%	5	63%	30	60%	20	61%	10	59%
Monitor if employees are following safe work practices	17	61%			2	100%	5	56%	5	63%	29	58%	19	58%	10	59%
Employee participation in problem solving on operational level	16	57%			1	50%	2	22%	5	63%	24	48%	17	52%	7	41%
Throughput time	10	36%	1	33%			5	56%	7	88%	23	46%	11	33%	12	71%
Measuring product / service defects	15	54%	1	33%			4	44%	1	13%	21	42%	16	48%	5	29%
Employee quality performance	11	39%					2	22%	8	100%	21	42%	11	33%	10	59%
Measure machine hours	10	36%	1	33%			3	33%	2	25%	16	32%	11	33%	5	29%
Measuring breakdowns	11	39%			1	50%	1	11%	1	13%	14	28%	12	36%	2	12%
Measuring scrap	13	46%							1	13%	14	28%	13	39%	1	6%
Employee punctuality	9	32%	1	33%	1	50%	1	11%	2	25%	14	28%	11	33%	3	18%
Value Stream Costing	7	25%					2	22%	4	50%	13	26%	7	21%	6	35%
Employee response time to queries	4	14%			1	50%	1	11%	7	88%	13	26%	5	15%	8	47%
Pull demand	10	36%					2	22%			12	24%	10	30%	2	12%
Measuring shutdowns	6	21%					1	11%	2	25%	9	18%	6	18%	3	18%
Delivery in Full in Time (DIFOT)	2	7%									2	4%	2	6%		
Employee Net Promoter Score (NPS)							1	11%			1	2%	0	0%	1	6%

Even though most of the organisations applied a wider variety of performance measures to monitor VSM, less than 50% of the organisations applied half of the identified measures. Some of them were only implemented by 18% and 4% of the organisations. This disproportioned implementation of the performance measures could lead to some areas of the lean techniques being more successful than areas not measured adequately. This can lead to VSM being not properly utilised by the organisations to successfully remove waste and reduce cost.

6.3.4 Standardisation

Standardisation involves documented procedures for manufacturing that capture best practices procedures, job instructions and operating procedures (Miller et al., 2010). Performance measures identified from relevant research literature indicated several that are appropriate to apply to monitor standardisation in the organisations. These are performance measures are quantifying quality processes, best practice procedures, measuring product defects and reworks, VSC, and using measures to control and improve processes (Kovàks et al., 2020). The critical areas identified for the successful implementation of standardisation are employee-related and safety-related.

Table 6.5 presents the summary research data on the performance measures applied by organisations that have implemented standardisations, and the critical areas required for successful implementation of standardisation. The findings indicate that in the critical area of employees, 41 (64%) of the 64 organisations include the importance of skill development and competency of their employees. In the critical area of safety, 36 (56%) have a work safety policy. Standardisation is also aimed at reducing costs, and again only a small

Table 6.5: KPIs and Performance Areas for Standardisation

Performance Measurement	MC (n=31)		SC (n=4)		WRC (n=2)		DHB (n=11)		LG (n=16)		Total		Private		Public	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Skill development / competency	21	68%	2	50%	2	100%	7	64%	9	56%	41	64%	25	68%	16	59%
Workplace safety policy	16	52%	2	50%	2	100%	7	64%	9	56%	36	56%	20	54%	16	59%
Procedures in place to quantify quality processes	13	42%	3	75%	2	100%	5	45%	9	56%	32	50%	18	49%	14	52%
Best practice procedures	12	39%	1	25%	2	100%	6	55%	8	50%	29	45%	15	41%	14	52%
Measuring product / service defects	15	48%	2	50%			4	36%	5	31%	26	41%	17	46%	9	33%
Measure reworks	13	42%	2	50%	1	50%	4	36%	6	38%	26	41%	16	43%	10	37%
Use of safety management scorecards	13	42%	1	25%			3	27%	3	19%	20	31%	14	38%	6	22%
Value Stream Costing	9	29%					2	18%	5	31%	16	25%	9	24%	7	26%
Measures to control and improve processes									3	19%	3	5%			3	11%

percentage of the participants utilise VSC, with only 16 (25%) doing so. Comparing organisations that are privately or publicly owned, there is no significant difference between the two sectors, indicating that they measure standardisation in the same manner.

The organisations do not appropriately measure the performance of standardisation. Performance measures are not applied to a sufficient extent to drive standardisation and therefore there can be issues in the successful implementation of standardisation.

6.3.5 Total Quality Management (TQM) & Quality

TQM is a continuously evolving management system that aims to create value for customers, continuously improve quality, enable precise measurement of the performance of each business process, and promote teamwork of employees (Topalović, 2015). Accordingly, TQM requires numerous relevant performance measures. The performance measures identified from previous research cover financial, customers, operations, and quality. The critical success areas identified were employee and safety-related.

Table 6.6 presents the summary research data on the performance measures applied by organisations that have implemented TQM and Quality and the critical success areas identified. The research findings indicate that organisations mostly focused on the critical areas of employees and safety, and operation-related performance measures. For example, in the critical area of employees, 20 (69%) of the 29 organisations included the importance of skill development and competency of employees, in the critical area of safety, 17 (59%) included identifying unsafe practices and procedures, and 16 (55%) measure inventory levels. A comparison between privately owned and publicly owned sectors, indicated that a larger percentage of privately owned organisations applied the relevant performance

Table 6.6: KPIs and Performance Areas for TQM and Quality

Performance Measurement	MC (n=17)		SC (n=0)		WRC (n=1)		DHB (n=6)		LG (n=5)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Skill development / competency	13	76%					4	67%	3	60%	20	69%	13	72%	7	64%
Unsafe practices and procedures identified	11	65%					3	50%	3	60%	17	59%	11	61%	6	55%
Inventory levels	13	76%					2	33%	1	20%	16	55%	13	72%	3	27%
Measuring product / service defects	11	65%					3	50%	2	40%	16	55%	11	61%	5	45%
Cross trained ability of employees	11	65%					2	33%	3	60%	16	55%	11	61%	5	45%
Monitor if employees are following safe work practices	10	59%					3	50%	3	60%	16	55%	10	56%	6	55%
Customer satisfaction	8	47%					4	67%	3	60%	15	52%	8	44%	7	64%
Use a dashboard	10	59%					4	67%	1	20%	15	52%	10	56%	5	45%
Measure and evaluate whether products or service adhere to customers' specifications and requirements	11	65%					3	50%	1	20%	15	52%	11	61%	4	36%
Measure percentage defects in products or services	12	71%					2	33%	1	20%	15	52%	12	67%	3	27%
Best practice procedures	8	47%					3	50%	3	60%	14	48%	8	44%	6	55%
Employee job satisfaction	8	47%					2	33%	3	60%	13	45%	8	44%	5	45%
Procedures in place to quantify quality processes	7	41%					3	50%	3	60%	13	45%	7	39%	6	55%
Use of safety management scorecards	8	47%					1	17%	3	60%	12	41%	8	44%	4	36%
Measure reworks	8	47%					3	50%	1	20%	12	41%	8	44%	4	36%
Customer query response time	6	35%					2	33%	3	60%	11	38%	6	33%	5	45%
Employee participation in problem solving on operational level	8	47%					2	33%	1	20%	11	38%	8	44%	3	27%
Active safety vision present and applied	7	41%					3	50%	1	20%	11	38%	7	39%	4	36%
Measure customer returns	7	41%					3	50%	1	20%	11	38%	7	39%	4	36%

measures and critical areas to monitor TQM and Quality. Manufacturing companies were most likely to implement TQM and Quality.

TQM encompasses a large portion of the organisation to measure numerous performance factors. However, research data indicates that many organisations do not do so. They are only focused on a handful of performance measures and critical areas, with most measures only being applied by less than 45% of organisations. The research data therefore shows that organisations do not adequately monitor the implementation of TQM and quality, which can result in the inadequate implementation of the lean technique.

6.3.6 CI/Kaizen

CI/Kaizen is part action plan and part philosophy (Singh & Singh, 2015). As an action plan, it is focused on improving specific areas within the organisation, such as removing bottlenecks and reducing waste by involving teams of employees at all levels, with an especially strong emphasis on involving plant floor employees. As a philosophy, CI/Kaizen is about building a culture where all employees are actively engaged in suggesting and implementing improvements to the organisation. Accordingly, CI/Kaizen encompasses all levels of the organisation and the performance measures identified from the research literature financial, customers, operations, and quality (Olsen et al., 2007). The critical success areas identified were employee and safety related.

The summary research data on the performance measures applied by the organisations that have implemented CI/Kaizen and the identified critical success areas, are presented in Table 6.7. The research data indicates that the employee-related and safety-related areas

Table 6.7: KPIs and Performance Areas for CI/Kaizen

Performance Measurement	MC (n=33)		SC (n=5)		WRC (n=21)		DHB (n=8)		LG (n=14)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Skill development / competency	24	73%	3	60%	2	100%	6	75%	8	57%	43	69%	29	73%	14	64%
Unsafe practices and procedures identified	22	67%	3	60%	2	100%	5	63%	11	79%	43	69%	27	68%	16	73%
Monitor if employees are following safe work practices	19	58%	2	40%	2	100%	5	63%	10	71%	38	61%	23	58%	15	68%
Measure and evaluate customer satisfaction	16	48%	2	40%	1	50%	6	75%	13	93%	38	61%	19	48%	19	86%
Cross trained ability of employees	21	64%	2	40%	2	100%	3	38%	7	50%	35	56%	25	63%	10	45%
Inventory levels	24	73%	1	20%	1	50%	3	38%	5	36%	34	55%	26	65%	8	36%
Employee job satisfaction	18	55%	2	40%	2	100%	4	50%	8	57%	34	55%	22	55%	12	55%
Use a dashboard	14	42%	3	60%	1	50%	3	38%	13	93%	34	55%	18	45%	16	73%
Procedures in place to quantify quality processes	15	45%	3	60%	2	100%	4	50%	9	64%	33	53%	20	50%	13	59%
Measure reworks	15	45%	2	40%	1	50%	4	50%	9	64%	31	50%	18	45%	13	59%
Measure percentage defects in products or services	19	58%	2	40%			3	38%	6	43%	30	48%	21	53%	9	41%
Employee participation in problem solving on operational level	17	52%	2	40%	1	50%	2	25%	7	50%	29	47%	20	50%	9	41%
Measuring product / service defects	17	52%	2	40%			4	50%	5	36%	28	45%	19	48%	9	41%
Customer query resolution time	12	36%			1	50%	3	38%	11	79%	27	44%	13	33%	14	64%
Measure and evaluate whether products or service adhere to customers' specifications and requirements	17	52%	3	60%	1	50%	4	50%	2	14%	27	44%	21	53%	6	27%
Number of customer queries	9	27%	1	20%	2	100%	3	38%	11	79%	26	42%	12	30%	14	64%
Active safety vision present and applied	14	42%	2	40%			3	38%	6	43%	25	40%	16	40%	9	41%
Customer query response time	13	39%					3	38%	8	57%	24	39%	13	33%	11	50%
Measuring breakdowns	12	36%	1	20%	1	50%	1	13%	9	64%	24	39%	14	35%	10	45%

were most important for the organisations to monitor. For example, 43 (69%) indicated the importance of skill development and competency of employees and identifying unsafe practices and procedures. Customer satisfaction was the only customer-related performance measure applied by most of the organisations, with 38 (61%) doing so. Half or less of the organisations applied other customer related performance measures. A comparison of the privately owned and publicly owned organisations, showed no marked difference, which indicates that these two sectors monitor CI/Kaizen at the same level.

CI/Kaizen is implemented throughout the whole organisation and therefore will also require many performance measures. Less than 50% of the organisations applied most of the relevant CI/Kaizen performance measures, mostly focusing on employees and safety. This indicates that the organisations do not adequately monitor CI/Kaizen. The organisations focus on a handful of KPIs, which do not cover all relevant areas. The research data therefore shows that organisations do not adequately monitor the implementation of CI/Kaizen which can result in the inadequate implementation of the lean technique.

6.3.7 Single-Minute-Exchange of Die (SMED)

SMED is used by manufacturing organisations to reduce the time wasted during equipment changeover and ensures that employees and machinery stay productive by reducing stoppage time. For example, employees complete as many steps as possible in the process while equipment is being used, to enable a quick changeover between products. Training for all the operators is paramount (Dave & Sohani, 2012). The performance measures identified from the research literature include throughput time and measuring shutdowns

(Cakmakci, 2009). The critical success areas identified for the successful implementation of SMED are employee-related and safety-related.

Table 6.8 presents the summary research data on the KPIs applied by participants that have implemented SMED. The research data indicates that it is only manufacturing companies (n=4) that implemented SMED, as this technique is only applicable to this type of organisation. The organisations mostly focused on the critical areas of employees and safety to ensure the successful implementation of SMED. Only two (50%) organisations measure throughput time and one (25%) measures shutdowns. The research data indicates that the training of employees and operating in a safe environment is paramount to the successful implementation of this lean technique.

The research data indicate that organisations measure the implementation of SMED adequately, which is a positive sign for the successful implementation of this lean technique.

6.3.8 5S

5S helps to reduce non-value adding time, while increasing productivity and improving quality (Bayo-Moriones et al. 2010). The research literature identified critical success areas for 5S as being related to safety and best practice procedures and using dashboards to monitor progress.

Table 6.9 presents the summary research data of the performance measures applied by the organisations who implemented 5S and the critical success areas. The research data indicates that the organisations mostly focused on the critical success areas safety and best

Table 6.8: KPIs and Performance Areas for SMED

Performance Measurement	MC (n=4)		SC (n=0)		WRC (n=0)		DHB (n=0)		LG (n=0)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Skill development / competency	4	100%									4	100%	4	100%		
Safe work environment	3	75%									3	75%	3	75%		
Monitor if employees are following safe work practices	3	75%									3	75%	3	75%		
Throughput time	2	50%									2	50%	2	50%		
Best practice procedures	2	50%									2	50%	2	50%		
Measuring shutdowns	1	25%									1	25%	1	25%		

Table 6.9: KPIs and Performance Areas for 5S

Performance Measurement	MC (n=30)		SC (n=4)		WRC (n=1)		DHB (n=8)		LG (n=2)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Unsafe practices and procedures identified	21	70%	3	75%	1	100%	5	63%	2	100%	32	71%	25	71%	7	70%
Safe work environment	21	70%	2	50%	1	100%	5	63%	2	100%	31	69%	24	69%	7	70%
Monitor if employees are following safe work practices	18	60%	3	75%	1	100%	5	63%	2	100%	29	64%	22	63%	7	70%
Best practice procedures	13	43%	2	50%	1	100%	5	63%	2	100%	23	51%	16	46%	7	70%
Use a dashboard	14	47%	3	75%			3	38%	2	100%	22	49%	17	49%	5	50%
Value Stream Costing	8	27%					2	25%			10	22%	8	23%	2	20%

practice procedures. For example, 32 (71%) of the organisations that implemented 5s, identified unsafe practices and procedures, 31 (69%) ensured safe work environments, and 23 (51%) have best practice procedures in place. One hundred percent of the LG and wholesale and retail companies applied these. Comparing the participants of privately and publicly owned organisations revealed similar monitoring of 5S.

The research data indicate that LGs and wholesale and retail company participants that implemented 5S properly measure the implementation of 5S, but that manufacturing companies, service companies, and DHBs do not adequately monitor the implementation of 5S.

