

Development of a lean leadership maturity model

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“Assume nothing, question everything”

- James Patterson

ABSTRACT

The lean philosophy is often utilised to improve business performance. However, the success rate of lean implementation remains low as organisations fail to recognise the crucial role that leadership plays in this continuous improvement initiative. Furthermore, following an SLR of the selected databases, no artefact or model was found that is dedicated to assessing the lean leadership maturity of an organisation. This study, therefore, designed a lean leadership maturity model (LLMM) that can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders. The purpose of the LLMM is for organisations to assess their current lean leadership maturity in order to determine the status quo and the starting point of development. A top-down model design approach was followed within the DSR paradigm.

In Phase 1, the problem was explicated where after the design requirements for an LLMM were formulated in the first part of Phase 2. This was followed by a systematic literature review (SLR) to search for any existing models within the domain of lean leadership or similar domain, forming the second part of Phase 2. No existing models were identified, and subsequently, in the first part of Phase 3, a lean leadership reference model (LLRM) was developed through a systematic literature review and applied thematic analysis (ATA). This, along with the design requirements, served as the input to the second part of Phase 3, where the lean leadership maturity model was finally designed. In the 4th and final phase, it was empirically verified that all the design requirements were met and that the research problem, -method and -output was valid. A questionnaire was prepared and an explanation of the model was presented in the form of a video that was sent to a panel of experts via email. Using the Delphi technique, consensus was achieved on all questions, verifying and validating the LLMM.

The LLMM consists of 4 dimensions and 11 subdimensions, each containing respective capability areas. These capability areas are measured along five cumulative maturity levels. Furthermore, each of the capability areas comprises of a set of capability statements which serve as a criteria or descriptor of a capability area as it applies to a specific maturity level, the highest of which is referred to as an ideal statement.

This study provides a new solution to a known problem and could contribute towards more successful lean implementation by addressing the need for an artefact that can assess the lean leadership maturity of organisations throughout the lean journey.

Keywords:

Lean manufacturing, Lean leadership, Lean management, Maturity model, Design science research, Systematic literature review, Applied thematic analysis, Delphi technique

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"So, whether you eat or drink or whatever you do, do it all for the glory of God."

1 Corinthians 10:31

LIST OF ACRONYMS

- (i) MM – Maturity model
- (ii) RQ – Research question
- (iii) RO – Research objective
- (iv) LLMM – Lean Leadership Maturity Model
- (v) DR – Design requirement
- (vi) DSR – Design science research
- (vii) TPS – Toyota production system
- (viii) CSF – Critical success factor
- (ix) QMMG – Quality management maturity grid
- (x) CMM – Capability maturity model
- (xi) LL – Lean leadership
- (xii) SEI - Software Engineering Institute
- (xiii) SLR – Systematic literature review
- (xiv) ATA – Applied thematic analysis
- (xv) EDS – Electronic database source
- (xvi) I/E – Inclusion/Exclusion
- (xvii) CI – Continuous improvement
- (xviii) LLRM – Lean leadership reference model
- (xix) LSW – Leader standard work
- (xx) LSO – Lean steering and oversight
- (xxi) PR&A – Project, resource and accountability
- (xxii) PD – Policy deployment

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CHAPTER 1: STUDY INTRODUCTION

In Chapter 1, the background and research problem that enabled this study is explicated. In addition, the aim of the study, along with the research questions and study objectives are also outlined.

1.1 Background

To remain competitive in today's challenging business environment, organisations are forced to continuously increase all aspects of their performance, driving down costs while remaining flexible enough to adapt to the ever-changing demands of customers. This constant pressure on business performance compels organisations to pursue and adopt a multitude of performance improvement methodologies (Ashtiani, et al., 2017).

One of the most reputable of these methodologies, namely *lean manufacturing*, or simply, *lean*, has been emulated by organisations globally due to the recognised benefits of improved lead times, productivity, quality, cost and delivery it offers (Hines, et al., 2004; Liker, 2004; James, et al., 1990; Mann, 2005). Lean's origins can be found in the process improvement tactics developed by the Automotive pioneer, Henry Ford (Womack & Jones, 1996), which was later adopted and refined by the Toyota Motor Company and resulted in the well-known *Toyota Production System*, simply referred to as *TPS* (Aij & Teunissen, 2017). The TPS is considered as the foundation of Lean (Lander & Liker, 2007; Coetzee, et al., 2018)

When implemented correctly, lean has the potential of positioning a company to achieve immense growth (Sisson & Elshennawy, 2015). Simply defined, lean is a management philosophy that focuses on improving the overall customer value by reducing different types of process wastes in operations and, over the years, has evolved into a continuous improvement philosophy that influences every aspect of the business system (Ashtiani, 2016).

An attractive feature of lean is that many of its principles and techniques are relatively easy to understand. Value stream maps, customer focus, one-piece flow, poka-yokes, standardised work and 5S are all relatively straightforward and readily grasped (Mann, 2005; Rathilall & Singh, 2018; Oliveira, et al., 2017). Furthermore, lean is usually not capital-intensive, requiring mostly inexpensive equipment and systems while its layouts and material flows are also relatively simple to design and implement (Mann, 2005; van Dun, et al., 2017).

However, Mann (2009) highlights that the implementation of these lean tools, although easily understood, only represents around 20% of the lean transformation effort and that the remaining 80% of the effort is expended on changing leadership's mindsets, practices and

behaviours. That is because, at its core, lean is a culture, a set of complex organisational attitudes rather than the use of tools (Mann, 2009; Wangwacharakul, et al., 2014; Walentynowicz, 2014; Urban, 2015).

Furthermore, another growing body of knowledge argues that the sustainability of a lean transformation largely depends on the system-wide change in organisational culture and the collective commitment to this change – questioning leadership's role in the change (Azuan & Ahmad, 2017; Aij & Teunissen, 2017; Mann, 2009; Liker & Convis, 2012; Jenkins, et al., 2011; AL-Najem, et al., 2012; Mann, 2005). This collective commitment not only means the adoption of new processes, but also new workforce competencies and cultural expectations (Jenkins, et al., 2011).

Lean, therefore, changes both technical and sociocultural aspects of an organisation, which produces expectations regarding leadership's capabilities to catalyse and sustain the changes demanded by the transformation (Aij & Teunissen, 2017; Tortorella, et al., 2017). This is also evident in the literature, where publications on the critical success factors or barriers of lean have singled out leadership as the pivotal factor that determines the success or failure of any lean transformation (Leite, et al., 2016; Kumar & Kumar, 2014; Netland, 2016; Sundareshan, et al., 2015; Fryer, et al., 2007; Laureani & Antony, 2012; Kundu & Manohar, 2012).

Leite, et al. (2016) highlighted that the cultural barriers of lean implementation include *a lack of leadership team involvement, a lack of employee development and poor managerial styles* while enablers such as *top management support, leadership empowerment of workforce and management buy-in* were presented. Similarly, according to Netland (2016), *management's commitment and involvement* in the lean implementation is crucial for its success, ranking *lead actively* and *educate employees* as some of the top success factors of lean. Moreover, Sundareshan, et al. (2015) concluded that *management involvement* is the most-cited barrier to lean implementation from a review of numerous studies. Similar findings were presented by Fryer, et al. (2007), who indicated that for mixed-, manufacturing-, service- and public sectors, *management commitment* is the most common success factor identified in the literature.

Considering the large body of literature available on the topic of lean implementation barriers and enablers, the success of lean relies on several complex and dynamic factors. However, one prominent factor present in every study is that of *leadership* or *management*. Whether strong leadership has been identified as an enabler or poor leadership as a barrier, there is consensus that leadership plays a crucial role in lean's sustainability.

1.2 Problem Statement

Lean is a well-established continuous improvement methodology that has the potential to enhance all aspects of business performance.