6.3.9 Six Sigma (SS) and Lean Six Sigma (LSS)

Six Sigma is a rigorous, focused and highly effective implementation of proven quality principles and techniques with the aim of virtually error free business performance (Pyzdeck & Teller, 2014). LSS is the combined principles and practices of lean manufacturing and Six Sigma, which are both independent methods used in the industry for quality improvement. LSS delivers an integrated enhancing method which improves quality by minimising discrepancies, reworks, and costs (De Koning et al., 2006). These two lean techniques offer similar improvements and lean outcomes and are therefore discussed together. The performance measures identified for the successful implementation of SS and LSS are operation-related and customer-related.

Table 6.10 presents the summary research data on the performance measures applied by organisations that have implemented SS and LSS. The evidence indicates that it is only

Table 6.10: KPIs and Performance Areas for SS and LSS

Performance Measurement	MC (n=3, 1)		SC (n=0)		WRC (n=0)		DHB (n=6, 7)		LG (n=3, 4)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
SS																
Measure and evaluate customer satisfaction	2	67%					5	83%	3	100%	10	83%	2	67%	8	89%
Throughput time	2	67%					4	67%	3	100%	9	75%	2	67%	7	78%
Measure reworks	2	67%					4	67%	3	100%	9	75%	2	67%	7	78%
Procedures in place to quantify quality processes	1	33%					4	67%	3	100%	8	67%	1	33%	7	78%
Measure machine hours	2	67%					4	67%			6	50%	2	67%	4	44%
Measure and evaluate whether products or service adhere to customers' specifications and requirements	2	67%					4	67%			6	50%	2	67%	4	44%
Measuring product / service defects	1	33%					4	67%			5	42%	1	33%	4	44%
Measure customer returns	1	33%					4	67%			5	42%	1	33%	4	44%
Value Stream Costing	2	67%					2	33%			4	33%	2	67%	2	22%
Measure machine hours	1	33%					3	50%			4	33%	1	33%	3	33%
LSS																
Measure and evaluate customer satisfaction	1	100%					5	71%	4	100%	10	83%	1	100%	9	82%
Throughput time	1	100%					4	57%	3	75%	8	67%	1	100%	7	64%
Procedures in place to quantify quality processes							4	57%	4	100%	8	67%	0	0%	8	73%
Measure reworks							4	57%	4	100%	8	67%	0	0%	8	73%
Measure machine hours							4	57%	1	25%	5	42%	0	0%	5	45%
Measure and evaluate whether products or service adhere to customers' specifications and requirements							4	57%	1	25%	5	42%	0	0%	5	45%
Measuring product / service defects							4	57%			4	33%	0	0%	4	36%
Measure customer returns							4	57%			4	33%	0	0%	4	36%
Measure machine hours							3	43%			3	25%	0	0%	3	27%

manufacturing companies, DHBs, and LGs that implemented SS and LSS. The research data further shows that 10 (83%) of the 12 organisations that implemented SS measure and evaluate customer satisfaction, nine (75%) measure throughput time and reworks of products, and 8 (67%) measure procedures to quantify quality processes. Fifty percent or less implemented the other performance measures. Organisations that implemented LSS present similar usage of the measures. A comparison across the sectors shows that 100% of the LGs apply performance measures relevant to their type of operations, while only around 67% of the manufacturing companies and DHBs do the same. A comparison of the privately owned and publicly owned organisations showed no marked difference, which indicates that these two sectors monitor SS and LSS at similar levels.

The research data indicate that LGs that implemented SS and LSS is the only sector that properly measure the implementation of the two lean techniques. Manufacturing companies and DHBs only partly monitor the implementation of SS and LSS, which can lead to the unsuccessful implementation of the lean techniques.

6.3.10 Total Productive Maintenance (TPM) & Poka-Yoke (PY)

TPM focus on the effective identification and elimination of waste, unproductive cycle time and rework in the manufacturing process (McCarthy & Rich, 2004). These include maintenance to enhance quality, eliminate waste, minimise operation cost and ensure availability of equipment. PY can be implemented as part of TPM to mistake-proof equipment or can be implemented on its own. PY's purpose is to eliminate product defects by reducing and correcting human errors to minimise defects and reduce inspections for quality control. PY can include implementing technological innovations to perform activities previously performed by humans to reduce errors. The relevant performance measures identified from the research literature to effectively monitor the implementation of TPM and PY covers operations, and quality (Agustiada & Cudney, 2018; Pötters, et al., 2018). Employee and safety related critical success areas were also identified.

Tables 6.11 and 6.12 presents the summary research data on the performance measures applied by organisations that have implemented TPM and PY, and the critical areas identified for successful implementation of TPM and PY. TPM and PY were implemented by a small number of the organisations. The evidence shows that the monitoring of TPM was mostly through the critical success areas of employee and safety. For example, 12 (71%) of the organisations included skill development and competency and 11 (65%) ensured safe work environments. Some operation-related measures were also applied, for example, 9 (53%) measured product defects and breakdowns. It was mainly manufacturing organisations that implemented

TPM with only one wholesale and retail company, one DHB and five LGs doing the same. The application levels of TPM's relevant performance measures and critical areas are similar for all sectors that applied TPM.

PY was also implemented by a small number of the organisations and the organisations monitored the successful implementation of PY through the employee critical success area and operational-related performance measures. For example, 11 (85%) of the organisations included skill development and competency and 8 (62%) measured product defect. PY monitoring is different from TPM monitoring, as the safety critical area was not used for the monitoring of PY. It was mostly manufacturing companies that implemented PY, with one

Table 6.11: KPIs and Performance Areas for TPM

Performance Measurement	MC (n=10)		SC (n=0)		WRC (n=1)		DHB (n=1)		LG (n=5)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Skill development / competency	8	80%					1	100%	3	60%	12	71%	8	73%	4	67%
Cross-trained ability of employees	7	70%					1	100%	3	60%	11	65%	7	64%	4	67%
Safe work environment	7	70%					1	100%	3	60%	11	65%	7	64%	4	67%
Unsafe practices and procedures identified	7	70%					1	100%	3	60%	11	65%	7	64%	4	67%
Monitor if employees are following safe work practices	6	60%					1	100%	3	60%	10	59%	6	55%	4	67%
Use of safety management scorecards	6	60%					1	100%	3	60%	10	59%	6	55%	4	67%
Best practice procedures	6	60%					1	100%	3	60%	10	59%	6	55%	4	67%
Measuring product / service defects	6	60%					1	100%	2	40%	9	53%	6	55%	3	50%
Measuring breakdowns	6	60%					1	100%	2	40%	9	53%	6	55%	3	50%
Safety workshops	5	50%					1	100%	3	60%	9	53%	5	45%	4	67%
Procedures in place to quantify quality processes	5	50%					1	100%	3	60%	9	53%	5	45%	4	67%
Measure percentage defects in products or services	7	70%					1	100%	1	20%	9	53%	7	64%	2	33%
Measure machine hours	6	60%					1	100%	1	20%	8	47%	6	55%	2	33%
Measuring shutdowns	4	40%					1	100%	3	60%	8	47%	4	36%	4	67%
Measuring scrap	7	70%							1	20%	8	47%	7	64%	1	17%
Workplace safety policy	6	60%					1	100%	1	20%	8	47%	6	55%	2	33%
Measure reworks	6	60%					1	100%	1	20%	8	47%	6	55%	2	33%
Measure customer returns	6	60%					1	100%	1	20%	8	47%	6	55%	2	33%
Value Stream Costing	3	30%					1	100%	3	60%	7	41%	3	27%	4	67%
Active safety vision present and applied	5	50%					1	100%	1	20%	7	41%	5	45%	2	33%
Measure machine hours	4	40%					1	100%	1	20%	6	35%	4	36%	2	33%

Table 6.12: KPIs and Performance Areas for PY

Performance Measurement	MC (n=8)		SC (n=0)		WRC (n=1)		DHB (n=4)		LG (n=0)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Skill development / competency	7	88%			1	100%	3	75%			11	85%	8	89%	3	75%
Cross-trained ability of employees	7	88%			1	100%	1	25%			9	69%	8	89%	1	25%
Measuring product / service defects	6	75%					2	50%			8	62%	6	67%	2	50%
Measuring scrap	7	88%									7	54%	7	78%		
Employee participation in problem solving on operational level	5	63%			1	100%	1	25%			7	54%	6	67%	1	25%
Best practice procedures	4	50%			1	100%	2	50%			7	54%	5	56%	2	50%
Procedures in place to quantify quality processes	4	50%			1	100%	2	50%			7	54%	5	56%	2	50%
Measure reworks	5	63%					2	50%			7	54%	5	56%	2	50%
Measure customer returns	5	63%					2	50%			7	54%	5	56%	2	50%
Measure percentage defects in products or services	6	75%									6	46%	6	67%		
Throughput time	3	38%					2	50%			5	38%	3	33%	2	50%
Measuring breakdowns	4	50%									4	31%	4	44%		
Measure machine hours	3	38%					1	25%			4	31%	3	33%	1	25%
Employee quality performance	3	38%									3	23%	3	33%		
Measuring shutdowns	1	13%									1	8%	1	11%		

wholesale and retail company and four DHBs, doing the same. A comparison of the sectors showed that the usage of PY relevant performance measures and critical areas are similar for all sectors.

Only one DHB implemented TPM. This organisation applied most of the relevant TPM performance measures and included the critical areas of employee and safety. For example, the organisation ensured the skilled development of employees and that they were cross trained to work in several different operational areas in the organisation, they ensured a safe work environment and that employees were following safe working practices, and measured machine hours, scrap, shutdowns, and reworks to name but a few. The manufacturing organisations and LGs that implemented TPM applied the same performance measures and focused on employees and safety, but at a lower level than the DHB.

6.3.11 Training Employees

The involvement and commitment of management and employees, with activities such as training, learning and teamwork, are crucial for the successful implementation of lean techniques (Zeng et al., 2015). Employees need to be effectively trained in lean concepts and techniques to be able to apply them in real contexts in the performance of their jobs (Dinis-Carvalho, 2021). The training includes multitasking training, flexible work, responsibility for quality and fundamental maintenance checks, and suggestions for improvement. To successfully implement lean techniques, managers and employees need to have a deep understanding of its principles and practices, with extensive education and training at all levels. Furthermore, assessments to measure the training impact are also of great importance (Hernandez-Matias et al., 2020).

Table 6.13 presents the summary research data on the performance measures applied by organisations that have implemented training of employees. The research data indicates that most of the 87 participants in this study, noted that they implemented training of employees. However, the research data further indicates that the organisations do not really monitor the success of the training. For example, the performance measure applied by most organisations was the monitoring of the skill development and competency of their employees. However, this was only applied by 43 (63%) of the 68 organisations and measuring employees' job satisfaction and their cross trained ability was only used by 37 (54%) of the organisations that implemented employee training.

A comparison of the different sectors shows that there is no consistency in the specific performance measures the sectors focus on. For example, manufacturing companies are more focused on the skills and abilities of the employees while LGs were more focused on the levels of job satisfaction of their employees. This was also true of a comparison between privately owned and publicly owned participants.

The research data shows that the organisations are not adequately monitoring the training of their employees. This can lead to the unsuccessful implementation of all the different lean techniques, as training employees is crucial for the successful implementation of all the lean techniques.

Table 6.13: KPIs and Performance Areas for Training Employees

Performance Measurement	MC (n=28)		SC (n=4)		WRC (n=2)		DHB (n=9)		LG (n=25)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Skill development / competency	19	68%	3	75%	2	100%	6	67%	13	52%	43	63%	24	71%	19	56%
Employee job satisfaction	15	54%	2	50%	2	100%	3	33%	15	60%	37	54%	19	56%	18	53%
Cross-trained ability of employees	19	68%	2	50%	2	100%	2	22%	12	48%	37	54%	23	68%	14	41%
Employee participation in problem solving on operational level	15	54%	2	50%	1	50%	3	33%	12	48%	33	49%	18	53%	15	44%
Employee team building	13	46%	1	25%			1	11%	11	44%	26	38%	14	41%	12	35%
Employee quality performance	10	36%	2	50%			2	22%	12	48%	26	38%	12	35%	14	41%
Employee punctuality	10	36%	2	50%	1	50%	1	11%	6	24%	20	29%	13	38%	7	21%
Value Stream Costing	10	36%					2	22%	5	20%	17	25%	10	29%	7	21%
Employee response time to queries	4	14%			1	50%	1	11%	12	48%	18	26%	5	15%	13	38%
Employee participation in problem solving on strategic level	4	14%	2	50%			2	22%	8	32%	16	24%	6	18%	10	29%
Employee Net Promoter Score (NPS)							1	11%			1	1%			1	3%

Table 6.14: KPIs and Performance Areas for Customers

Performance Measurement	MC (n=35)		SC (n=6)		WRC (n=4)		DHB (n=11)		LG (n=31)		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Customer satisfaction	20	57%	4	67%	1	25%	5	45%	20	57%	50	57%	25	56%	25	60%
Number of customer queries	10	29%	2	33%	2	50%	4	36%	23	66%	41	47%	14	31%	27	64%
Customer query resolution time	13	37%			1	25%	3	27%	22	63%	39	45%	14	31%	25	60%
Customer query response time	13	37%					4	36%	19	54%	36	41%	13	29%	23	55%
Customer demand	13	37%	2	33%			3	27%	8	23%	26	30%	15	33%	11	26%
Customer value	10	29%	3	50%			1	9%	9	26%	23	26%	13	29%	10	24%
Customer retention	15	43%	3	50%	1	25%	1	9%	2	6%	22	25%	19	42%	3	7%
Growth in customer market share	16	46%			1	25%			1	3%	18	21%	17	38%	1	2%
Customer profitability	8	23%	1	17%							9	10%	9	20%		

6.3.12 Customers

The aim of implementing lean techniques is to create optimum customer value through business practices focused on continuous improvement and the reduction of waste (Albzeirat et al., 2018; Bhamu & Sangwan, 2014; Alves et al., 2012). Customer value is created by delivering products and services that satisfy customers' requirements. Accordingly, performance measurements identified from the lean literature cover areas such as customer satisfaction, demand, retention, queries and resolution of the queries, and customer profitability (Vignesh et al., 2016).

The research data on the performance measures applied by all 87 participants of the study, are presented in Table 6.14. The research data shows that most organisations do not have performance measures in place to monitor customer-related aspects. The performance measurements applied by most organisations was measuring customer satisfaction, with 50 (57%) of the 87 organisations applying this performance measure. Between 41% and 47% of the organisations measured the number of customer queries and responses to and resolution of customer queries. Only 26 (30%) measured customer demand, which can be related back to the small percentage of participants basing production on customer demand. Comparing the different sectors, shows that LGs had the highest percentage of organisations that measured customer satisfaction and queries, which also leads to publicly owned organisations applying more customer-related performance measures than privately owned organisations.

The research data shows that the organisations do not adequately monitor customer aspects. The main aim of lean is to provide value to customers. If this aspect is not monitored adequately though relevant performance measurements, lean techniques will not be implemented successfully.

6.4 Chapter Summary

This chapter discussed and analysed the perception of participants of whether they adapted their PMSs to accommodate lean and whether they considered lean to be an integral part of their PMSs. The chapter also discussed and analysed the specific performance measures organisations implemented to accommodate lean techniques and the critical success areas related to each lean technique.

The research findings show that less than half of the organisations of this study adapted their PMSs to accommodate lean in some way and that around 14% used existing measures to accommodate lean. Around 45% of the participants did not adapt their PMS to accommodate lean, in any way. The findings further show that it was mainly privately owned manufacturing companies and service companies that adapted their PMSs, being just around half of the organisations that did so. The research findings further show that most of the organisations felt that lean did not form an integral part of their PMSs. The two results together indicate that most of the organisations feel that they did not adapt their PMSs properly, to accommodate lean.

The research findings further showed that the organisations implemented a variety of performance measures to accommodate each lean technique. The evidence also showed that the organisations did not only implement performance measures, but that they related critical success areas to several of the lean techniques. These areas were employee-related and safety-related, where the organisations ensured that specific aspects of these critical areas were adequately implemented and monitored to ensure the successful implementation of the lean techniques. For example, organisations indicated the importance of the training of employees to ensure that their skills in lean are developed, that they were competent to perform their tasks, and that they could perform tasks in several operational areas (cross-trained). Furthermore, organisations ensured employees work in safe environments and that employees follow safe work practices and procedures. The evidence showed that, regardless of the variety of lean performance measures implemented and the two critical success areas of the lean techniques, the application was not at sufficient levels for all sectors to adequately measure the outcomes of each of the implemented lean techniques.

The research evidence showed that employees was a critical success area for several lean techniques, and that the training of employees in lean concepts and techniques is paramount to the successful implementation of lean. Accordingly, organisations would then monitor this, but this does not seem to be the case. Only 63% of all the organisations monitor the skill development and competency of employees, with only 54% monitoring the cross-trained ability of employees and employee job satisfaction. This indicates that, even though it is crucial for successful lean outcome, the training of employees is not adequately monitored by the organisations, in any of the sectors.

Creating value for customers is the core aim of lean and it is vital for the organisations to have performance measures in place to monitor aspects relating to their customers. Participants of the study were evaluated in terms of their performance measures related to customers, regardless of whether they noted implementing customer techniques or not. Only

57% of the organisations measure customer satisfaction. Between 10% and 47% of the organisations applied other customer related performance measures, such as measuring the number of queries and the query resolution and response times. The LG sector was the only one in which between 57% and 66% of the organisations applied three of the performance measures. Customer related aspects are not adequately monitored by the participants.

Chapter 7 will extend the knowledge and provide a discussion and analysis on the relationship between lean and lean performance measures within the New Zealand context.

CHAPTER 7 THE RELATIONSHIP BETWEEN LEAN AND PERFORMANCE MEASUREMENT PRACTICES

7.1 Introduction

This chapter presents and discusses findings regarding the relationship between the lean techniques and the performance measurement systems (PMSs) implemented by the organisations that participated in this study. The literature has shown that an equilibrium must be created between an organisation's strategy and performance measurements (Zizlavzky, 2014; Kaplan & Norton, 2001, 1992) which will enable the organisation to determine if it is meeting strategic goals and objectives. Performance measures indicate areas that require improvement, but if the incorrect aspects of an organisation are measured and rewarded, the strategic goals and objectives will not be met. Accordingly, lean organisations must adapt their PMSs to appropriately measure and incentivise lean (Thornton et al., 2019; Thornton & Nath, 2015; Maskell & Baggaley, 2006; Kroll, 2004). This equilibrium or relationship between lean and lean performance measures is illustrated through Searcy's (2004) lean performance dimensions (LPDs).

Current research has not yet examined whether New Zealand lean organisations have adapted their PMSs to fit the lean techniques they implemented, or what this adaption entails. Some organisations failed to acknowledge that they implemented lean, thus further influencing the adaptation or lack of adaption of the PMS. Furthermore, current lean research has not fully related the adaptions organisation make to their PMSs to measure the outcomes of lean, to Searcy's LPDs. Chapter 7 will therefore discuss and analyse the participants' perceptions of how their organisations' PMSs are aligned to each of the six LPDs proposed by Searcy, namely financial, customer, operating, employee, safety, and quality. To further illustrate the relationship between lean and performance measures, critical success factors for lean, as identified by the participants, and their perception of how lean techniques were influenced by performance measures and what the influences were, are also discussed. Furthermore, findings of this study are informed by CT, and therefore the contingency factors, namely strategy, organisational decision style, systems' adaptability, organisational size, and sector, that drive the relationship between lean the performance measures will be illuminated.

Chapter 7 is structured as follows: section 7.2 discusses and analysis the link between the CLSFs the participants identified, and the performance measures applied by the participants, illustrating this link through the LPDs. This is followed by section 7.3 which discusses and analysis if participants included lean in their strategic aims, corporate documents, and vision statements and at which organisation level the decision to implement lean was made, and the organisation level lean was implemented. Section 7.4 illustrates the influence of CT factors on the lean techniques implemented and lean performance measures included in the PMSs. Finally, section 7.5 draws conclusions resulting from the findings in this chapter.

7.2 Searcy's (2004) Lean Performance Dimensions (LPDs)

Organisations need to understand how performance measures can guide and focus them on superior results and should be chosen in such a way as to enable organisations to measure their progress against targets (Bhasin, 2008). There are claims that accounting research has been slow to recognise the importance of aligning performance measurement with a lean strategy (Fullerton et al., 2013; Castellano & Burrows, 2011; Haskin, 2010). Therefore, it is important to examine the following research question:

RQ3: What is the relationship between performance measures used and lean techniques?

Thornton et al. (2019) researched how manufacturing and service organisations in New Zealand prioritise Searcy's (2004) LPDs. The authors asked participants to rank the importance of the six LPDs but failed to expand on the alignment of specific performance measures, implemented by the participants to measure lean, with the LPDs. Accordingly, there is a gap in the lean literature on the alignment of the LPDs with the performance measurements implemented by lean organisations in NZ, to accommodate lean techniques.

This research study will therefore fill this gap in the research literature by answering the following research question:

RQ4: Do the performance measures implemented relate to Searcy's (2004) lean performance dimensions, and if so, how?

This section addresses the above research questions, by reporting, explaining, and analysing the findings of the survey on how the performance measures the participants applied to measure lean are aligned with the LPDs. Moreover, the survey asked participants to indicate the performance measures they applied, categorised under each of the six LPDs. The survey questionnaire further asked the participants to reflect on what they considered as critical for ensuring the success of lean, referred to as; critical lean success factors

(CLSF). To solicit further information, the survey also required the participants to indicate whether specific lean techniques influenced the performance measures and what the influence was. To further expound on the relationship between lean and performance measurements, a comparison will be made between manufacturing companies, wholesale and retail companies, service companies, DHBs, and LGs. A comparison will also be made in terms of whether the organisations are privately or publicly owned, as it is expected that the results will differ due to ownership.

Table 7.1 presents the summary research data collected on the KPIs the organisations implemented as related to the LPDs. The evidence shows that there is inconsistent application of KPIs between the different sectors. For example, about two-thirds of the DHBs applied safety KPIs with only half of the wholesale and retail companies doing the same. About 70% of the manufacturing companies applied operating KPIs, with only 40% of LGs doing the same. There is also inconsistent application per sector of the relevant KPIs of each LPD. For example, the research data shows that 25 (71%) of the 35 manufacturing companies applied one of the operating KPIs, with 19 (54%) applying one other operating KPI, and less than 50% any of the other operating KPIs. The inconsistent application of KPIs between the six LPDs is also present in each of the different sectors. For example, between 61% and 74% of the LG participants applied four of the KPIs from the customer LPDs, with only 39% applying two of the KPIs from the operating LPDs and 23% or less applying any of the other operating LPDs. The research data shows that organisations from all sectors placed different levels of importance on the six LPDs. All the differences between the sectors can be explained by the choice of performance measurements being informed by the different lean techniques implemented and the CLSFs the organisations identified, and the lack of lean being included in organisational strategy. Furthermore, it seems that the .

Table 7.1 (Panel A): KPIs per LPD

KPIs	MC (n=35)		SC (n=6)		WRC (n=4)		DHB (n=11)		LG (n=31)		Total		Private		Public	
PANEL A: Financial and Customer	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Lean Financial Performance Dimensions																
Return on Assets (ROA)	9	26%			1	25%	2	18%	9	29%	21	24%	10	22%	11	26%
Value Stream Costing	10	29%					2	18%	7	23%	19	22%	10	22%	9	21%
Self-financing	6	17%	1	17%			1	9%	5	16%	13	15%	7	16%	6	14%
Return on Investment (ROI)	1	3%					1	9%	1	3%	3	3%	1	2%	2	5%
Lean Customer Performance Dimensions																
Customer satisfaction	20	57%	4	67%	1	25%	5	45%	20	65%	50	57%	25	56%	25	60%
Number of customer queries	10	29%	2	33%	2	50%	4	36%	23	74%	41	47%	14	31%	27	64%
Customer query resolution time	13	37%			1	25%	3	27%	22	71%	39	45%	14	31%	25	60%
Customer query response time	13	37%					4	36%	19	61%	36	41%	13	29%	23	55%
Customer demand	13	37%	2	33%			3	27%	8	26%	26	30%	15	33%	11	26%
Customer value	10	29%	3	50%			1	9%	9	29%	23	26%	13	29%	10	24%
Customer retention	15	43%	3	50%	1	25%	1	9%	2	6%	22	25%	19	42%	3	7%
Growth in customer market share	16	46%			1	25%			1	3%	18	21%	17	38%	1	2%
Customer profitability	8	23%	1	17%							9	10%	9	20%		

Table 7.1 (Panel B): KPIs per LPD

KPIs	MC (n=35)		SC (n=6)		WRC (n=4)		DHB (n=11)		LG (n=31)		Total		Private		Public	
PANEL B: Operating & Employee	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Lean Operating Performance Dimensions																
Use a dashboard	19	54%	1	17%	2	50%	6	55%	12	39%	40	46%	22	49%	18	43%
Inventory levels	25	71%	1	17%	1	25%	4	36%	5	16%	36	41%	27	60%	9	21%
Measuring product / service defects	17	49%	2	33%			4	36%	7	23%	30	34%	19	42%	11	26%
Measuring breakdowns	13	37%	2	33%	1	25%	1	9%	12	39%	29	33%	16	36%	13	31%
Throughput time	12	34%	2	33%			5	45%	8	26%	27	31%	14	31%	13	31%
Measure machine hours	12	34%	2	33%			3	27%	3	10%	20	23%	14	31%	6	14%
Measuring shutdowns	8	23%	1	17%			1	9%	8	26%	18	21%	9	20%	9	21%
Measuring scrap	14	40%							1	3%	15	17%	14	31%	1	2%
Pull demand	10	29%					2	18%	1	3%	13	15%	10	22%	3	7%
Delivery in Full in Time (DIFOT)	2	6%									2	2%	2	4%		
Lean Employee Performance Dimensions																
Skill development / competency	24	69%	4	67%	2	50%	7	64%	16	52%	53	61%	30	67%	23	55%
Employee job satisfaction	18	51%	2	33%	2	50%	4	36%	18	58%	44	51%	22	49%	22	52%
Cross trained ability of employees	21	60%	2	33%	2	50%	3	27%	14	45%	42	48%	25	56%	17	40%
Employee participation in problem solving on operational level	17	49%	2	33%	1	25%	3	27%	12	39%	35	40%	20	44%	15	36%
Employee team building	15	43%	1	17%			2	18%	13	42%	31	36%	16	36%	15	36%
Employee quality performance	12	34%	2	33%			2	18%	12	39%	28	32%	14	31%	14	33%
Employee punctuality	11	31%	2	33%	1	25%	1	9%	6	19%	21	24%	14	31%	7	17%
Employee response time to queries	5	14%	1	17%	1	25%	1	9%	14	45%	22	25%	7	16%	15	36%
Employee participation in problem solving on strategic level	6	17%	2	33%			2	18%	8	26%	18	21%	8	18%	10	24%
Employee Net Promoter Score (NPS)	0	0%					1	9%			1	1%			1	2%

Table 7.1 (Panel C): KPIs per LPD

KPIs	MC (n=35)		SC (n=6)		WRC (n=4)		DHB (n=11)		LG (n=31)		Total		Private		Public	
PANEL C: Safety & Quality	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Lean Safety Performance Dimensions																
Safe work environment	22	63%	3	50%	2	50%	7	64%	22	71%	56	64%	27	60%	29	69%
Workplace safety policy	22	63%	4	67%	2	50%	7	64%	21	68%	56	64%	28	62%	28	67%
Unsafe practices and procedures identified	19	54%	3	50%	2	50%	7	64%	21	68%	52	60%	24	53%	28	67%
Monitor if employees are following safe work practices	17	49%	2	33%			8	73%	21	68%	48	55%	19	42%	29	69%
Health and safety practice drills	17	49%	4	67%	2	50%	7	64%	17	55%	47	54%	23	51%	24	57%
Safety workshops	14	40%	4	67%	1	25%	4	36%	22	71%	45	52%	19	42%	26	62%
Use a dashboard	14	40%	3	50%			4	36%	11	35%	32	37%	17	38%	15	36%
Active safety vision present and applied	14	40%	2	33%			3	27%	7	23%	26	30%	16	36%	10	24%
Use of safety management scorecards	9	26%	2	33%	1	25%	5	45%	12	39%	29	33%	12	27%	17	40%
Measure machine hours	4	11%	1	17%	1	25%	2	18%	1	3%	9	10%	6	13%	3	7%
Lean Quality Performance Dimensions																
Measures to control and improve processes	16	46%	2	33%	1	25%	8	73%	18	58%	45	52%	19	42%	26	62%
Measure and evaluate customer satisfaction	13	37%	2	33%	2	50%	6	55%	20	65%	43	49%	17	38%	26	62%
Best practice procedures	15	43%	3	50%	2	50%	5	45%	14	45%	39	45%	20	44%	19	45%
Procedures in place to quantify quality processes	15	43%	2	33%	1	25%	4	36%	12	39%	34	39%	18	40%	16	38%
Measure reworks	17	49%	4	67%	1	25%	4	36%	5	16%	31	36%	22	49%	9	21%
Measure and evaluate whether products or service adhere to customers' specifications and requirements	19	54%	2	33%			4	36%	6	19%	31	36%	21	47%	10	24%
Measure percentage defects in products or services	15	43%	1	17%			5	45%	7	23%	28	32%	16	36%	12	29%
Measure customer returns	19	54%	1	17%	2	50%	3	27%	5	16%	30	34%	22	49%	8	19%

organisations are still gravitating to traditional performance measurements, which were focused on the performance perspectives of financial, customer, learning and growth, and internal business processes, which did not include performance dimensions such as health and safety.

Table 7.2 presents a summary of the research data of the CLSFs identified in the survey. The evidence shows that CLSFs most identified by the organisations related to the employee and operating performance dimensions. Very few CLSFs were identified that related to the other four LPDs, of financial, customer, safety, and quality. Furthermore, the highest identification of CLSFs to a specific LPD, was in manufacturing organisations where 80% identified CLSFs relating to the operating performance dimension, which can be explained by the nature of their business being operating-related.

The aim of lean is to deliver value to customers, and only a few of the organisations identified customer related CLSFs. The organisations do not rate all six LPDs as crucial for the successful implementation of lean, by mainly focusing on the employee and operating LPDs. This again indicates that organisations gravitate to more traditional performance measurements, rather than focusing on lean-related performance measurements.

The next section will further discuss and analyse the link between the relevant CLSFs and the KPIs.