However, the success rate of lean implementation is highly dependable on the lean leadership capabilities of an organisation and, therefore, the lack of mature lean leadership creates a barrier to successful lean implementation.

1.3 Research opportunity

A gap has been identified for an artefact that is dedicated to describing and assessing the maturity of lean leadership within an organisation, which could contribute towards more successful lean implementation.

One way of assessing the lean leadership capabilities within an organisation is with maturity models. Simply put, maturity models can be described as a set of characteristics, attributes, indicators or patterns that represent progression and achievement within a specific domain or discipline (Caralli, et al., 2012). They aim to assess and benchmark the maturity (i.e. competencies or capabilities) of a specific domain based on a comprehensive set of criteria (De Bruin, et al., 2005). This implies that maturity models can be used to assess the capability of leadership within the context of lean organisations.

1.4 Research aim and objectives

1.4.1 Research aim

This study aims to develop a lean leadership maturity model (LLMM) that can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders. Also, the purpose of the LLMM is for organisations to assess their current lean leadership maturity to determine the status quo and the starting point of development.

1.4.2 Research objectives

The research aim will be realised through the following objectives:

1. Explore the concept of **lean leadership** and clarify the core factors that sustain it;
2. Explore the concepts behind **maturity models** and outline the **methods** relevant to the study;
3. Define the **design requirements** for a lean leadership maturity model;

4. **Search** for an existing maturity model devoted to the domain (of lean leadership) or similar domains;
5. If such a model exists, conduct a **gap analysis** of design requirements against the identified model(s);
6. If no existing models are identified, **develop** a new LLMM;
7. **Verify** whether the LLMM addresses all the design requirements;
8. **Validate** the research problem, research design and output.

1.4.3 Research questions

The research aim and objectives raise various research questions that have to be answered. Table 1 provides the research objectives, the corresponding research questions that assist in achieving the objectives and the chapter number in which it is addressed.

Table 1: Research objectives and respective research questions

Research Objectives	Research Questions	Chapter
1. Explore the concept of lean leadership and clarify the core factors that sustain it.	1.1 What are the characterisations and theories of lean and lean leadership?	Chapter 2
2. Explore the concepts behind maturity models and outline the methods relevant to the study.	2.1 What are the characterisations and theories of maturity models? 2.2 What are the different development approaches relevant to maturity models? 2.3 What research methods are relevant to this study?	Chapter 2
3. Define the design requirements for an LLMM.	3.1 What design requirements should the LLMM satisfy to describe and assess lean leadership maturity within an organisation?	Chapter 4
4. Search for an existing maturity model devoted to the domain or similar domains.	4.1 What artefacts or models exist that are dedicated to assessing lean leadership?	Chapter 5
5. If such a model exists, conduct a gap analysis of design requirements against the identified model(s).	5.1 Does an artefact or model exist that can satisfy all the design requirements?	Chapter 5
6. If no existing models are identified, develop a new LLMM.	6.1 What are the themes applicable to lean leadership? 6.2 What does a reference model for lean leadership look like? 6.3 What model design will address all the design requirements?	Chapter 6 & 7
7. Verify whether the LLMM addresses all the design requirements.	7.1 Does the LLMM address all the design requirements?	Chapter 9

8. Validate the research problem, research design and output	8.1 Is the research problem valid? 8.2 Is the research design that was followed valid? 8.3 Is the research problem addressed by the research output?	Chapter 10
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1.5 Limitations and further research

In this study, a LLMM is developed that consists of 4 dimensions, 11 subdimensions, 43 capability areas and 215 capability statements. Combined, these components explain the different phases that leadership should progress through while maturing as lean leaders and enable organisations to assess their current lean leadership maturity. These components were all theoretically derived and empirically verified and validated by a panel of experts on lean leadership. Nevertheless, some limitations do apply to this study and should be prioritised in future research:

1. The LLMM should ideally be applied to a large sample group over an extended period while noting the applicability of each lean leadership capability towards the entity under consideration. This includes the LLMM's applicability to various demographic areas (such as countries and cultures).
2. The constructs used to define maturity, maturation and the application domain are limited by the availability of theoretical research at the time of the study. Each of these should each be empirically evaluated and revised iteratively to maintain the LLMM's reliability, generalisability and growth.
3. The LLMM does not include the roles of different hierarchical levels of leadership within an organisation. Levels such as *strategic*, *programmatic* and *tactical* can be incorporated as a third dimension in future applications of the LLMM to ensure relevance is maintained. In addition, perhaps a specific leadership style such as *transactional* and *transformational* could also be included for future model development.
4. Using a *descriptive* approach, the LLMM is developed as a diagnostic tool to assess the "as-is" lean leadership maturity within organisations. After several applications and testing of the model, it could be developed for *prescriptive* use (De Bruin, et al., 2005). Once applied in a diverse group of industries or regions and sufficient data has been collected from large sample groups, the LLMM can finally be developed into a *comparative* model (De Bruin, et al., 2005).
5. The LLMM does not include a comprehensive assessment instrument or methodology and could be developed to support future applications and ensure more accurate measurements or interpretations or maturity.

6. The review protocol used in both systematic literature reviews in this study only focuses on peer-reviewed, scholarly publications as sources. In future, grey literature could also be included in the search criteria to potentially expand the theoretical foundation of the LLMM – with the condition that a strict quality assessment protocol should be applied.

1.6 Conclusion

This chapter explained the study rationale and research opportunity. The research aim and each of the respective objectives and research questions were presented in Table 1. Finally, the limitations and future research applicable to this study are presented.

In Chapter 2, a comprehensive literature review on the concepts, definitions and paradigms relevant to the study is provided where after the research design (Chapter 3) used to achieve the aim of this study is discussed.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The objective of this chapter is to explore the characterisations, theories and approaches relevant to this study through a comprehensive literature review on the two primary subject matters, namely *lean leadership* and *maturity models*.

Section 2.2 discusses the various definitions and the principles of lean before presenting lean leadership as a critical success factor of lean implementation. This is followed by a discussion to clarify the interchangeable use of *leadership* and *management* in this study where after the literature focuses on the concepts or theories relevant to lean leadership.

Section 2.3 is dedicated to literature on maturity models, providing a background to their origin and the concept of maturity. The structural components of maturity models, different types of maturity models and approaches relevant to their development are discussed.

Section 2.4 provides an overview of the research methodologies utilised for the model development in this study.

This chapter's position relative to the overall research design is indicated in the top-middle section of Figure 1. The transparent blue blocks indicate the sections of the research design that are still to be explored.