Table 7.2 (Panel A): Critical Lean Success Factors (CLSFs)

Critical Lean Success Factors **PANEL A: Employee & Operating**	**Manufacturing Companies**		**Service Companies**		**Wholesale & Retail Companies**		**DHB**		**LG**		**Total**		**Private**		**Public**	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Employee																
Employee training	7	20%			1	25%	2	18%	2	6%	12	14%	8	18%	4	10%
Staff engagement/involvement	3	9%	2	33%	1	25%	2	18%	4	13%	12	14%	6	13%	6	14%
Staff satisfaction	2	6%	1	17%					1	3%	4	5%	3	7%	1	2%
Staff take ownership of lean	2	6%					1	9%			3	3%	2	4%	1	2%
Share gains with staff through remuneration	1	3%					1	9%			2	2%	1	2%	1	2%
Operating																
5S	4	11%									4	5%	3	7%		
Inventory control	2	6%							1	3%	3	3%	2	4%	1	2%
Cost	1	3%							1	3%	2	2%	1	2%	1	2%
Delivery in Full on Time (DIFOT)	3	9%									3	3%	3	7%		
Standardisation	1	3%			1	25%					2	2%	2	4%		
Productivity	5	14%	1	17%							6	7%	5	11%		
Continuous improvement/Kaizen	4	11%									4	5%	3	7%		
Reduce waste	4	11%									4	5%	4	9%		
Reduce reworks	2	6%									2	2%	2	4%		
Communication of key areas between levels	1	3%									1	1%	1	2%		
Daily meetings with relevant metrics	1	3%									1	1%	1	2%		

Table 7.2 (Panel B): Critical Lean Success Factors (CLSFs)

Critical Lean Success Factors **PANEL B: Management, Strategy, Customer, Quality, Financial, Expert Support, & Safety**	**Manufacturing Companies**		**Service Companies**		**Wholesale & Retail Companies**		**DHB**		**LG**		**Total**		**Private**		**Public**	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Management																
Strong leadership	6	17%	2	33%	1	25%	2	18%			11	13%	9	20%	2	5%
Strong middle management driving the process	1	3%					1	9%			2	2%	1	2%	1	2%
Strategy																
Build lean into culture			1	17%			1	9%			2	2%	1	2%	1	2%
Commitment to lean	2	6%	2	33%							4	5%	4	9%		
Shared vision									1	3%	1	1%			1	2%
Make lean part of strategy	1	3%									1	1%	1	2%		
Customer																
Customer feedback	1	3%							2	6%	3	3%	1	2%	2	5%
Needs of customers									1	3%	1	1%			1	2%
Satisfied customer									3	10%	3	3%			3	7%
Quality																
Quality accreditation	1	3%									1	1%	1	2%		
Quality	1	3%	1	17%					1	3%	3	3%	2	4%	1	2%
Quality improvements	3	9%									3	3%	3	7%		
Financial			1	17%					2	6%	3	3%	1	2%	2	5%
Expert support	3	9%					1	9%			4	5%	3	7%	1	2%
Safety							1	9%	1	3%	2	2%			2	5%

7.2.1 Lean Operating Performance Dimension

Traditionally, lean has been implemented at the operational level of an organisation (Alkhoraif et al., 2019), which is also illustrated by the participants of this research study, as depicted in Table 7.5. Searcy (2004) indicated that the internal processes that most influence customer satisfaction and value creation for customers are measured in the lean operating performance dimension and, therefore, the KPIs in this dimension are critical for the successful measurement of lean. The research data, as presented in Table 7.2 (Panel A) indicate that participants do seem to realise the importance of the operating LPD.

Figure 7.1 illustrates the summary research data of the operating CLSFs identified by the organisations, the relevant KPIs for measuring the CLSFs, and the inclusion of the KPIs in the organisations' PMSs. This figure was developed by triangulation of research data and current lean literature to indicate the KPIs relevant to measure each of the identified CLSFs, and to show the uptake of these KPIs in the organisations' PMSs.

Figure 7.1 illustrates that the operating related CLSFs identified by most of the organisations were: Kanban/visualisations, productivity, inventory control, reducing reworks, reducing waste, DIFOT, 5S, standardisation, CI/Kaizen, cost, daily meetings with relevant metrics, and communication of key areas between levels. Despite this, Figure 7.1 indicates that only some of the organisations included KPIs to measure these CLSFS in their PMSs, with between 2% and 52% using the relevant KPIs.

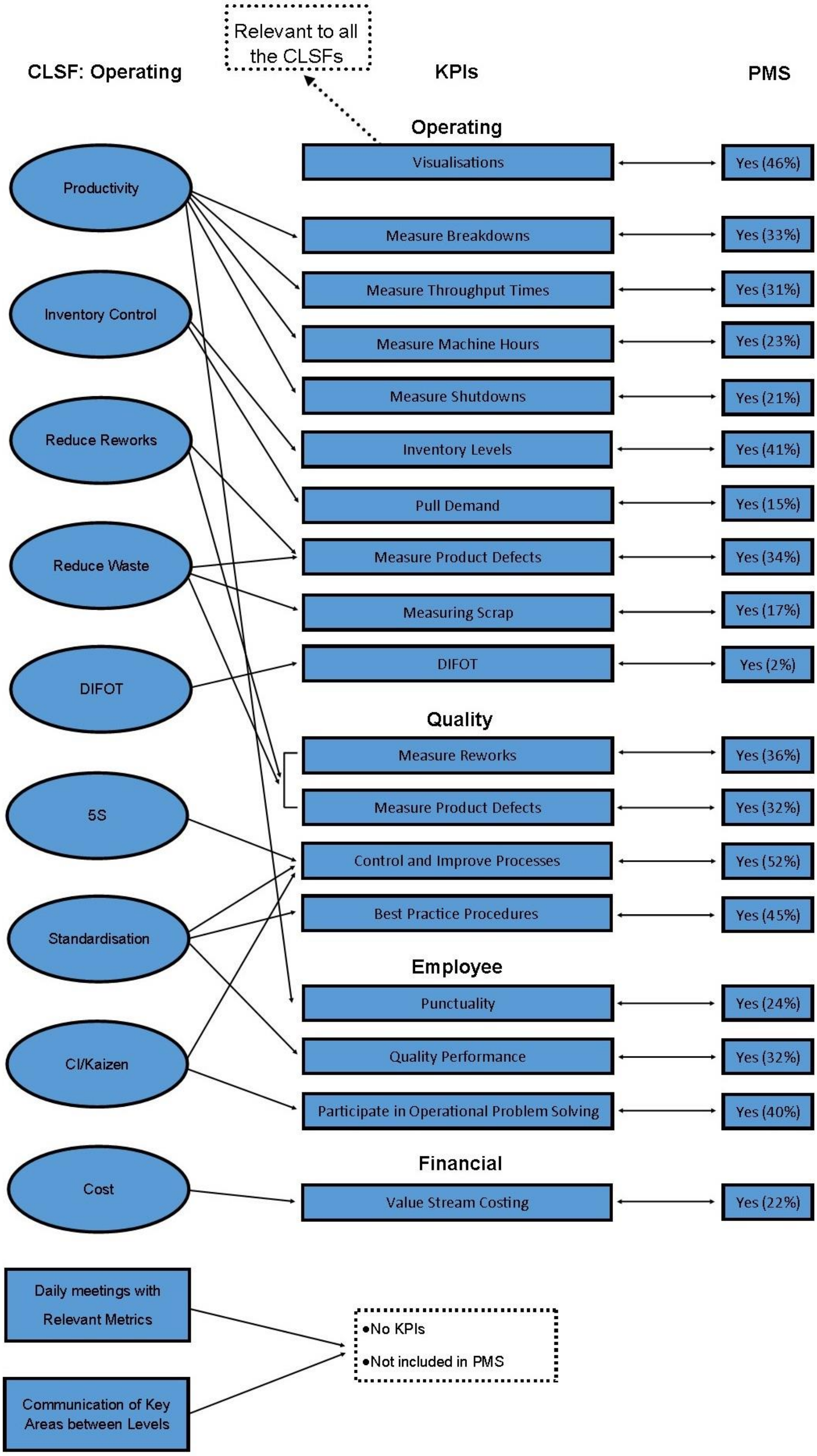

Figure 7.1: Operating CLSFs and KPIs

Furthermore, productivity, reducing waste, inventory control, 5s, and DIFOT were the most noted and crucial CLSFs related to the operating LPD. The importance of the operating LPD is illustrated by the production manager of a manufacturing company who related all their CLSFs to the operating performance dimension:

> *'… inventory management … JIT order and delivery … waste reduction … re-use where possible … quality first time (no re-work) …'* (Manager 60)

Figure 7.1 further shows the relevant KPIs organisations implemented that relate directly to each of the identified operating related CLSFs. For example, organisations implemented KPIs for measuring breakdowns, measuring throughput time, measuring machine hours, and measuring shutdowns to measure the CLSF of productivity. However, the research data as depicted in Figure 7.1 show that these KPIs were not implemented by all the organisations. This indicates that most of the organisations did not adapt their PMSs to include KPIs relevant to measure the CLSFs. The evidence indicates that the uptake of the KPIs in the organisations PMSs ranged between 2% and 52% of the organisations. For example, 29 (33%) of the 87 organisations measured breakdowns and 27 (31%) measured throughput time.

This was not representative for all the different sectors, as can be seen in Table 7.1 (Panel B), with none of the wholesale and retail companies applying these KPIs. It was also more privately owned organisations that applied these KPIs than publicly owned organisations. This can be due to the nature of the organisations' operations, where the privately owned organisations' business activities were more production related than the privately owned organisations' business activities.

Although Figure 7.1 shows that monitoring the movement in inventory levels was implemented by 41% of the organisations, Table 7.1 (Panel B), shows that this is not representative of all the organisation types. For example, 25 (71%) of the 35 manufacturing companies, four (36%) of the 11 DHBs, and five (16%) of the 31 LGs implemented this KPI. Inventory levels were mostly measured by manufacturing companies, as this is the only organisation type that has and holds inventory in terms of direct material, work in progress, and finished goods. An analysis of the research findings indicated the number of manufacturing companies that measure the various aspects of JIT (push and pull) at various inventory levels range between 15 to 34 (17% to 39%). This finding strongly advocates a disconnect between organisational strategy, as depicted in the decision to implement JIT, and the choice of performance measurements to measure the implementation of such a lean technique.

There are several KPIs within this dimension that have been implemented by around 30% to 34% (26 to 29) of all the participating organisations, namely, measuring product/service defects, measuring breakdowns, and measuring throughput time, as depicted in Figure 7.1. The organisations are very much focused on operating-related performance measures, which can be explained by the operational/production level of the business being the main area in which lean is implemented. In most cases, these KPIs were implemented by manufacturing companies and DHBs. Accordingly, the research data indicate that manufacturing companies were the most likely to implement lean operating performance measures and the most variety of KPIs in this dimension. The research data further indicate that privately owned organisations were more likely to implement lean operating performance dimension KPIs than publicly owned organisations. This is due to manufacturing companies being the largest portion of the privately owned organisations, and being the organisations that were most likely to implement lean operating KPIs. This may be explained by the nature of business of manufacturing organisations compared to the other organisations.

An analysis of the findings shows that only15% of the organisations noted that they work on a pull system for production purposes. Lean literature notes that lean should be focused on meeting customer demand based on a pull system for production (Kennedy, et al., 2006), but the research data indicate that most of the organisations still function on a push system for producing products and services. Thornton et al. (2019) showed that production in New Zealand lean organisations is driven by demand forecast, not by actual customers' orders, which leads to production being a response to data. This is confirmed by the research data, with the organisations' products based on their budgets and production capacity, instead of on customer demand. This could ultimately lead to inventory levels that are too high, with products unable to find a market and unnecessary inventory carrying costs.

Further analysis of the research data shows a disconnect between the identified CLSFs and the KPIs applied to measure the CLSFs, as illustrated in Figure 7.1. Two of the operating related CLSFs, namely, daily meetings with relevant metrics and communication of key areas between levels, were not measured through any KPIs. Some KPIs were applied to measure more than one of the identified CLSFs. For example, measuring product defects relate to both the CLSFs of reducing reworks and reducing waste. Some of the KPIs were identified under more than one LPD. For example, measuring product defects are both an operating LPD and a quality LPD. Furthermore, operating-related KPIs were also present under some of the other LPDs. For example, monitoring safe working practices is identified under the safety LPD, but not under the operating LPD. Some CLSFs were not measured by any operating related KPIs, but by KPIs identified under other LPDs. For example, 5S, is measured by the control and improve processes KPIs under the quality LPD, standardisation was measured by KPIs under the quality LPD and employee LPD, and cost was only measured by a financial-related KPI. This disconnect between the identified CLSFs and the LPD KPIs, can lead to lean techniques not being adequately measured.

Such instances of disconnect are also illustrated in Tables 6.2 to 6.14, which show that not all the organisations applied relevant KPIs to measure the lean techniques that they had implemented. It was also revealed that some of the participants noted that they did not implement lean, but further investigations showed that some lean techniques were present in their organisations. This could lead to organisations not identifying the importance of the lean techniques applied in their organisations, and accordingly, they failed to apply the relevant related KPIs.

Table 7.3 presents the summary research data collected on the perception of how lean techniques were influenced by performance measures. The evidence indicates that participants have a more positive view on the effect of performance measures at the operational level of the organisation.

For example, 38 (44%) of the 87 organisations perceive that performance measures reinforce and 33 (38%) that performance measures increase efficiency, with 5 (6%) perceiving it as limiting and one (1%) as decreasing efficiency. The effect on productivity is perceived in similar terms. This is, however, not representative of all the participants. For example, 23 (66%) of the manufacturing company participants perceive performance

Table 7.3: Influence Between Performance Measures and Lean

	Manufacturing Company		Service Company		Wholesale and Retail Companies		DHB		LG		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Reinforcing & Increasing																
Reducing Waste/Scrap	24	69%	1	17%			3	27%	8	26%	36	41%	25	56%	11	26%
Efficiency	23	66%	1	17%	1	25%	5	45%	9	29%	38	44%	25	56%	14	33%
Diversity in products/services delivered	4	11%	1	17%					3	10%	8	9%	5	11%	3	7%
Pursuing a cost leadership strategy	6	17%	1	17%					4	13%	11	13%	7	16%	4	10%
Employee empowerment	22	63%	1	17%	1	25%	4	36%	11	35%	38	44%	24	53%	15	36%
Increased productivity	23	66%	2	33%			4	36%	7	23%	36	41%	25	56%	11	26%
Limiting & Decreasing																
Reducing Waste/Scrap	2	6%	1	17%	1	25%	1	9%	6	19%	10	11%	4	9%	7	17%
Efficiency	3	9%							2	6%	5	6%	3	7%	2	5%
Diversity in products/services delivered	7	20%					1	9%	3	10%	11	13%	7	16%	4	10%
Pursuing a cost leadership strategy	3	9%					1	9%			4	5%	3	7%	1	2%
Employee empowerment	2	6%							1	3%	3	3%	2	4%	1	2%
Increased productivity	3	9%					1	9%	1	3%	5	6%	3	7%	2	5%

measures as positively affecting efficiency, and only one (25%) of wholesale and retail companies do the same. A comparison of privately owned and publicly owned organisations indicates that more privately owned organisations perceive the effect of performance measures as positive, due to the manufacturing companies.

Some participants reported that they did implement KPIs relevant to the lean techniques they implemented, noting that these were also linked to CLSFs, but that after the desired level of activity was reached, they reverted to traditional operational techniques and performance measures. For example, the production manager of a manufacturing company noted that:

> *'… we did obviously use that program internally in our business, as I said, for 3 to 5 years, and maybe a little bit longer. But currently … we don't focus on lean anymore ...'* (Manager 70/Interviewee: Company 2)

Furthermore, the participants noted that even though the lean techniques and performance measures are not applied in the organisation at present, the advantages of lean are still ongoing and the benefits of what was learned from lean are still present in the organisation. For example, Manager 70/Interviewee: Company 2, further noted:

> *'... parts of it is still ingrained in the long-serving staff who was originally part of that [lean] training.'* (Manager 70/Interviewee: Company 2)

Thornton et al. (2019) showed that New Zealand organisations emphasise operating performance. This is partly confirmed by the research data, with the majority of identified CLSFs being focused on both operating-related CLSFs and employee-related CLSFs. There is, however, a disconnect between the lean techniques implemented and operating CLSFs and the applied performance measures.