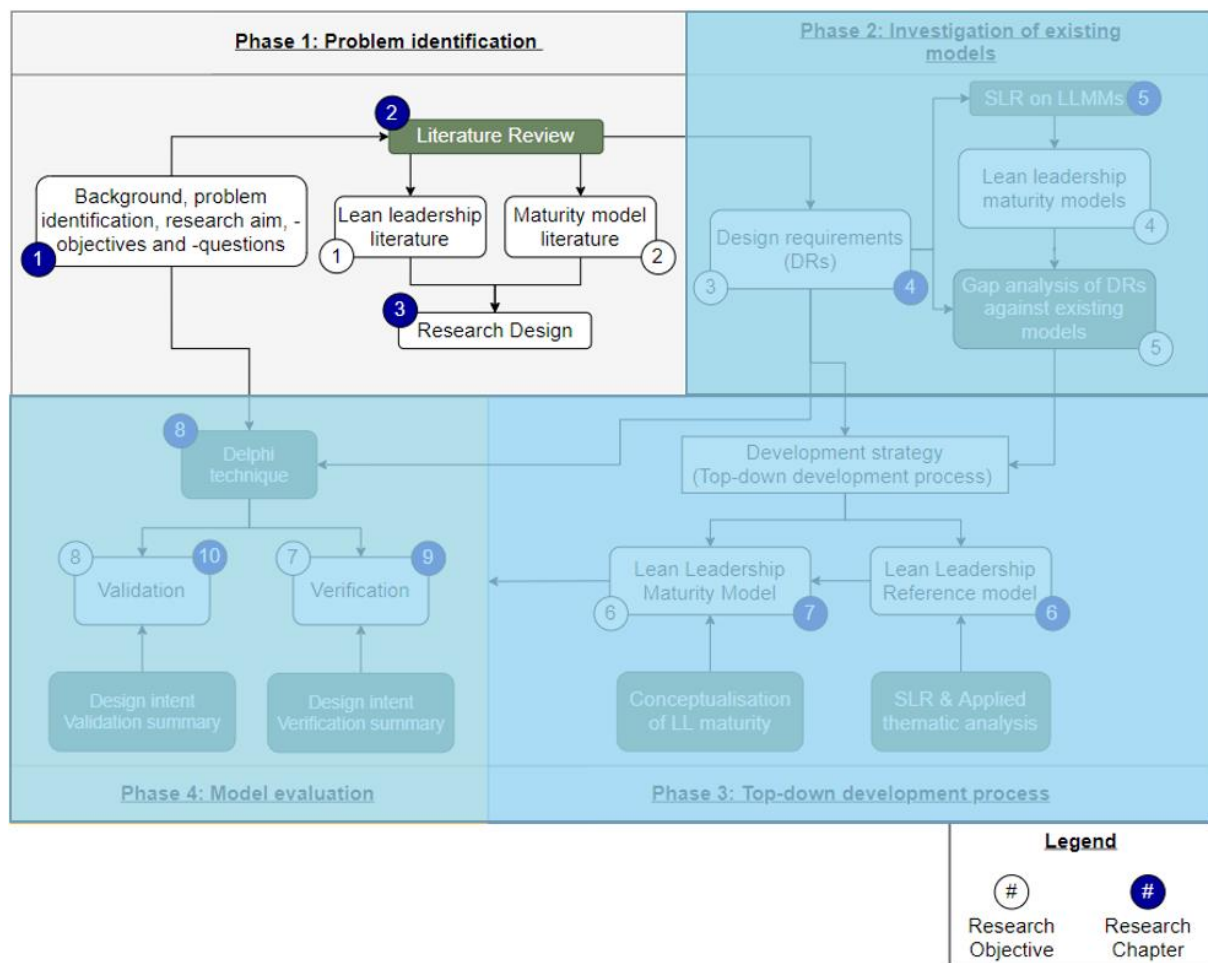


Figure 1: Section of the research design relevant to Phase 1

Furthermore, an overview of the research method, -objectives and -questions applicable to this part of the research is presented in Table 2:

Table 2: Overview of research methods, -objectives and -questions applicable to Phase 1

Phase 1: Problem identification	
Research Method	Literature review.
Research Objectives	1. Explore the concept of lean leadership and clarify the core factors that sustain it. 2. Explore the concepts behind maturity models and outline the methods relevant to the study.
Research Questions	1.1 What are the characterisations and theories of lean and lean leadership? 2.1 What are the characterisations and theories of maturity models? 2.2 What are the different development approaches relevant to maturity models? 2.3 What research methods are relevant to this study?

2.2 The lean leadership philosophy

The characterisations and theories relevant to lean leadership are explained in the following section.

2.2.1 Definitions of lean

A *paradigm*, as popularised by Thomas Kuhn in the 1960's, refers to a "dominant way of thinking and doing things, shared expectations and rules" and is "an excellent example, a model to which others inspire" (Bird, 2002, p.5). To successfully understand the lean paradigm and the underlying principles that sustain it, various definitions will be explored in this section.

Until recently, there continues to remain uncertainty as to a clear definition of lean and which characteristics should be associated with the concept. It is also argued that the lack of a universally accepted definition may contribute to the underdevelopment of the lean concept. Also, confusion surrounding the real meaning of lean has resulted in many failed implementation attempts as companies who apply only the tools of lean without embracing the underlying philosophy (such as lean leadership) will not gain anything more than temporary and limited results (Seddon & Caulkin, 2007).

Initially, the tools and practices were confused with the lean system itself as the focus was mainly on the visible features of lean such as 5S, Kanban, Total Productive Maintenance (TPM), process mapping and single minute exchange of dies (SMED) (Coetzee, et al., 2018). There were also difficulties regarding the transfer of certain practices and tools as lean evolved from the manufacturing industry to other areas such as the service industry (Holm, 2010).

According to the International Labour Organization (2017, p.19) *lean* is described as "the part of the meat that consists mainly of lean muscle (fat-free)".

This then raises the question;

"What describes the "fat" in a non-lean setting?"

Taiichi Ohno, who is considered to be the founding father of the Toyota Production System (TPS) (Coetzee, et al., 2018), identified this fat as *waste* in the manufacturing system and it is argued that companies that exhibit characteristics of a lean enterprise are those that can eliminate this fat, or *waste* (Hallam, 2003). The lean paradigm differentiates between what is *waste* and what is *value* within an organisation (Stone, 2012). This *waste* is defined by Womack with Jones (1996) as "any human activity which absorbs resources but creates no value". *Value*, then, is defined as "a capability provided to a customer at the right time at an appropriate price, as defined in each case by the customer" (Womack with Jones, 1996).

In their book, *The Machine that Changed the World*, Womack, et al. (1990) define lean based on its outcomes as compared with the mass production system. Lean is said to use less of

everything – “half the production space, half the human effort, half the investment tools and engineering hours to develop a new product, in half the time”.

Six years later, in the publication of the book *Lean Thinking*, lean is again defined as a system that utilises less, this time in terms of all its inputs, to create the same outputs as compared to the traditional mass manufacturers while enabling the producer to contribute increased varieties to the customer (Womack & Jones, 1996). In this definition, the authors again compare lean to the traditional mass production system, but this time highlights the flexibility of lean in providing the end customer with increased varieties. It is clear that these early definitions of lean pointed to a *flexible system* that utilises *less* by doing *more*, but it does not help one understand the specific meaning of lean as these definitions are generic and broad.

Hallam (2003) argues that the proper delineation of lean should actually contain three terms, one which describes the end state, one where the process to achieve the end state is described and one where the tools used to execute the process are described. Hallam (2003) further explains that this *state* of the manufacturer is created through the underlying principles and practices of the TPS.

In a paper published by the *Framework of the Lean Advancement Initiative* by the *Massachusetts Institute of Technology*, lean is defined in terms of the organisational change required, where emphasis is placed on the focus-shift from the *practices* to the *people* (Joe, et al., 2000). Here, lean is described not only as a set of practices commonly found on the shop floor, but rather as a fundamental change in the way people within the organisation think and what they value, ultimately transforming how they behave (Joe, et al., 2000).

This definition leads one to consider that the application of the lean paradigm is not merely just a set of practices, but rather demands a *fundamental change* in organisational culture and the way people think. Alves, et al. (2012) support this statement by explaining that, in a lean environment, the people have adopted the role of thinkers where their involvement promotes continuous improvement and gives organisations the necessary agility to meet market demands and environment changes.

Exploring further definitions, Shah with Ward (2007) points out that the scope of lean extends beyond the internal organisation to the entire supply chain network, being a management philosophy that focuses on identifying and eliminating waste throughout a product's entire value stream, extending both internally and externally along its entire supply chain network.

Ultimately, the lean paradigm is characterised by the continuous identification and elimination of waste throughout the value stream of an organisation (Stone, 2012; Duque & Cadavid,

2007). It is, however, clear that the understanding of lean is subject to interpretive viability, meaning different things to different people at different moments in time (Samuel, et al., 2015).

Next, with the various descriptions of lean in mind, the principles of lean will be briefly discussed.

2.2.2 Lean principles

As outlined in the previous section, the two basic concepts of the lean paradigm are to eliminate waste and create value. Though a great deal of uncertainty exists over its official definition, the debate, however, does not extend to its principles.