7.2.2 Lean Employee Performance Dimension

The employee performance dimension is essential for the current and future success of the organisation (Baroma et al., 2013). Organisations need to focus on the needs, learning and progress of individual employees (Chiarini et al., 2012), and further focus on the employees' commitment to lean, and creating multi-functional employee teams (Womack & Jones, 1997). The employee performance dimension should form a crucial part of lean organisations' PMSs. The research data indicate that the participants realise the importance of the employee LPD, as presented in Table 7.2 (Panel A).

Figure 7.2 illustrates the summary research data of the employee CLSFs identified by the organisations, the relevant KPIs for measuring the CLSFs, and the inclusion of the KPIs in the organisations' PMSs. Through triangulation of the research data and lean literature, this figure was developed by triangulation. The research data and current lean literature was triangulated to develop Figure 7.2 to show the relevant employee related KPIs for each CLSF, and to incorporate the KPIs in the organisations' PMSs.

The findings, as illustrated in Figure 7.2, show that the employee related CLSFs identified by the participants were: training, employee satisfaction, employee involvement, employees taking ownership of lean, and sharing gains with employees.

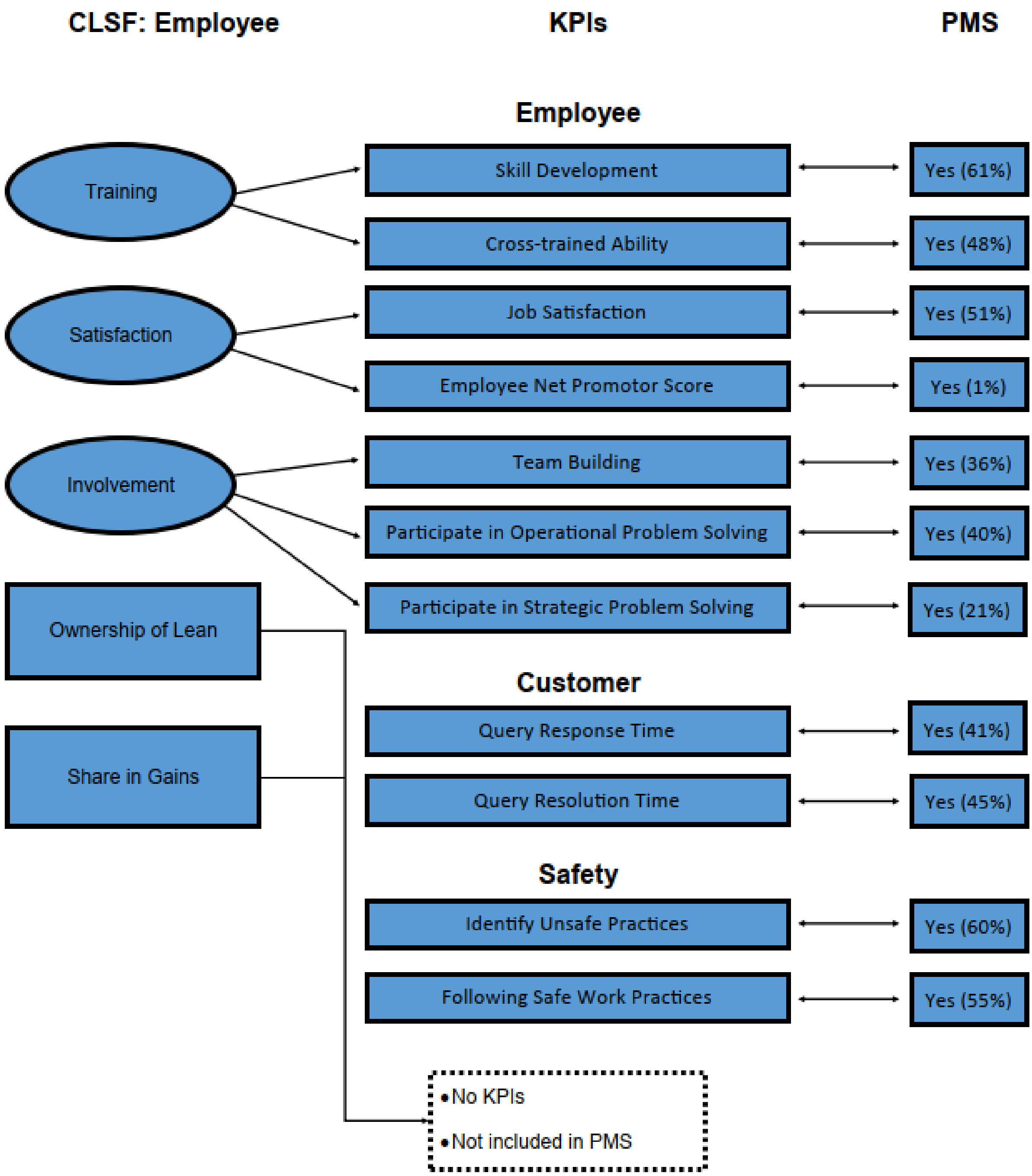

Figure 7.2: Employee CLSFs and KPIs

Furthermore, training and staff involvement in the lean process were the two most noted and crucial CLSFs related to employees. For example, the general manager of a manufacturing company indicated that:

> *'… the key of lean success is to involve people in the process ...'* (Manager 57)

Additionally, the team leader of logistics of a wholesale and retail company noted:

> *'… ongoing education to keep it top of mind and ensure that new employees understand the core principles …'* (Manager 51)

The link between training and involving employees in lean is illustrated by the general manager of a manufacturing company:

> *'… training at all levels of the business so everyone feels empowered to improve …'* (Manager 67)

Figure 7.2 further shows the relevant KPIs that organisations implemented that relate directly to each of the identified employee related CLSFs. For example, organisations implemented KPIs for skill development, cross-trained ability of employees, and employee quality performance to measure the CLSF of training. Staff involvement and staff satisfaction were also measured through different KPIs. Despite this, Figure 7.2 indicates that only some of the organisations included KPIs to measure these CLSFs in their PMSs, with between 1% and 61% using the relevant KPIs. This indicates that the organisations do not adequately measure the employee CLSFs in their PMSs.

However, Table 7.1 (Panel B) also shows that these KPIs were not implemented by all the organisations. For example, 53 (61%) of the 87 organisations measured the skill development and competency of their employees. This is representative of all the separate groups of organisations. The manufacturing companies showed the highest level of implementation of this KPI, with 24 (69%) of the 35 organisations, doing so. About half of the 87 organisations also implemented measurement of their employees' cross-trained abilities. In terms of cross-trained abilities, manufacturing companies implemented this KPI the most, with 21 (60%) of the 35 doing so. The research data further indicate that there was not a marked difference between publicly owned and privately owned organisations in terms of implementing lean employee KPIs. Not all the participants measured the training their employees received to ensure it was effective. This can lead to employees not being trained well enough to optimally identify areas in the organisations that require improvement, which could lead to the benefits of lean not fully being realised.

Furthermore, Table 7.1 (Panel B), also showed that measuring their employees' job satisfaction was implemented by about half of the organisations, which indicates that, even though this was identified as a CLSF, this was not a priority for the organisations to measure. This is also reflected in the research literature, where Thornton et al. (2019) showed that New Zealand managers had minimal focus on employees' job satisfaction.

Figure 7.2 indicates a disconnect between the identified CLSFs and the KPIs applied to measure the CLSFs. Two of the employee-related CLSFs, namely, staff taking ownership of lean and sharing gains with staff, were not measured through any KPIs. Some KPIs, applied under the employee LPD were not linked with any of the identified employee related CLSFs, namely, employee punctuality and employee response time to queries.

Furthermore, employee related KPIs were also present under some of the other LPDs. For example, monitoring if safe working practices are followed, was identified under the safety LPD. One of the KPIs was identified as both an employee LPD and a customer LPD. As illustrated with the operating CLSFs in section 7.2.1, this disconnect can also be explained by Tables 6.2 to 6.14, which show that not all the organisations applied relevant KPIs to measure the lean techniques that they had implemented. Furthermore, some participants noted that they did not implement lean, but further investigations showed that some lean techniques were present in their organisations. This indicates that these organisations do not see lean as part of their strategy and would then also not perceive the implemented lean techniques as crucial to measure through KPIs.

The evidence, as illustrated in Table 7.3 also indicates that some participants have a more positive view of the effect of performance measures on the organisation. For example, 38 (44%) of the 87 participants perceive that performance measures reinforce and 32 (3%) that performance measures increase employee empowerment, with 3 (3%) perceiving it as limiting and two (2%) as decreasing it. This is not representative of all the participants. For example, 22 (63%) of the manufacturing company participants perceive performance measures as positively affecting employee empowerment, and only one (17%) of the service companies doing so. Comparing privately owned and publicly owned organisations, indicates that more privately owned organisations perceive the effect of performance measures as positive, again mainly due to the manufacturing companies.

The literature on lean LPDs advocates that the employee performance dimension plays a significant role in the current and future success of the organisation (Baroma et al., 2013; Chiarini et al., 2012). Interestingly, the research findings indicate that not enough of the participants consider this dimension as crucial, and therefore do not include relevant employee related performance measures in their PMSs. This can have a negative effect on the participant's ability to implement lean successfully and to reap the full benefits of lean.

7.2.3 Lean Financial Performance Dimension

Thornton et al. (2019) argue that New Zealand managers are mostly focused on the operating and financial performance dimensions of lean. However, this focus on the financial LPD is not reflected in the CLSFs identified by the participants of this study.

Additional analysis of Table 7.2 (Panel B) shows that the only CLSF identified by the participants that can be connected to the financial LPD was cost. No other financial-related CLSFs, such as sales or profit, were identified. The research data shows that one (3%) of the 35 manufacturing companies and two (6%) of the 31 LGs indicated cost as a CLSF. For example, the chief executive of a LG indicated the following as CLSF that must be measured for successful lean implementation:

> *'… need to deliver … at a reasonable cost.'* (Manager 39)

The organisations do not seem to either relate or consider traditional financial performance KPIs with lean. For example, Table 7.1 (Panel A) indicates that 21 (14%) of the 87 organisations noted that they apply Return on Assets (ROA) and 19 (22%) that they use Value Stream costing (VSC) as lean performance measurements. Furthermore, a CEO of a manufacturing company noted that he *'wouldn't call RIO lean'* (Manager 66/Interviewee: Company 1). The organisations indicated that they rather see lean as building to the *'financial numbers'* (Manager 66/Interviewee: Company 1) with lean having the aim of increasing returns or increasing profits, through the reduction of cost. The reduction of cost was also related to the financial LPD by Thornton et al. (2019). Organisations are more focused on the operational level of reducing cost than the effect on the bottom line.

Further analysis shows that it was mainly manufacturing companies and LGs that applied these financial performance measures. The results relating to the manufacturing organisations is also reflected in Thornton et al.'s (2019) study, which only included manufacturing and service companies. The present study includes organisations in other sectors, such as LGs, DHBs and wholesale and retail companies, which could explain the differences in results.

The research data indicates that only a small percentage of the organisations identified financial-related CLSFs. They perceive that lean performance cannot directly be measured by KPIs such as ROI and ROA, but rather by performance measures related to the reduction of cost, which would then result in improved ROI and ROA.

7.2.4 Lean Customer Performance Dimension

One of the most important principles of lean is organisations delivering optimum customer value (Stefanović & Čečević, 2018). Thornton et al. (2019) showed that New Zealand managers are less focused on customer value than on operating performance. This was also evident in the present study's findings, thereby reaffirming Thornton et al.'s (2019) claim.

A small percentage of the organisations identified customer related CLSFs. Table 7.2 (Panel B) further indicates that only one (3%) of the 35 manufacturing companies and seven (19%) of the 31 LGs indicated CLSFs relating to their customers. The organisations noted that successful lean is linked to the needs of their customers and customer satisfaction. The research data seems to indicate that the organisations equate providing value to customers through the satisfaction levels of their customers. If their customers are satisfied with the product or service delivered, the customer must perceive to have received a valuable product or service. Value products and services are reflected through happy customers. The general manager of an LG indicated the 'customer satisfaction', was a CLSF (Manager 12).

Customer satisfaction was also one of the KPIs implemented by most of the organisations. Table 7.1 (Panel A) indicates that 51 (59%) of the 87 organisations implemented measuring customer satisfaction. This was not representative of all the different organisation types. For example, 20 (65%) of the 31 LGs applied this KPI, but only one (25%) of the four wholesale and retail companies did so. Other lean customer KPIs implemented by less than half of the total organisations were measuring the number of customer queries and measuring the customer query resolution times. Forty-two (48%) of the 87 organisations implemented both KPIs. Once again, as illustrated in the other LPDs, this again is not representative of all the organisation types. It was mostly LGs that implemented these two KPIs, with 24 (77%) of the 31 LGs implementing both. An insignificant percentage of the other types of organisations implemented these two KPIs. For example, 10 (29%) of the 35 manufacturing companies implemented measuring the number of customer queries, and four (36%) of the 11 DHBs implemented measuring customer query resolution times. It was mainly LGs that identified customer-related CLSFs, and it was also mainly LGs that applied customer-related KPIs. This is further reflected in a comparison between privately owned and publicly owned organisations, with LGs, being publicly owned resulting in publicly owned organisations being more likely to implement lean customer KPIs than privately owned organisations.

Overall, the research data indicate that LGs were more likely to use lean customer KPIs than other types of organisations. LGs are service organisations, and it is encouraging to see that this type of organisation does include customer-related measurements in their PMSs. Only a small percentage of the organisations see the customer as crucial for the successful implementation of lean. This is consistent with the New Zealand research literature, which also indicates that New Zealand managers overlook customer value (Thornton et al., 2019).

7.2.5 Lean Safety Performance Dimension

Lean organisations must provide a safe work environment for employees and must deliver a safe product or service to customers (Thornton & Nath, 2015). The authors claimed that New Zealand managers do not understand the relation of the safety LPD to lean performance. This was also evidenced and affirmed by the research data in the current research.

The summary research data, as presented in Table 7.2 (Panel B), indicate that only one (17%) of the 6 service companies and one (3%) of the 31 LGs indicated safety as a CLSF. The CEO of the LG stated that:

> '*… safe workplace and reduce downtime from preventable injury ...*' (Manager 40)

The lean performance measures implemented by the organisations, however, as presented in Table 7.1 (Panel C), indicate that safety is much more of a priority than is reflected in the identified CLSFs. For example, the summary research data shows that 56 (64%) of the 87 organisations implemented a safe work environment and a safe workplace policy. This is representative of all the different organisation types. For example, 22 (63%) of the 35 manufacturing companies implemented a safe work environment and 21 (68%) of the 31 LGs have a workplace safety policy in place. Around half of the organisations also aimed to identify unsafe practices and procedures, monitor if employees follow safe working practices, run health and safety drills, and run safety workshops. This is representative of all the organisation types. The research data also indicate there was not a distinct difference between publicly owned and privately owned organisations in terms of implementing lean employee KPIs.