According to Womack with Jones (1996), lean is supported by the following five principles:

1. **Specify value from the end-customer's perspective:** As the starting point for lean thinking, this principle focuses on understanding what the customer defines as *value* in terms of the specific product or service. The seven main types of waste include overproduction, defects, inventory, transportation, waiting, motion and over-processing (Womack, et al., 1990; Womack & Jones, 1996).
2. **Identify the value stream:** Once it is understood exactly what the customer wants, the next step would be to identify the *value stream* for each product, or product families, and how value is (or is not) being delivered to them.
3. **Flow:** Once the previous two principles have been addressed, the next step would be to establish *flow* for the remaining value-added activities.
4. **Pull:** Customers can *pull* work through the system rather than being *pushed* at the convenience of operation.
5. **Pursue perfection:** This principle is based on the conviction that pursuing lean is a never-ending process, as the wasteful activities will always exist along the value stream and the complete elimination of these wastes is a continuous process.

2.2.3 Toyota Culture

When discussing lean principles, it is imperative to acknowledge Liker's (2004) work on the Toyota culture in his book, *The Toyota Way*. Liker (2004) emphasises Toyota's active focus on developing leaders throughout its internal organisation and a culture that represented the five principles of lean daily. Liker's (2004) principles, although not explicitly opposing those of Womack with Jones' (1996), do move lean's focus from tools, structures and techniques towards matters concerning leadership development, employee empowerment and organisational learning.

Liker (2004) explains that Toyota's actual culture is a lean culture and that the essence of continuous improvement and respect for the people are built into its DNA. Based on this argument, Liker (2004), developed the 14 management principles of the Toyota Way, grouping them in a 4P model, namely *Philosophy, Process, People (and Partners) and Problem-solving*. Even though Liker (2004) acknowledges that the 14 principles and 4Ps are specific to Toyota's culture, he does argue that they apply to any lean organisation. These 14 management principles and how they relate to the 4P model are presented in Figure 2:

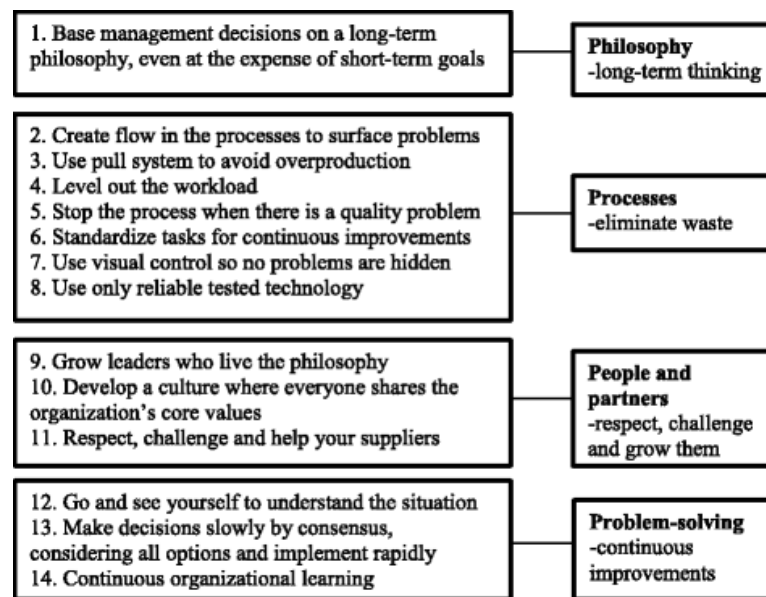


Figure 2: The 14 management principles of the Toyota way (Liker 2004)

Studies later conducted by Bhasin (2013); Leyer & Moorman (2014); Bortolotti et al., (2015), set out to investigate whether these 14 principles of the Toyota Production System only applied to Toyota, or if they could be adopted by all lean organisations, with four mutual findings being obtained:

1. It was determined that operational performance and success is the result of the collective actions of the people at the frontlines;
2. Performance can be improved through employee development;
3. Leadership's primary role is mentorship, not control;
4. For lean to be sustainable, it requires a long-term commitment from the organisation's leadership.

From these four points, it is evident that people, rather than tools, play an important role in the creation of value within and organisation. The first point focuses on the long-term role of frontline employees within a lean organisation, while the other three emphasise the role of

leadership within a lean organisation. This connection between *lean* and *leadership* will be explored in the following sections.

2.2.4 Lean leadership as a critical success factor of lean implementation

Despite the popularity of lean, very few organisations have managed to sustain the improvements it offers in the long run (Coetzee, et al., 2016). This high failure rate, contrasted by noteworthy success stories, has inspired numerous studies aiming to establish the enablers and barriers to lean implementation, with *leadership* or *management* consistently being cited in the literature, regardless of the industry applicable (Leite, et al., 2016; Kumar & Kumar, 2014; Netland, 2016; Sundareshan, et al., 2015; Fryer, et al., 2007; Laureani & Antony, 2012; Kundu & Manohar, 2012).

Leite, et al. (2016) presents a classification model based on an extensive literature review of 115 papers on the barriers and enablers of lean. They divided these factors into seven organisational elements, with a specific focus on cultural and technical factors. For the technical aspects, organisational elements such as processes, technology & tools, training and resources were identified. Strategy alignment, leadership and behaviour & engagement were identified as organisational elements for the cultural aspects. Their findings on the barriers and enablers related to each of these elements are outlined in Table 3:

Table 3: Barriers and enablers related to organisational elements of lean (Leite, et al., 2016)

	Organizational Elements	Barriers	Enablers
Technical Aspects	Processes	Demand uncertainty Supply chain characteristics Weak supplier performance	Infrastructural elements Managing demand and capacity levels Continuous improvement
	Technology and Tools	Lack of lean experience Lean terminology Lack of consultants in the field	Visual information management system Measures and measurement systems Process investigation VSM
	Training	Lack of lean understanding Lack of people development Insufficient workforce implementation skills	Training culture Personnel training and involvement in lean principles and methods Understanding of lean tools
	Resources	Lack of human resources Lack of people development Lack of time	Dedicates full time resources for lean Availability of resources Resources and capabilities
Cultural Aspects	Strategy and Alignment	Poor communication Lack of strategy perspective Lean viewed as a Fad	Clear communication Clarity of vision Involvement of all parties (ownership)
	Leadership	Lack of leadership team involvement Lack of employee empowerment Managerial style	Top management support Leadership empowering the workforce Management commitment (buy-in)
	Behaviour and Engagement	Lack of engagement Resistance to change Organisational culture and structure	A culture that creates people involvement Improvement culture Employee commitment (buy-in)

Kumar with Kumar (2014) conducted a survey of 163 companies from various Indian industries to determine the barriers in lean implementation. They've ranked their results from the lowest impact to highest as indicated in Figure 3:

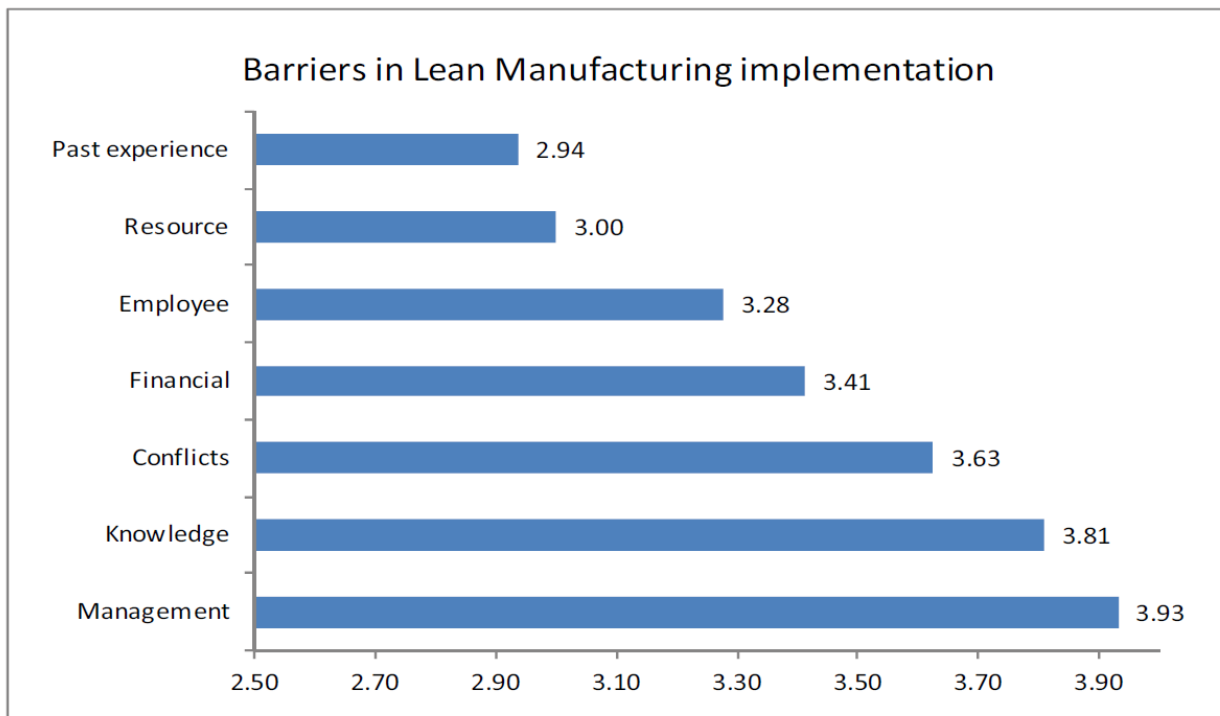


Figure 3: Barriers in lean manufacturing implementation (Kumar & Kumar, 2014)

From this data, it is evident that *management* is perceived to play the most important role in the implementation of lean since, according to the authors, managers are responsible for the implementation of major transformations such as lean.

Similarly, Netland (2016) conducted a survey of 432 practitioners from 83 factories to investigate the influence of contingency variables on practitioners' perceptions of lean success factors. His analysis supports a generic list of critical success factors. A final set of 24 factors were identified and ranked according to as indicated in Table 4:

Table 4: Lean success factors (Netland, 2016)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Rank	Success factor	Total #	Total %	Corporation			Factory size			Chi test size	Lean maturity stage			Chi test stage	National culture		
				Firm C	Firm V	Chi test corp.	SME	Large	Huge		Low	Inter.	High		Indiv.	Coll.	Chi test culture
1	Lead actively	160	15.8 %	12 %	17 %	0.06	14 %	19 %	15 %	0.23	14 %	15 %	18 %	0.32	16 %	15 %	0.52
2	Participate personally	91	9.0 %	6 %	10 %	0.07	7 %	10 %	11 %	0.15	5 %	10 %	13 %	0.01**	10 %	8 %	0.26
3	Educate employees	78	7.7 %	10 %	7 %	0.05*	9 %	5 %	8 %	0.14	10 %	6 %	7 %	0.22	7 %	9 %	0.15
4	Educate managers	68	6.7 %	4 %	8 %	0.03**	5 %	6 %	10 %	0.03*	5 %	8 %	7 %	0.39	8 %	5 %	0.07
5	Communicate, inform and discuss	64	6.3 %	6 %	7 %	0.61	6 %	8 %	5 %	0.38	7 %	7 %	5 %	0.43	6 %	6 %	0.88
6	Set and follow-up targets	63	6.2 %	7 %	6 %	0.69	7 %	7 %	4 %	0.41	7 %	5 %	6 %	0.78	6 %	6 %	0.96
7	Involve and support employees	56	5.5 %	4 %	6 %	0.31	5 %	6 %	5 %	0.79	3 %	6 %	8 %	0.07	6 %	5 %	0.75
8	Dedicate human resources	55	5.4 %	7 %	5 %	0.16	6 %	6 %	3 %	0.23	7 %	5 %	3 %	0.09	5 %	6 %	0.73
9	Use lean tools and methods	51	5.0 %	7 %	4 %	0.07	6 %	3 %	7 %	0.08	4 %	5 %	6 %	0.73	5 %	5 %	0.57
10	Integrate lean in everyday business	50	4.9 %	3 %	6 %	0.14	5 %	4 %	6 %	0.78	4 %	6 %	6 %	0.37	6 %	4 %	0.11
11	Develop vision and roadmap	37	3.6 %	3 %	4 %	0.75	3 %	5 %	4 %	0.31	4 %	3 %	4 %	0.73	4 %	3 %	0.51
12	Use rewards and recognition	36	3.5 %	6 %	3 %	0.01**	5 %	2 %	3 %	0.11	7 %	3 %	1 %	0.00**	2 %	5 %	0.01*
13	Monitor and audit implementation	32	3.2 %	3 %	3 %	0.58	3 %	2 %	4 %	0.53	4 %	2 %	4 %	0.25	3 %	4 %	0.43
14	Standardise and manage discipline	23	2.3 %	2 %	2 %	0.72	1 %	3 %	3 %	0.12	2 %	3 %	2 %	0.46	3 %	2 %	0.42
15	Find and share best practices	23	2.3 %	3 %	2 %	0.14	3 %	2 %	2 %	0.60	4 %	2 %	1 %	0.03*	2 %	3 %	0.38
16	Stepwise approach	23	2.3 %	3 %	2 %	0.31	3 %	2 %	1 %	0.09	2 %	3 %	1 %	0.34	2 %	2 %	0.70
17	Focus on areas and prioritise activities	21	2.1 %	2 %	2 %	0.93	2 %	2 %	2 %	0.94	1 %	3 %	1 %	0.12	2 %	2 %	0.36
18	Invest time and money	20	2.0 %	2 %	2 %	0.59	3 %	1 %	1 %	0.03*	2 %	4 %	0 %	0.00**	2 %	2 %	0.46
19	Benchmark others	16	1.6 %	2 %	1 %	0.48	2 %	1 %	1 %	0.50	2 %	1 %	2 %	0.31	1 %	3 %	0.01*
20	Emphasise team concept	13	1.3 %	1 %	1 %	0.61	1 %	1 %	2 %	0.58	1 %	2 %	1 %	0.42	1 %	1 %	0.73
21	Use external experts	12	1.2 %	2 %	1 %	0.12	2 %	1 %	1 %	0.50	3 %	1 %	0 %	0.01*	1 %	2 %	0.03*
22	Hold regular implementation meetings	12	1.2 %	2 %	1 %	0.03*	1 %	1 %	1 %	0.83	2 %	1 %	1 %	0.54	1 %	2 %	0.10
23	Emphasise safety and job attractiveness	6	0.6 %	1 %	1 %	0.84	0 %	1 %	1 %	0.33	0 %	0 %	1 %	0.12	1 %	0 %	0.63
24	Commit corporate management	5	0.5 %	0 %	1 %	0.64	0 %	1 %	0 %	0.91	0 %	0 %	1 %	0.30	0 %	1 %	0.45
	SUM	1015	100 %	100 %	100 %		100 %	100 %	100 %		100 %	100 %	100 %		100 %	100 %	

Notes: Percentages in columns E, F, H, I, J, L, M, N, P and Q show distribution of mentions for the respective contingency variable.
Confidence intervals in columns G, K, O and R: * p < 0.05 and ** p < 0.01

The author's conclusion is that to successfully implement lean, managers should commit to and involve themselves in the lean transformation (Netland, 2016).

Furthermore, Kundu with Manohar (2012) presented a paper that is based on a discussion of the critical success factors of lean as it applies to the manufacturing and service industries. As a result, eight critical success factors were identified namely; (1) Management leadership, (2) Management support, (3) Top management commitment, (4) Organisational culture, (5) Communication, (6) Training and skill-building, (7) Financial capability and, (8) Measurement framework.

In their literature review on the barriers faced when implementing lean, Sundareshan, et al. (2015) were able to identify 14 different factors, ranked by their presence in research papers as illustrated in Table 5. Considering the number of factors identified, the involvement of management again is the most cited barrier to lean.

Table 5: Barriers to lean implementation versus number of research papers (Sundareshan, et al., 2015)

Barriers	Number of research papers.	Barriers	Number of research papers.
Management involvement	22	Past Experience	7
Employee involvement	20	Resources utility	4
Communication	14	Knowledge	4
Lack of training	12	Budgets	4
Culture issue	10	Scared of failure	4
Lack of Know how	10	Conflicts	2
Financial	7	Improper Utilization of potential capacity of workers	2

Fryer, et al. (2007) also conducted a literature review on the critical success factors when implementing continuous improvement initiatives. They were able to collect 24 papers on the topic and ranked the presence of each CSF according to the applicable industry, as presented in Table 6. From their findings, management commitment is present in 23 of the 24 papers across different industries. These authors also argue that management commitment is the one factor observed across all the industries and concluded that, without active and visible support from management, a continuous improvement program (such as lean) will not succeed.

Table 6: Success factors when implementing continuous improvement initiatives (Fryer, et al., 2007)

Success Factor	Mixed sectors (13 papers)	Manufacturing (6 papers)	Service (3 papers)	Public Sector (2 papers)
Management commitment	13	5	3	2
Training and learning	9	5	2	0
Supplier management	8	3	2	2
Customer management	8	3	3	1
Quality data, measurement and reporting	7	3	2	2
Having aims and objectives that are communicated to the workforce and used to prioritise individual's actions – a corporate quality culture	7	4	3	2
Communication	7	4	2	1
Teamwork	5	1	1	1
Employee empowerment	5	2	1	1
Process Management	3	2	0	2
Organisational structure	3	1	1	0
Product design	2	2	0	0
Ongoing evaluation, monitoring and assessment	2	2	0	0

Moreover, in a mixed-method study of the critical success factors of lean implementation done by Laureani with Antony (2012), which included a literature review and survey of managers from service and manufacturing companies, it was concluded that the most important factors are *management commitment, cultural change, linking lean to the business strategies, and leadership* styles. It can be implied that leaders are responsible for the cultural change as well as linking lean to the business strategy (Abbas & Asghar, 2010; Houmanfar & Mattaini, 2015).

Table 7 provides an overview of the core strengths and weaknesses related to each of the studies explicated above:

Table 7: Overview of core strengths and weaknesses of each study

Author	Strengths	Weaknesses
(Leite, et al., 2016)	Addresses the organisational classification of various lean barriers and enablers related to cultural and technical dimensions. For the cultural dimensions, "Top management support", "empowering the workforce" and "management commitment" are listed as key enablers to lean implementation.	Lack of empirical evidence to support results.
(Kumar & Kumar, 2014)	Provides a hierarchical map of seven primary barriers related to lean manufacturing implementation through empirical input.	Focus of the study is based on input from predominantly Indian companies. Difficult to generalise.
(Netland, 2016)	Addresses the fundamental question of "what are the critical success factors for implementing lean"? Results are statistically ranked from highest to lowest impact, with "Lead actively" ranking as the most critical success factor. Interestingly, each of the 24 CSF's in the list is influenced by management or leadership either directly or indirectly.	Possibility of generalisability is limited since only two multinational firms were used for empirical input.
(Kundu & Manohar, 2012)	Provides a set of integrative perspectives of the critical success factors for implementing lean principles in the IT support services sector. "Management leadership", "management support" and "top management commitment" are listed as the top three enablers of lean implementation.	Lack of empirical validation and relevance of the critical success factors are questionable.
(Sundareshan, et al., 2015)	Provides a framework of the most used lean tools and barriers related to various organisations. The results are ranked according to their presence in each study and "Management Involvement" is listed as the most critical factor.	Lack of empirical validation could influence relevancy of the results.
(Fryer, et al., 2007)	Presents the differences and similarities of the critical success factors for the successful implementation of lean programs across different industries. Results are ranked from highest- to lowest impact with "Management Commitment" listed as the most critical success factor.	Only a handful of papers were identified through the research and further research on the critical success factors must be conducted to understand the differences between various sectors.
Laureani with Antony (2012),	Provides an overview of the critical success factors of Lean Six Sigma implementation and compares these between manufacturing and service organisations. Results were ranked from most- to least important.	The study is limited by the empirical input from its sample group of 101 companies. Further longitudinal studies are required to make further conclusions about the results.

Drawing from the body of knowledge available on the topic of lean implementation barriers and enablers as summarised in Table 7, it is suggested that *leadership* or *management* plays a crucial role in lean's sustainability. The next section briefly explains the similarities and differences between these two terms and what specific viewpoint is adopted in this study.

2.2.5 Leadership and Management

Leadership can be interpreted in many ways. In fact, the common misconception that leadership and management mean the same thing has inadvertently led to confusion between their definitions in the literature (Ashtiani, et al., 2017). To address the objectives of this study, it is first necessary to differentiate between *leadership* and *management* in an organisational environment and how it is approached in this study.

Wajdi (2017, p.75) highlights the interconnection between *leadership* and *management* by stating that "good *managers* should strive to be good *leaders* and good *leaders*, need *management* skills to be effective". However, Wajdi (2017, p.75) also highlights the differences between leadership and management by stating that "*leaders* have a vision of what can be achieved and then communicate this to others and evolve strategies for realising this vision" while "*managers* ensure that the available resources are well organised and applied to produce the best results". This implies that *leadership* provides the "direction" to achieve a specific vision while *management* provides the necessary structures and resources to accomplish this "vision".

Furthermore, Băeșu with Bejinaru (2013, p.146) states that a *leader* is "an individual who promotes change through applying customised *management* styles that accommodate the behaviours and qualities of their employees and a *leading style* is influenced by various factors that can be analysed from the position of the *manager*".

Kaliprasad (2006, p.28) makes the clear distinction that "*leaders* create and change cultures, while *managers* live within them". Rother (2010) explains that *leaders* provide vision or direction to the organisation while *managers* implement the structures that support organisational movement in the direction of that vision – which compliments Wajdi's (2017) statement earlier.

Nonetheless, a *leader*, with or without authority, from above or below, must be able to engage people in confronting challenges, teach them new habits and change their values and perspectives (Zaleznik, 2004).

This individual may, however, be able to provide *leadership* while assuming *managerial* roles (Northouse, 2012). In this study, this specific viewpoint is adopted, where both *management*

and *leadership* activities are considered, and the roles, behaviours, activities or capabilities of *leaders* and *managers* are mutually inclusive. This will also support the theoretical foundation of the study since the literature could assume both *leadership* and *management* as being the same concept.

2.2.6 Lean leadership

In the next section, the theory of leadership and its role in lean will be discussed

As the literature has argued, lean implementation requires fundamental changes across all levels within an organisation and its sustainability depends on the organisation's collective response to the change being implemented (Alefari, et al., 2017; Pearce & Pons, 2013). This change, however, is not a once-off project but rather an ongoing, continuous process with impacts on both technical and sociocultural aspects of an organisation (Alefari, et al., 2017). The implementation of any change process such as lean, is considered the essence of leadership since it produces expectations regarding leadership's behaviours and attitudes (House, et al., 2004). Leaders are responsible for influencing a team or individuals toward achieving certain strategic objectives (Sethuraman & Suresh, 2014) and therefore play an important role in the establishment and continuous reinforcement of a lean culture (Tortorella & Fogliatto, 2017).