The research data further indicates that the organisations were more likely to implement lean safety KPIs, than they were to implement any of the other lean dimensions' KPIs. This is also reflected in the research literature. Thornton et al. (2019) and Thornton and Nath (2015) noted that New Zealand organisations rated safety as the most important performance dimension.

Further analysis shows a disconnect between the identified CLSFs and the safety performance measures implemented, which may be explained by health and safety being an important part of New Zealand organisations' daily operations. Health and safety is strictly regulated by the Health and Safety at Work Act of 2015. Standards New Zealand (2022a) also has health and safety-related standards, with some of the participants noting on their websites that they were accredited for AS/NZS ISO 45001:2018 and AS/NZS ISO

4801:2001. Furthermore, the research data, as presented in Table 5.4, indicated that none of the organisations implemented health and safety techniques as part of their lean implementation. This can be due to the organisations equating health and safety with normal business practices and not specifically with lean, and that the safety practices are already in place due to the regulations in place.

7.2.6 Lean Quality Performance Dimension

Another important principle of lean is organisations delivering quality products and services to their customers (Thornton & Nath, 2015). Thornton et al. (2019) showed that New Zealand managers are yet to realise the importance of product quality. The research data also confirm this through the CLSFs identified by the organisations.

Table 7.2 (Panel B) shows that only a few organisations identified quality related CLSFs, with five (14%) of the 35 manufacturing companies, one (17%) of the six service companies, and one (33%) of the 31 LGs indicating quality as a CLSF. The general manager of a manufacturing company indicated that they ensure quality through their ‘quality accreditation (Manager 74).

However, the lean performance measures implemented by the organisations, indicate that quality is much more of a priority of measuring than is reflected in the identified CLSFs. For example, Table 7.1 (Panel C) showed that around 50% or less of the 87 organisations implemented quality related KPIs in their PMSs. Forty-five (52%) of the 87 organisations indicated that they implemented measures to control and improve processes, 43 (49%) implemented measures to evaluate customer satisfaction, and 39 (45%) implemented best practice procedures. These were, however, not representative of all the organisation types. For example, eight (73%) of the 11 DHBs, 18 (58%) of the 31 LGs, and one (25%) of the four wholesale and retail companies implemented measures to control and improve processes. The research data shows a disconnect between the sectors that identified quality as a CLSF and the sectors that implemented quality-related performance measures. The privately owned manufacturing companies identified quality-related CLSFs but did not reflect this in their performance measurements, while publicly owned DHBs did not identify any quality-related CLSFs, with one publicly owned LGs identifying quality as a CLSF, but together DHBs and LGs showed the highest levels of applying quality-related performance measures. This can be explained by quality being entrenched in DHBs, as discussed in section 5.2.1, through government-directed initiatives such as the Working Group for Achieving Quality in Emergency Departments (2009).

The research data shows a disconnect between the identified CLSFs and the performance measures implemented. The organisations do not focus on quality, which is also evidenced in the research literature (Thornton et al., 2019). This lack of focus on quality implies that they are unable to see the bigger picture of how quality influences customer satisfaction and customer retention whilst enhancing efficiency in production.

7.3 Strategy and Decision Level to Implement Lean

Discussing barriers to lean implementation can further illuminate the relationship between lean and performance measures and provide reasons for organisations not adequately measuring lean. Some of the key barriers to successful lean implementation are the lack of management commitment (Sharma & Thakar, 2017; Bhasin, 2012b) and that lean is implemented at an operational level (Bhasin & Burcher, 2006) instead of being viewed as a philosophy or strategy (Bellisario & Pavlov, 2018).

Lean should be viewed as an organisation-wide philosophy or strategy, which will then be a catalyst for lean implementation (Bhasin & Burcher, 2006). Consequently, the following two research questions will be answered:

> *RQ5: Do organisations' managers view lean as part of their organisational strategic aims, and if so, how?*

An organisation's strategy is observable in its corporate documents, strategic aims, and vision statements. Table 7.4 presents a summary of the research data of the level of participating organisations including lean in their strategic aims, corporate documents, and vision statements. Most organisations did not include lean in these documents. For example, 43 (49%) of the 87 organisations included lean in their strategic aims. This was not representative of all the separate groups. Twenty-three (66%) of the 35 manufacturing companies include lean in their strategic aims, compared to only two (33%) of the six service companies. More privately owned organisations (60%) included lean in their strategic aims than publicly owned organisations (38%).

The research data further indicates that 33 (38%) of the 87 organisations included lean in their corporate documents. This, again, is not representative of all the separate groups. For example, 19 (61%) of the LGs and 10 (29%) of the manufacturing companies are doing so.

Table 7.4: Inclusion of Lean in the Strategy and Corporate Documents

	Manufacturing Companies		Service Company		Wholesale & Retail Companies		DHB		LG		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Lean included in Strategic Aims																
Yes	23	66%	2	33%	2	50%	2	18%	14	45%	43	49%	27	60%	16	38%
No	12	34%	4	67%	2	50%	9	82%	17	55%	44	51%	18	40%	26	62%
Lean included in Corporate Documents																
Yes	10	29%	1	17%	2	50%	1	9%	19	61%	33	38%	13	29%	20	48%
No	25	71%	5	83%	2	50%	10	91%	12	39%	54	62%	32	71%	22	52%
Lean included in Vision Statement																
Yes	10	29%	2	33%	1	25%	2	18%	11	35%	26	30%	13	29%	13	31%
No	25	71%	4	67%	3	75%	9	82%	20	65%	61	70%	32	71%	29	69%

More publicly owned organisations (48%) included lean in their strategic aims than privately owned organisations (29%). Furthermore, 26 (30%) of the 87 organisations included lean in their vision statements. This was representative of the separate groups, and both privately and publicly owned organisations showed similar levels of including lean in their vision statements.

The research data, as presented in Table 7.2 (Panel B), indicates that organisations of each sector, except the wholesale and retail companies, identified lean being related to strategy is a CLSF, but it was only a minimal percentage of each group. For example, three (9%) of the 35 manufacturing companies and three (50%) of the six service companies, noted that lean should be made part of the organisation’s strategy, and that there should be some commitment to the implementation of lean. For example, a production manager from a manufacturing company noted:

> *‘Make it a part of strategy. Whole business to own and support ...’* (Manager 72)

Even though lean was not formally included in the strategy and corporate documents of the respondents, it is encouraging to see that some managers are recognising the importance of including strategy as a CLSF. Most of the organisations did not include lean in their corporate documents, vision statements, and strategic aims, despite some identifying to include lean in strategy, as a CLSF. This can partly explain why the organisations do not recognise that they did implement lean and do not adequately measure their lean implementation. If lean is not seen as an organise wide philosophy, it will not be present in all areas of the organisation, of which the PMSs is an example in point.

Furthermore, the lean literature noted that lean is implemented at an operational level (Bhasin & Burcher, 2006) and is not an organisation wide philosophy. The summarised research data, as presented in Table 7.5, indicates that 43 (49%) of the 87 organisations made the decision to implement lean on a strategic/management level, with 17 (20%) making the decision on both the operational/production level and strategic/management level. This indicates that most of the organisation sectors involved the strategic/management level in the decision. This is a further reflection on the involvement of strategy in lean in the participating organisations.

The research data, illustrated in Table 7.5, further shows that 38 (44%) of the 87 participants implemented lean in both the operational/production level and strategic/ management level, with 26 (30%) implementing it only on the operation/production level. The research data indicate that less than half of the organisations realise that lean is an organisation wide philosophy and implemented it accordingly. The majority only implemented lean on the operational/production level. This can partly explain why the organisations do not measure lean appropriately.

The research data indicates that most of the organisations made the decision to implement lean partly on a strategic/management level and implemented lean partly on a strategic/management and operational/production level. Despite the involvement of upper management, the level of lean inclusion in the organisations strategy and corporate documents is still low, which can result in inadequate PMSs.

Table 7.5: Decision Level to Implement Lean and Level Implemented

	Manufacturing Company		Service Company		Wholesale and Retail Company		DHB		LG		Total		Private		Public	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Decision level																
Operational/production	7	20%					3	27%	2	6%	12	14%	7	16%	5	12%
Strategic/management	20	57%	4	67%	2	50%	5	45%	12	39%	43	49%	26	58%	17	40%
Operational/production & Strategic/management	7	20%	2	33%	2	50%	1	9%	5	16%	17	20%	11	24%	6	14%
Strategic/management/Ownership	1	3%									1	1%	1	2%		
Not implemented							2	18%	12	39%	14	16%			14	33%
Implementation Level																
Operational/production	13	37%	2	33%			4	36%	7	23%	26	30%	15	33%	11	26%
Strategic/management	4	11%					1	9%	1	3%	6	7%	4	9%	2	5%
Operational/production & Strategic/management	17	49%	4	67%	4	100%	3	27%	10	32%	38	44%	25	56%	13	31%

7.4 Contingency Theory Factors

It is important to provide further context to the specific lean techniques implemented by organisations and the adaptation of the organisations' PMSs to measure the outcomes of lean. The context will be provided by establishing the factors that drive the implementation of lean techniques and adaptation of PMSs.

Accordingly, the following research question will be examined:

> *RQ6: What factors drive the implementation of lean techniques, the application of performance measures to measure lean outcomes, and the relationship between the lean techniques and the current performance measures?*

As presented in Chapter 3, contingency theory (CT) is shown as an appropriate theoretical framework to illustrate the relationship between lean and performance measurements, within a contextual setting. To answer RQ6, the CT factors, as presented in section 3.5, namely strategy, organisational decision style, systems' adaptability, organisational size, and sector, will be applied to ground the findings of the study.

In the following sections, each of the identified CT factors will be discussed to illustrate whether the factors drive the implementation of lean techniques and adaptation of PMSs to measure lean outcomes.

7.4.1 Strategy

A comparison of the number of lean techniques implemented to whether lean strategy is included in the organisational aims shows that the CT factor of strategy influences the number of lean techniques implemented. Organisations that did not include lean in their strategic aims implemented a lower number of lean techniques than organisations that did include lean in their strategic aims. Most LGs did not include lean in their strategic aims, and on average only implemented around two different lean techniques. Most manufacturing companies did include lean in their strategic aims, and on average implemented six different lean techniques.

There is an indication that strategy influences the lean performance measurements applied. A comparison of whether lean is included in the organisational strategy and whether the organisations implemented lean performance measures, shows that organisations that did not include lean in their strategic aims did not include lean performance measures in their PMSs. Most LGs and DHBs did not include lean in their strategic aims and did not include lean performance measures in their PMSs. Most manufacturing companies did include lean in their strategic aims and included lean performance measures in their PMSs.

The findings of the study indicates that strategy, as a CT factor both influenced the lean techniques implemented and the lean performance measurements included in the organisations' PMSs. This fits previous studies that also indicated a relationship between strategy and systems effectiveness. Not embracing lean as an organisation wide philosophy and including lean in organisational strategy, are major barriers for the implementation of lean. This is reflected in the findings where with organisations not including lean in their strategy, did not include adequate PMs in their PMSs to measure lean outcomes.

7.4.2 Organisational Decision Style

The research data indicate that the CT factor of organisational decision style influences the lean performance measures the organisations implemented. Most manufacturing companies and service companies made the decision to implement lean on a strategic level and the majority indicated that they added PMs to fit lean tools. Less than 50% of DHBs and LGs decided to implement lean on a strategic level, and the majority did not add lean performance measures. This may be due to research showing that manager involvement is a CLSF, and if management is not involved in lean implementation, they will not require reporting on lean performance, and accordingly, lean PMs will not be included in the organisations PMSs.

The findings therefore indicate that organisational decision style influences the lean performance measures implemented by lean organisations. If the decision to implement lean is not done at the management level, it indicates a lack of management commitment, which is important for lean implementation, which leads to less PMs being implemented to measure lean outcomes.

7.4.3 System's Adaptability

It is evidenced in the research data that not all organisations were able to adapt their PMSs to fit lean and appropriately measure lean outcomes. Most manufacturing companies and service companies indicated that they adapted their PMSs to fit lean, while most DHBs indicated that they did not. This may be due to DHBs having to report to the Ministry of Health which sets what DHBs must report on. DHBs therefore have less autonomy in choosing the PMs they include in their PMSs. Private companies have the autonomy to choose which PMs they include in their PMSs and accordingly are more likely to adapt their PMS to fit the lean techniques implemented.

Systems' adaptability is shown to have an influence on the performance measures applied to measure lean outcomes. Organisations that are not adaptable to changes in their environments, will not successfully implement lean techniques and will not adequately measure lean outcomes.

7.4.4 Organisational Size

The research data indicate that organisational size does influence the lean techniques implemented. A comparison of organisational size and the number of lean techniques implemented shows that the smaller-sized organisation, implemented more lean techniques than larger-sized organisations. On average, smaller-sized organisations implemented almost six lean techniques, while larger-sized organisations only implemented three lean techniques. This may be because the organisational structure is more complex, with more staff and different departments, which can hamper the implementation of new techniques. Smaller organisations are more manageable and can make implementation easier.

The research data also shows that organisational size influence the lean performance measures implemented. Most of larger-sized organisations included lean performance measures in their PMSs, while most of the smaller-sized organisations included lean performance measures in their PMSs. This again can be due to larger organisations having more complex organisational structures which makes it harder to implement change.

The findings indicate that organisational size does influence the lean techniques implemented and the PMs applied to measure lean outcomes.

7.4.5 Sector

The research data indicate that the lean techniques organisations implement are directly influenced by the characteristics of the sectors the organisations belong to. JIT is mainly implemented by manufacturing companies and wholesale and retail companies. Manufacturing companies carry inventories of raw materials, work in progress, and finished goods. Wholesale and retail companies carry inventories of products to sell to customers. JIT is implemented to assist with the optimal purchasing and carrying of these inventories. Service companies, LGs and the majority of DHBs did not implement JIT. These organisations do not carry inventories in the same manner as manufacturing and wholesale and retail companies, and accordingly do not require to implement JIT. SMED was only implemented by manufacturing companies and not by any of the other types of participants. This lean technique is directly related to a manufacturing process, and it is fitting that only manufacturing organisations implement SMED. Quality/TQM was mainly implemented by DHBs, which can be explained by the Working Group for Achieving Quality in Emergency Departments (2009) directing DHBS to implement this lean technique.

The sector also influences the inclusion of lean performance measurements in the PMSs. Manufacturing companies and service organisations included lean performance measures in their PMSs, while DHBs, LGs, and wholesale and retail companies did not. This lack of using lean performance measures in DHBs can related back to this sector having less autonomy in selecting performance measures as they must report back to the Ministry of Health. Manufacturing companies implement a larger number of lean techniques, which may require a larger number of performance measures to measure the outcomes of the techniques, which may be why manufacturing companies used more lean performance measures.

Previous research on the relationship between sector and systems' effectiveness have been inconclusive, with this study showing that sector do influence lean techniques implemented and lean performance measures applied.

7.5 Chapter Summary

This chapter presented and discussed findings regarding the relationship between lean techniques and the PMSs. This relationship was illustrated through Searcy's (2004) LPDs. Furthermore, the relationship was explained through the CLSFs identified by the participants, the effect of the performance measures on lean techniques as perceived by the participants, the inclusion of lean in the organisations' strategy, and the organisation level at which the decision to implement lean was made and was implemented on.

The research findings show that there is a disconnect between the CLSFs the organisations identified and the lean performance measures implemented, as they both relate to the LPDs.

One of the two CLSFs most identified by organisations related to the operating LPDs, which is consistent with current New Zealand lean literature. The other CLSF most identified was the employee LPD, which is not consistent with current New Zealand lean literature. The research data shows a disconnect between the performance measures relating to the operating and employee LPDs, and the lean techniques implemented and identified CLSFs.

Current lean literature indicated that New Zealand managers also focused on the financial LPD. This was, however, not visible in the research data, as reflected in the minimal financial-related CLSFs identified by organisations. Organisations do not relate the traditional financial KPIs as relevant measures of lean performance, but rather just as an indication of the result of lean implementation, and rather measure the operational effect of lean on the reduction of cost.

Very few CLSFs relating to the other three LPDs, of customer, safety, and quality, were identified. The research data also shows a disconnect between the performance measures relating to the customer, safety, and quality LPDs, and the lean techniques implemented and identified CLSFs. In particular, the disconnect relating to the safety LPD is due to this area being heavily regulated by the New Zealand Government.

The research evidence advocates that the relationship between lean and performance measures are influenced by the contingency factors of sector, organisation size, strategy, systems adaptability, and organisational decision style. The evidence shows that the organisations that were more inclined to apply the different lean performance measures from the six LPDs were privately owned, manufacturing organisations, smaller-sized, had included lean as part of their organisation’s strategic aims, and decided to implement lean on the strategic/management level. Accordingly, the research evidence corroborates the literature research on strategy and provides new research on the sector, organisation size, systems' adaptability, and organisational decision level, in a New Zealand context.

Chapter 8 will summarise the key findings, explicitly answer the research questions, discuss the main contributions and limitations of this study, and recommend further research.

CHAPTER 8 CONCLUSION

8.1 Introduction

This thesis aims to contribute to research on lean implementation and the related performance measurement in a New Zealand context. It seeks to provide insights into how lean organisations measure the performance of lean techniques implemented. New Zealand provides a unique setting in that most private organisations fall in the Small and Medium Enterprise (SME) category and the public sector forms a major part of the economy. Additionally, the New Zealand government had an impact on the implementation of lean in both the private and public sectors. Lean research has predominantly focused on the manufacturing sector; accordingly, this study adds a new dimension by incorporating the wholesale and retail sector and service sector drawing upon both the private and public sectors. The study makes use of qualitative analysis to explore and interpret the lean techniques implemented and the performance measures applied to measure the outcomes of these lean techniques to establish the relationship between the lean techniques and performance measures. CT is applied to ground the findings.

Research has shown that lean is not always successfully implemented, with some of the major barriers being that lean is not viewed as an organisation-wide philosophy, lean is not included in the organisational strategy, and poor communication (Thornton et al., 2019; Narayanamurthy et al., 2018; Samuel et, al 2015; Bhasin, 2012a). Lean implementation must be incorporated in the organisation's strategy and accordingly be implemented at both the strategic and operational levels. The performance measurement system (PMSs) provides effective communication by identifying areas that require improvement. Therefore, it is critical to examine the relationship between lean and performance measures to ensure that the correct information is communicated to ensure that strategic goals and objectives relating to lean implementation, are met. Research has been slow to recognise that PMSs play a significant role in the effective implementation of a lean philosophy (Merchant & Van der Stede, 2016), and accounting research has been slow to research this in-depth (Castellano & Burrows, 2011; Haskin, 2010). This study aims to add to this gap.

Moreover, Searcy's (2004) lean performance dimensions (LPDs), can be used to measure lean performance but there is limited research that has fully illustrated how the LPDs have been integrated into a comprehensive PMS (Thornton et al., 2019). This study contributes to new knowledge by eliciting how the LPDs are incorporated into a PMS for successful diffusion of lean. The research also contributes to existing lean knowledge by adding a New Zealand dimension including manufacturing, service, wholesale and retail, private, and public sectors.

The remainder of the chapter is structured as follows: section 8.2 presents a summary of the research findings. This is followed by section 8.3 which expounds on the implications of the study, section 8.4 outlines the contribution the thesis makes to lean literature, and section 8.5 identifies the limitations of the study. Finally, section 8.6 proposes potential research studies emerging from the limitations and findings of this research.

8.2 Research Findings

This section presents the findings of this research regarding the emergence of lean in New Zealand, the lean techniques implemented, the performance measures applied to measure lean outcomes, and the established relationship between lean techniques and performance measures.

8.2.1 Emergence of Lean in New Zealand

The implementation of lean in New Zealand is on par with global organisations, but the initiatives for implementing lean are different. Within the global context lean implementation spread to make organisations more competitive and to reduce cost. In a New Zealand context, private sector organisations were introduced to lean by the New Zealand government to boost productivity and growth. Public sector organisations in New Zealand were not targeted by this specific New Zealand government initiative. Public sector organisations' reasons for implementing lean were at first in line with those of global organisations in seeking ways to improve quality and efficiency. In 2008, this also became a government initiative through the Working Group for Achieving Quality in Emergency Departments to the Minister of Health, which made recommendations to improve quality and efficiency in New Zealand ED's partly based on the success implementation of lean through Project RED and Middlemore. The research data, therefore, indicates that the New Zealand government influenced the start of implementing lean and is still influencing the implementation of lean in both the private sector and the public DHB sector.

New Zealand managers connect lean only partly with the current global view on lean of value to customers through continuous improvement (CI). The participants are still mostly focused on the reduction of waste that leads to a reduction in cost, but they are starting to embrace the current views.

8.2.2 Lean Techniques Implemented

New Zealand organisations is on par with global organisations by implementing a combination of lean techniques. The combination most implemented was standardised work and CI. The second highest combination was standardisation, CI/Kaizen, and training of employees for skill development. Some of the sectors added other techniques that complimented the standardised work and CI/Kaizen, namely 5S, VSM, VM, JIT, Kanban, and TQM. These techniques were combined with standardisation and CI/Kaizen in different combinations. Manufacturing companies especially implemented 5S in combination with other lean techniques. This was not the case with service companies, wholesale and retail companies, DHBs and LGs. All the identified combinations of lean techniques had the aim to reduce waste and cost or to promote CI or were aimed at both.

The implementation of lean techniques was partly driven by the CT factors of strategy, organisational decision style, systems adaptability, and sector. The manufacturing organisations was the only sector where most of the organisations included lean in the organisational strategy and corporate documents with most of the other sector's organisations not doing so. This impacted the lean implementation where the sectors that did not include lean in strategy and corporate documents implemented fewer lean techniques at lower uptake levels. Most of the organisations made the decision to implement lean on the strategic level, but implementation was more focused on the operational level. The involvement of upper management in the decision to implement lean was not translated in the inclusion of lean in organisational strategy or corporate documents, which influenced lean implementation. The lack of systems adaptability can be seen in the low number of lean techniques implement by the different sectors, with only CI/Kaizen and standardisation being implement by most organisations.

8.2.3 Performance Measurements Practices

Most New Zealand organisations did not adapt their PMSs to accommodate lean implementation and perceived that lean did not form an integral part of their PMSs. A variety of performance measures were implemented but not at sufficient levels to adequately measure the outcomes of the different lean techniques implemented by the organisations. This was applicable to all sectors.

The implementation of performance measures was also impacted by the CT factors. Most of the organisations did not include lean in their corporate documents, vision statements, and strategic aims. If lean is not included in the strategy, the organisation will not set objectives and goals linked to lean, and therefore will not require performance measures related to lean outcomes. Therefore, lack of a lean strategy can partly explain why the organisations do not adequately measure their lean implementation. The insufficient application of performance measures aimed at lean outcomes also indicates the lack of systems adaptability in most of the organisations. It was mostly organisations from the manufacturing sector and LGs that applied financial performance measures and mostly private organisations that that operating performance measures. Therefore, sector also partly drives the implementation of lean performance measures.

8.2.4 The Relationship between Lean and Performance Measurement Practices

Lean New Zealand organisations are still gravitating to traditional performance measurements, rather than focusing on the six lean performance measurements (LPDs) as proposed by Searcy (2004). The organisations do not rate all six LPDs as crucial for the successful implementation of lean but focus on the employee and operating LPDs.

There is a disconnect between the lean techniques implemented and the performance measures included in the PMSs. The disconnect can be explained by the CT factors. Most organisations did not included lean in organisational strategy or corporate documents which and even though the decision to implement lean was mostly made on the strategic level, implementation was mad on the operational level. This indicates that the participants still do not see lean as an organisation-wide philosophy or strategy which affects the identified CLSFs, and relevant lean performance dimensions applied to measure lean techniques. Furthermore, some organisations do not acknowledge that they implemented lean, which further explain the lack of adaption of the PMS. The organisations' systems seem to not be adaptable, as the organisations still gravitated to the traditional performance measures already present in the organisations rather than adapting the PMS to include lean performance measures. Sector is also a driving force in the relationship between lean and performance measures as reflected in the sectors implementing different lean KPIs at different uptake percentages.

8.2.5 Contingency Factors Driving the Relationship between Lean and Performance Measures

The contingency factors of sector, organisation size, strategy, systems adaptability, and organisational decision style influences the lean techniques implemented, the adaptation of the PMSs to measure lean outcomes, and the relationship between lean and performance measures. Organisations that are privately owned, SMEs, included lean as part of their organisation's strategic aims, and made the decision to implement lean on the strategic/management level, were more inclined to implement most of the lean techniques, adapt their PMSs to measure lean outcomes, and applied performance measures liked to the LPDs.

8.3 Implications of the Research Findings

The research findings have implications for practitioners, academics, and policymakers. The findings add to the literature on lean in a New Zealand setting. There is a large body of research on lean directly related to the evaluation process and applications of lean principles (Albzeirat et al., (2018), and also the dissemination of the knowledge on lean (Samuel et al., 2015) but, research in a New Zealand context is minimal (Deakins & Bensemann, 2018; Grigg et al., 2018; Wilson et al., 2018; Doevendans et al., 2015; Vilasini et al., 2014; Agarwal et al., 2013; Basnet et al., 2006; Dyer, 1998). With New Zealand being so different from the global market, this research provides New Zealand organisations with valuable insights and can assist them in growing their business and becoming more competitive, nationally, and internationally. This is valuable for the wholesale and retail sector and the public sectors of DHBs and LGs where limited research on lean implementation and performance measures have been conducted up to now.

This study provides information regarding the relationship between lean techniques implemented and performance measurement, by linking lean organisations' PMSs to the lean techniques implemented and to Searcy's LPDs. This research therefore provides managers at the strategic and operational levels of manufacturing companies, service companies, wholesale and retail companies, DHBs, and LGS, policymakers, and practitioners with valuable information. This research reiterates the importance of management commitment to lean implementation, including lean in organisational strategy, and implementing lean on both the strategic and operational levels of the organisation as being crucial for successful lean implementation.

This study also has implications for academics. Tertiary education institutes can enhance their curriculum with research-based data on the CLSFs required for lean implementation, and the appropriate lean PMS based on Searcy's LPDs associated with different lean techniques. This will provide students with contemporary skills that they can apply in practice.

Implications for policymakers relate to policymakers at managerial level of organisations and policymakers with the Ministry of Business and Innovation. Managers in organisations can construct organisational policy to ensure the correct implementation of lean techniques and ensure the correct and adequate measurement of lean outcomes. Policymakers with the Ministry of Business and Innovation can require organisations to include lean critical success factors, lean performance indicators, and the use of lean targets in the organisational corporate plans.

8.4 Contributions of the Study

This study makes contribution of new knowledge on several fronts.

This study contributes to the existing global literature on the implementation of lean and the performance measures related to lean by adding the context of New Zealand. This is a unique setting for two reasons. First, lean implementation was partly government directed, which is not the case globally. Second, New Zealand is atypical in that around 80% of organisations fall in the Small and Medium Enterprises (SMEs) category and research that addresses SMEs are scarce. This study therefore adds new knowledge on lean in a different setting.

Furthermore, the study included sectors not previously researched, namely wholesale and retail companies and LGs. There is also limited research on DHBs. Including DHBs and LGs in this study, not only provided the opportunity to increase research on the service sector, but also to compare the private and public sector, which has not been done before.

This research provides a timeline for the emergence of lean in New Zealand in manufacturing companies, service companies, wholesale and retail companies, DHBs, and LGs. In establishing the meanings, the organisations attributed to lean, it emerged that DHBs also include health and safety as a meaning of lean, which is not a global meaning of lean. Both the timeline of lean implementation and health and safety as a meaning of lean, are new knowledge.

This study contributes new knowledge on the implementation of lean techniques on two fronts. First, by establishing the lean techniques implemented by each of the sectors. Lean literature has indicated that organisations do not implement individual lean techniques, and therefore, secondly, the study contributes new knowledge by determining in what combinations the sectors implemented lean techniques.

Lean literature has not focused on the performance measures applied to measure the outcomes of lean, and therefore this research contributes new knowledge in three areas. First, by establishing if the organisations did adapt their PMSs to accommodate lean implementation, and second, by ascertaining which performance measures were applied for each specific lean technique implemented. Third, by determining the level of uptake of the performance measures for each sector.

A major contribution of this research is the relation of Searcy's LPDs to the adaptations organisations made to their PMSs. Current lean literature has successfully linked Searcy's LPDs to lean to replace the use of traditional performance measures in lean organisations, but this has not been examined fully in a New Zealand context. Accordingly, this research adds new knowledge by relating the performance measures the New Zealand sectors applied to measure the outcomes of the lean techniques, to each of the six LPDs.

Current lean literature noted that lean should be viewed as an organisation wide strategy (Bellisario & Pavlov, 2018; Bhasin & Burcher, 2006), and should be included in organisations' vision and mission, key success factors, organisational structure, strategies, and plans. This has not been completely researched in a New Zealand context, and therefore this study adds new knowledge by establishing the inclusion of lean in the organisational strategy and corporate documents of the organisations.

The use of CT to ground the findings of the study is also a major contribution of this research. CT has been an important approach to the study of the role of management accounting within organisations and has been used in several global lean studies, but, up to this point, has only been applied in one New Zealand study to ground their findings on lean studies. Furthermore, the majority of current New Zealand research has not been based on theory. Therefore, this research contributes new knowledge by grounding the findings in CT, and establishing CT factors that drive the relationship between lean and performance measurement.

Furthermore, from the CT perspective, this study adds research data to the contingency variables. First, by corroborating the research literatures proposal that sector is an important contingency factor that influences the nature of PMSs. Second, the study adds new knowledge by indicating that sectors previously not researched in terms of lean implementation and lean performance measurement. The sectors of privately owned organisations, publicly owned organisations, services companies, wholesale and retail companies, DHBs and LGs influence lean implementation, adaptation of the PMSs to measure lean outcomes, and the relationship between lean and performance measures. Third, the study adds new knowledge by adding a new dimension to the organisation size factor. The study indicates that SMEs, in a New Zealand context implemented lean, adapted their PMSs and applied LPDs in the PMSs differently than large organisations. Fourth, organisations decision style has been unexamined (Macy & Arunachalam, 1995) and accordingly this study adds new knowledge on this contingency factor in indicating that organisations that make the decision to implement lean on the strategic/management level, is more inclined to implement lean techniques, adapt their PMSs to measure lean outcomes, and apply the LPDs, their PMSs. Fifth, the research corroborates the research literature's proposal that strategy is an important factor that influences the PMS. Sixth, the research adds new knowledge on systems adaptability, by indicating that a lack of systems adaptability negatively influences the implementation of lean, the adaption of the PMSs to measure lean outcomes, and the linkage of the performance measures to the LPDs.

8.5 Limitations of the Study

The findings in this study must be seen in the light of some limitations.

During the interviews, it became known that some of the participants stopped using lean. The interviewees reported that they implemented lean to meet a specific goal, and as soon as that was met, they discontinued the use of lean, reverting to their previous operational activities. The survey did not include questions relating to this phenomenon. This topic was therefore not thoroughly investigated for all survey participants, but only for the interview participants. Future studies can attempt to fill this gap identified in this research.

This study is qualitative in nature and is reliant on self-reported data which has the characteristic of not being able to be independently verified. Future studies can attempt to overcome this limitation by collecting data through case studies.

Access to interviewees was limited. Some potential interviewees' work commitments meant they were unable to grant the researcher interviews.

Some limitations pertain to application of all the contingency factors, as identified by Macy and Arunachalam's (1995) contingency theory framework, in this research. Due to constrained access to participants' organisational data, it was not possible to scope every factor.

8.6 Future Research Opportunities

The first limitation identified in the previous section was the survey not collecting data relating to the phenomenon of participants ceasing the use of lean after a specific objective was met. This limitation can be overcome with future studies establishing whether this is a common thread in lean implementation in New Zealand. The reasons for the phenomenon can also be established and studies can attempt to indicate if this phenomenon is unique to New Zealand or comparable to global implementation.

Future studies relating to the relationship between lean and performance measurement can collect data with the use of case studies in place of surveys and single interviews. Case studies will allow the researcher to experience and observe the implementation and measurement of lean at the coalface of the participating operations. Case studies will also provide the opportunity to interview several employees in each participating organisation. This will improve the verification of self-reported data and enable the research to view the complete lean journey of participants.

This research study has identified the limited research on lean implementation in wholesale and retail organisations and LGs. This provides the opportunity for future research on these sectors to expand the research literature and to corroborate the findings of this study.

Another research opportunity is the possibility of developing a theoretical framework of how lean organisations can ensure that their organisations' PMSs can fully reflect Searcy's LPDs and the lean techniques they implemented. This framework can be tested for viability through case studies in lean organisations.

Accountability and sustainability were beyond the scope of this study, but recent studies have shown that lean techniques can assist organisations in their pursuit to be more accountable and sustainable. Linking lean and sustainability provides the opportunity for a wide range of research opportunities.

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Appendix 1: Survey

Introduction

This survey is for my PhD research titled, 'The Association between Lean and Performance Measurement in Service and Manufacturing Organisations in New Zealand.

The purpose of this research is to investigate the relationship between key lean performance dimensions organisations use to measure lean performance and their integration in the performance management system. Lean refers to business practices focused on continuous improvement through the reduction of waste and non-value-added activities, which leads to quality products or services that provide optimum value to customers.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Professor Craig Johnson, Director - Ethics, telephone 06 356 9099 ext. 85271, email humanethics@massey.ac.nz.

Please note: Your participation in this research project is completely voluntary. You may decline altogether or leave blank any questions you don't wish to answer. Your responses will remain confidential and anonymous. Data from this research will be kept under lock and key and reported only as a collective combined total. No one other than the researcher will know your individual answers to this questionnaire. I am happy to share the research results with participants if they so wish. You can indicate your preference at the end of this questionnaire.

Your input and support in completing this survey is greatly appreciated.

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Section A

This section seeks some background information on your organisation.

A1 In what year was your organisation established?

____

A2 In which sector does your organisation fall?

- ☐ Manufacturing
- ☐ Retailer
- ☐ Wholesaler
- ☐ Aviation
- ☐ Health
- ☐ Services (Please, specify)

____

- ☐ Other (Please, specify)

____

A3 What is the ownership profile of your organisation?

- ○ New Zealand
- ○ International
- ○ New Zealand and International

A4 Why did your organisation decide to implement lean?

____

A5
At what level of your organisation was the decision made to implement lean? Please, select all relevant options.

- [ ] Operational/production level
- [ ] Strategic/management level
- [ ] Other (Please, specify)

____

A6
At what level did your organisation implement lean? Please, select all relevant options.

- [ ] Operational/production level
- [ ] Strategic/management level
- [ ] Other (Please, specify)

____

A7 When did your organisation start implementing lean?

____

<u>Section B</u>

This section will ask questions relating to lean practices your organisation apply.

Lean refers to business practices focused on continuous improvement through the reduction of waste and non-value-added activities. These practices lead to quality products or services that provide optimum value to customers.

There are a variety of lean tools and techniques that organisations are known to apply as a part of lean practices.

B1
Listed below are some of the **general features of lean** commonly applied in organisations.

Please, tick all the features that are applied in your organisation.

- ☐ Reduction of resources
- ☐ Regular maintenance
- ☐ Identify and remove waste
- ☐ Map areas of the organisation that add value to identify waste
- ☐ Regular reports on value adding areas for control and management
- ☐ Standardising work by documenting best practices, instructions and procedures
- ☐ Create graphics (visualisations) of standards and processes
- ☐ Minimise errors
- ☐ Minimise breakdowns
- ☐ Minimise shutdowns
- ☐ Implement proven quality principles and techniques
- ☐ Achieve consistent improvements by employees on all levels
- ☐ Training of employees for skill development
- ☐ Other (Please, specify)

____

B2

Listed below are some of the **lean features commonly applied in manufacturing organisations.**

Please, tick all the features that are applied in your organisation.

- ☐ Remove waste in inventory (material) flow
- ☐ Reduce waiting time for inventory (material) from suppliers
- ☐ Deliver the correct amount of inventory (material) to production
- ☐ Timely delivery of inventory (material) to production
- ☐ Manage the flow of production by identifying and fixing bottlenecks
- ☐ Regular communication between the production and maintenance teams
- ☐ Ability to change/adapt machinery quickly to manufacture different products
- ☐ Minimise / eliminate discrepancies in final products
- ☐ Minimise / eliminate correcting of faulty products
- ☐ Minimise / eliminate scrap
- ☐ Other practices not listed before that you have applied to provide quality products ____
- ☐ Other practices not listed before that you have applied to provide optimum customer value ____

B3

Listed below are some of the **lean features commonly applied in service-related organisations.**

Please, tick all the features that are applied in your organisation.

- ☐ Base service design on customer needs
- ☐ Simplifying the service process
- ☐ Reduce over-processing
- ☐ Reduce waiting/idle time of customers
- ☐ Remove activities in the service process not adding value to customer
- ☐ Make full use of service capacity
- ☐ Reduce supplies
- ☐ Reduce time lost in transportation / movement of customers
- ☐ Reduce time lost in transportation / movement of supplies
- ☐ Other practices not listed before that you have applied to provide quality services ____
- ☐ Other practices not listed before that you applied to provide optimum customer value ____

B4

This question aims to determine knowledge regarding lean tools/techniques applied in organisations.

Listed below are some of the lean tools/techniques commonly used.

Please, indicate for each tool/technique whether, (i) you apply it in your organisation, or (ii) whether you have knowledge of the tool, but it is not applied, or (iii) whether you do not have knowledge of it.

	Apply this tool in you organisation.	Have knowledge of the tool, but not applied in your organisation.	Do not have knowledge of this tool.
Just-in-Time (JIT)	◯	◯	◯
Kanban	◯	◯	◯
Total Quality Management (TQM)	◯	◯	◯
Total Productive Maintenance (TPM)	◯	◯	◯
Continuous Improvement / Kaizen	◯	◯	◯
5S	◯	◯	◯
Value Stream Mapping	◯	◯	◯
Visual Management	◯	◯	◯
Standardising	◯	◯	◯
Single-Minute-Exchange of Die	◯	◯	◯
Poka-Yoke	◯	◯	◯
Six Sigma	◯	◯	◯
Lean Six Sigma	◯	◯	◯

Section C

This section will relate to lean performance measurement and how the lean key performance indicators (KPIs) are incorporated into your organisation's performance measurement system.

C1 Was your organisation's performance measurement system adapted to incorporate lean KPIs? Were new / or additional KPIs incorporated in the system to measure lean?

Please describe in a few sentences how the system was changed, and which measures were added.

____

____

____

C2 Does the current system adequately reflect the benefits from the application of lean practices? Please explain.

____

____

____

C3 **Lean performance dimensions are usually categorised under the following six labels listed below, with each having multiple lean KPIs: Financial Customer Operating performance Employee Safety Quality**
The following six questions relate to the key lean performance lean dimensions.

I have listed commonly used lean key performance indicators (KPIs) under each. Please, tick all KPIs your organisation applies. Add any KPI that is applied and is not listed. Some KPIs may be applicable in more than one LPD, please add them to the LPD if not listed.

C3a
This question relates to KPIs applied in the **Lean F**inancial Performance Dimension.

Please, tick all options that apply to your organisation.

If you use any other lean KPIs that can be categorised as 'financial related', which is not listed below, please add under 'Other'.

List overlapping KPIs.

- ☐ Return on Assets (ROA)
- ☐ Self-financing
- ☐ Value Stream Costing
- ☐ Other (Please, specify) ____________________
- ☐ Overlapping KPIs (Please, specify) ____________________

C3b

This question relates to KPIs applied in the **Lean Customer Performance Dimension.**

Please, tick all options that apply to your organisation.

If you use any other lean KPIs that can be categorised as 'customer related', which is not listed below, please add under 'Other'.

List overlapping KPIs.

- [ ] Customer niche market share
- [ ] Growth in customer market share
- [ ] Customer retention
- [ ] Customer profitability
- [ ] Customer satisfaction
- [ ] Customer value
- [ ] Customer demand
- [ ] Customer query response time
- [ ] Number of customer queries
- [ ] Customer query resolution time
- [ ] Other (Please, specify)

____

- [ ] Overlapping KPIs (Please, specify)

____

C3c
This question relates to KPIs applied in the **Lean Operating Performance Dimension.**

Please, tick all options that apply to your organisation.

If you use any other lean KPIs that can be categorised as 'operating performance', which is not listed below, please add under 'Other'.

List overlapping KPIs.

- ☐ Throughput time
- ☐ Inventory levels
- ☐ Value Stream Mapping
- ☐ Measuring product / service defects
- ☐ Measuring scrap
- ☐ Measuring breakdowns
- ☐ Measuring shutdowns
- ☐ Pull demand
- ☐ Push demand
- ☐ Use a dashboard
- ☐ Measure machine hours
- ☐ Other (Please, specify)

____

- ☐ Overlapping KPIs (Please, specify)

____

C3d
This question relates to KPIs used in the **Lean Employee Performance Dimension.**

Please, tick all options that apply to your organisation.

If you use any other lean KPIs that can be categorised as 'employee related', which is not listed below, please add under 'Other'.

List overlapping KPIs.

- ☐ Skill development / competency
- ☐ Cross trained ability of employees
- ☐ Employee participation in problem solving on operational level
- ☐ Employee participation in problem solving on strategic level
- ☐ Employee quality performance
- ☐ Employee job satisfaction
- ☐ Employee team building
- ☐ Employee punctuality
- ☐ Employee response time to queries
- ☐ Other (Please, specify)

____

- ☐ Overlapping KPIs (Please, specify)

____

C3e

This question relates to KPIs used in the **Lean Safety Related Performance Dimension.**

Please, tick all options that apply to your organisation.

If you use any other lean KPIs that can be categorised as 'safety related', which is not listed below, please add under 'Other'.

List overlapping KPIs.

- ☐ Unsafe practices and procedures identified
- ☐ Use of safety management scorecards
- ☐ Active safety vision present and applied
- ☐ Monitor if employees are following safe work practices
- ☐ Health and safety practices drills
- ☐ Safety workshops
- ☐ Safe work environment
- ☐ Workplace safety policy
- ☐ Use a dashboard
- ☐ Measure machine hours
- ☐ Other (Please, specify)

____

- ☐ Overlapping KPIs (Please, specify)

____

C3f
This question relates to KPIs used in the **Lean Quality Related Performance Dimension.**

Please, tick all options that apply to your organisation.

If you use any other lean KPIs that can be categorised as 'quality related', which is not listed below, please add under 'Other'.

List overlapping KPIs.

- ☐ Best practice procedures
- ☐ Measure and evaluate whether products or service adhere to customers' specifications and requirements
- ☐ Measure and evaluate customer satisfaction
- ☐ Measures to control and improve processes
- ☐ Procedures in place to quantify quality processes
- ☐ Measure percentage defects in products or services
- ☐ Measure reworks
- ☐ Measure customer returns
- ☐ Product/Service features specific to pre-order purposes
- ☐ Other (Please, specify)

____

- ☐ Overlapping KPIs (Please, specify)

____

C3g

Lean performance measures can limit the implementation of lean techniques or reinforce the implementation of lean techniques.

For each of the listed lean attributes, list the performance measures that affect lean attributes indicating:

i) whether the effect is reinforcing or limiting lean performance.
ii) whether the lean attribute increased or decreased.
iii) if the attribute is not applicable to your organisation.

	Reinforcing	Limiting	Increase	Decrease	Not applicable
Reducing waste / scrap	☐	☐	☐	☐	☐
Improving efficiency	☐	☐	☐	☐	☐
Improving employee relationship	☐	☐	☐	☐	☐
Diversity in products/services delivered	☐	☐	☐	☐	☐
Pursuing a cost leadership strategy	☐	☐	☐	☐	☐
Employee empowerment	☐	☐	☐	☐	☐
Increased productivity	☐	☐	☐	☐	☐
Other (Please, specify)	☐	☐	☐	☐	☐
Other (Please, specify)	☐	☐	☐	☐	☐
Other (Please, specify)	☐	☐	☐	☐	☐

Section D

This section relates to your organisation's strategy and corporate documents.

D1 Do your organisation's managers view lean as part of their organisational strategic aims? If so, please explain how? If not, please explain why not.

____

____

____

D2 Is the implementation of lean included in your organisation's corporate documents? If so, please explain or indicate 'No'.

____

____

____

D3 Are there any lean philosophy incorporated in your organisation's vision statement? If so, please explain or indicate 'No'.

____

____

____

D4 Do lean KPIs form an integral part of your performance measurement system? If so, please explain how. If not, please explain why not.

____

____

____

D5 Are the lean principles and tools used by your organisation readily acceptable by stakeholders? Please, explain.

____

____

D6 Please list the critical lean success factors from a management perspective.

____

____

____

<u>Section E</u>

Thank you for your willingness to complete this survey.

Your participation is appreciated.

If you would like to be informed about the results of this study, please provide your email address below.

____

Appendix 2: Semi-structured Interview Questions

- Questions 1 to 9, and 15 to 17 was asked of every interviewee.
- Question 10 to 14 was specifically tailored to relevant interviewees.

1. Before we start, are there any questions you want to ask me first?

2. Can you please elaborate a bit on how you first became involved with lean?

3. Please discuss why you chose the specific lean techniques you implemented? What objectives did you try to meet?

4. Any other factors influencing your decision?

5. How do you measure performance in your business in general?

6. How do you measure the effect of the lean techniques you implemented?

7. Are these measures you specifically starting using after implementing the lean?

8. Do you think that the performance measures are effectively driving lean?

9. Would you say measuring the performance of lean is important or not important. Can you explain why you say that?

10. In your survey you stated that you did not relate lean to your financial KPIs, can you please elaborate why not?

11. You noted that you use visual management, can you please explain what that entails in your business?

12. You noted that you did not use value stream mapping? Can you please explain why not.

13. You included health and safety as critical for the success of lean. Can you please explain a bit more why. What does this include? For patients, staff, whole organisation?

14. When you first implemented lean, did you make a reference to it on your website or annual reports? Do you still do?

15. Are there any lean measure or tools that you have not mentioned before that you would like to discuss?

16. Are there any aspects of your performance measurement you would like to discuss that we have not talked about yet?

17. Anything else regarding lean you would like to add?