This *culture* is simply defined by Mann (2009) as how an organisation would describe "the way things are done around here". The customary way of doing things, in other words, *behaviour*, reflects the actual culture regardless of the official rules and policies. The most important source of reinforcement in an organisational setting is leadership and, *the way things are done around here*, in other words, reflects leadership's reinforcement, whether conscious or not (Mann, 2009). In addition, from the conclusions of many studies that set out to identify and establish the critical success factors to lean, leadership has emerged as a term that is consistently highlighted as discussed in the previous section (Leite, et al., 2016; Kumar & Kumar, 2014; Netland, 2016; Kundu & Manohar, 2012; Sundareshan, et al., 2015; Fryer, et al., 2007; Laureani & Antony, 2012)

Perhaps the most notable statement pertaining to the role of leadership in lean, is that of Liker with Convis (2012, p.13), who stated that; "the biggest gap in capabilities in the lean movement, and the root cause of failure on many lean programs, is in leadership".

Based on this statement, the question which then comes to mind is;

"What is lean leadership and how should it be applied in a lean environment?"

Like with the term *lean*, no official definition for lean leadership exists yet. Some of its prevailing definitions in the literature are summarised in Table 8:

Table 8: Definitions of lean leadership

Source	Lean Leadership Definition
(Dombrowski & Mielke, 2013)	"Lean leadership is a methodical system for the sustainable implementation and continuous improvement of LPS. It describes the cooperation of employees and leaders in their mutual striving for perfection. This includes the customer focus of all processes as well as the long-term development of employees and leaders."
(Emiliani, et al., 2007)	"Beliefs, behaviours, and competencies that demonstrate respect for people, improve business conditions, minimise or eliminates organisational politics, ensure effective utilisation of resources, and eliminate confusion and rework."
(Mann, 2009)	"A set of leadership behaviours and structures that make up the (lean) system."
(Poksinska, et al., 2013)	"A set of leadership skills, practices and behaviours to successfully implement the system."
(Liker & Convis, 2012)	"Value-based leadership that encapsulates the true north of lean (namely spirit of challenge, <i>Kaizen</i> , <i>genchi genbutsu</i> (<i>go & see</i>), teamwork & respect)."

Of interest is Emiliani's (2007) definition, where three distinct aspects of lean leadership are highlighted, namely its *beliefs*, *behaviours* and *competencies*. According to an earlier study by Emiliani (2003), there exists a natural progression from *beliefs* to *behaviours* and finally to *competencies*, which emphasises Toyota's inclination to first identify and develop employees who embodied the company's philosophy (Baisley, 2015). To certain extents, this *progression* can also be considered as a form of *maturation* of lean leadership. Furthermore, two distinct elements from the definition can also be highlighted, namely the emphasis on respect for the people and leadership's responsibility to identify and eliminate waste.

Mann (2009) elaborated on his definition, stating that lean management bridges the critical gap between lean tools and lean thinking, and therefore, lean's sustainability. Mann (2009) argues that during lean transformations, 80% of the effort is expended on changing the practices and behaviours of leaders and that implementing the tools only represents at most 20% – which to various extents supports what Hines et al. (2004) advocated in their article about lean thinking.

This section then concludes the literature review on lean leadership. The purpose of the next section is to gain a deeper understanding of maturity models and to define the concepts and theories applicable to this study.

2.3 Maturity models

The characterisations and theories relevant to maturity models are explained in the following section.

2.3.1 Introduction to maturity models

In its simplest form, a maturity model (MM) can be described as a “set of characteristics, attributes, indicators or patterns that represent progression and achievement within a specific domain or discipline” (Caralli, et al., 2012). It is an artefact used to solve the problems of establishing an organisation’s status quo towards its capabilities and deriving improvement measures therefrom (Becker, et al., 2009). De Bruin et al. (2005) explains that the aim of MMs is to assess and benchmark the maturity (i.e. competencies and capabilities) based on a comprehensive set of criteria. This ability to benchmark allows organisations to establish their current capability levels and drive improvement through the application of MMs over time and, when applied in a broader framework, MMs could allow organisations benchmark their performance with outside organisations in similar domains or industries (Caralli, et al., 2012).

Although a large element of subjectivity is present in assessing the maturity of an organisation, the utilisation of MMs does, however, introduce a degree of objectivity through the application of its assessment process (Andersen & Jessen, 2003; Richardson, 2010). Becker, et al. (2009) also highlights the fact that MMs support an assessment process through the establishment of anticipated, logical, typical and desired *evolution paths*, otherwise known as *maturity levels*. Each of these levels is defined by *corresponding attributes (capabilities)* and, should an organisation demonstrate these attributes, it is considered to have achieved both that level and the capabilities that the level represents (Caralli, et al., 2012).

2.3.2 Origin of maturity models

The earliest examples of maturity models can be found in a hierarchy of human needs (Maslow, 1954), the stages of economic growth (Kuznets, 1965) and the evolution of Information Technology within organisations (Nolan, 1973; Nolan, 1979). Although faced with criticism, Nolan’s (1979) stage model was considered useful by academics and practitioners and has led to the rise of a multitude of MMs based on a staged sequence of levels (Pöppelbuß & Röglinger, 2011; Solli-Sæther & Gottschalk, 2010). However, Crosby (1979) is considered the first scholar to introduce a MM and presented a Quality Management Maturity Grid

(QMMG) that illustrated the behaviour of an organisation as it evolves through five stages of maturity (Nesensohn, 2014). In order to rate the quality of an organisation, Crosby developed five measurement categories, namely: (1) Management understanding and attitude, (2) Quality organisation status, (3) Problem handling, (4) Cost of quality as % of sales, (5) Quality improvement actions. These categories were measured according to five phases, namely: (1) Uncertainty, (2) Awakening, (3) Enlightenment, (4) Wisdom and (5) Certainty

The ground-breaking work that was done by Crosby (1979) within the domain of MMs and the developed QMMG greatly influenced the developers of one of today's most popular maturity models, the *Capability Maturity Model (CMM)* (Nesensohn, 2014; Sun, et al., 2009). The CMM was introduced by the Software Engineering Institute (SEI) at the Carnegie Mellon University and was created to support organisations with the development and improvement of their software development processes (De Bruin, et al., 2005; Moyersoen, 2017). In total, the SEI has developed six MMs and recently integrated three legacy CMMs into one model called the *Capability Maturity Model Integration (CMMI)* (Ahern, et al., 2004; De Bruin, et al., 2005). The remaining two models include the *Software Acquisition Maturity Model* and the *People Capability Maturity Model* (De Bruin, et al., 2005).

In addition to the SEI, more than 150 maturity models have been developed to date, with emphasis on measuring the maturity of, amongst others, IT Service Capability, Innovation Management, Strategic Alignment and Program Management (De Bruin, et al., 2005). Mettler with Rohner (2009) reviewed and compared 135 different maturity models, all retrieved from well-known electronic databases. Their study highlights that the number of maturity models developed have increased exponentially over time, especially since the introduction of the CMM as indicated by Figure 4:

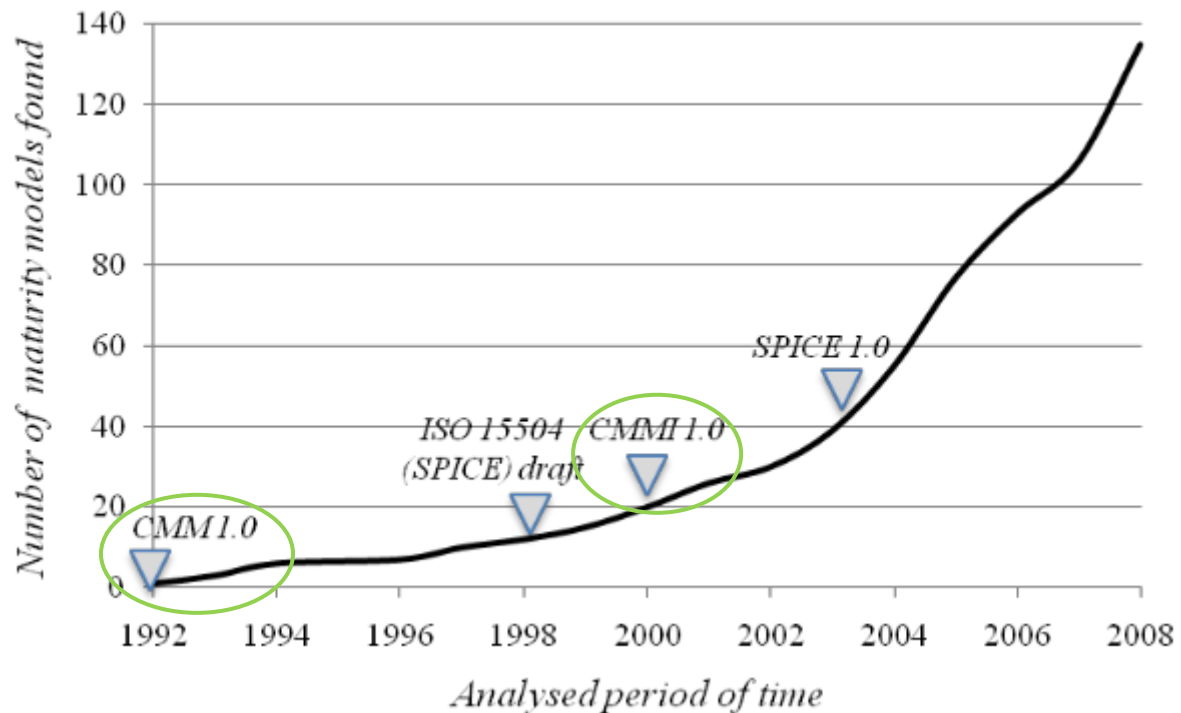


Figure 4: Number of maturity models identified over time (Mettler & Rohner, 2009)

2.3.3 The notion of maturity

Maier *et al.* (2012) describe maturity as “state of being complete, perfect or ready”. This implies some sort of evolutionary progress that demonstrates a particular ability or accomplishment of a specific goal from an initial to desired end state (Mettler & Rohner, 2009). Maturity, then, provides an understanding of why success occurs and should enable the identification of common inhibitors or enablers thereof (Schlichter, 1999). Although often used in the information systems and engineering fields, the concept of maturity has also been adopted by other industries such as project management and is widely used in various management contexts, such as organisational maturity and business process maturity (Cooke-Davies & Arzymanow, 2003).

In an organisational context, maturity refers to a “measure that enables organisations to assess their capabilities regarding a particular problem within various domains such as processes, people and technologies” (De Bruin *et al.* 2005; Mettler, 2011).

From a *leadership* and *management* perspective, maturity can be understood as the “sum of action (ability to act and decide), attitude (willingness to be involved) and knowledge (understanding of the impact of willingness and action)” (Andersen & Jessen, 2003). Similarly, from a *psychological* point of view, maturity can be defined as “a person’s ability to respond appropriately to the environment, being aware of the correct time and location to behave, and

knowing when to act according to the circumstances and culture of the society one lives in” (Hunt, 1941; Wechsler, 1950; van Dyk, 2013).

Many publications on the topic of maturity models provide a definition for a *maturity model*, but rarely define the notion of maturity (van Dyk, 2013). Therefore, in this section, *psychological* maturity within the context of *human development* and *leadership* is considered. More specifically, the definition for leadership or management maturity as it applies to this dissertation is defined by combining the definitions of Andersen & Jessen (2003), Hunt (1941), Wechsler (1950) and van Dyk, (2013):

“Maturity indicates a person’s ability to respond appropriately to the environment through action, attitude and knowledge, being aware of the correct time and location to behave and knowing when to act according to the circumstances and culture of the society one lives in”

2.3.4 Maturity model components

Despite several differences in types of maturity models, they all share a common property of defining a set of dimensions at various distinct maturity stages or levels, each containing a description or characteristic of performance at several levels of granularity (Fraser, et al., 2002). The design components typically found in maturity models include (Fraser, et al., 2002; Lasrado, et al., 2015; Caralli, et al., 2012):

- *maturity levels* (usually 3-6);
- a *descriptor* for each maturity level;
- a general description or *summary of the characteristics of each level* as a whole;
- *dimensions* (and/or *subdimensions*);
- *activities* related to each *dimension* and;
- a *description* of each *activity* as it could be performed at each *maturity level*.

Lasrado, et al. (2015) also provided a schematic of the general structure of a maturity model as depicted in Figure 5. The first part (left-hand side) describes the general structure of MMs consisting of various stages, each with different dimensions and sub-categories. The second part (right-hand side) depicts the hierarchical relationship between the common MM components.

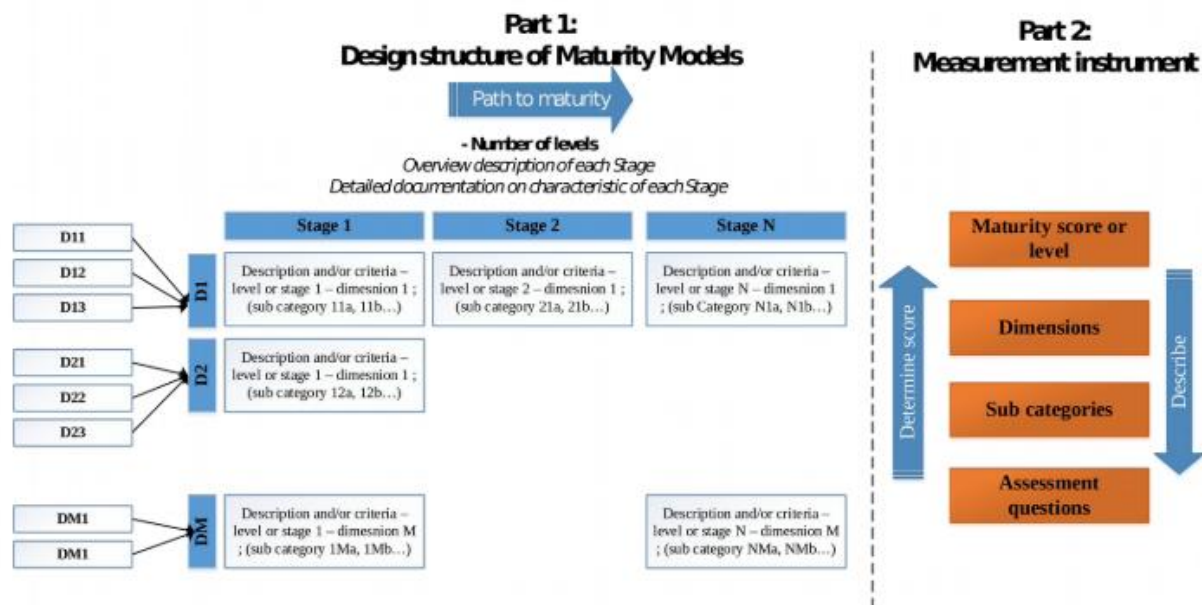


Figure 5: Generic structure of a maturity model (Lasrado, et al., 2015)

Each of the design components mentioned in in Figure 5 and how they are used in the development of the LLMM are discussed in the following section.

2.3.5 Domains and dimensions

Using the definition of leadership or management maturity as it applies to this study, the areas relevant to domains and dimensions are formatted in bold:

*Maturity indicates a person's ability to respond appropriately to the **environment** through action, attitude and knowledge, being aware of the correct time and location to behave and knowing when to **act according to the circumstances and culture of the society one lives in.***

Most maturity models include domains or dimensions as components. However, as with the notion of maturity, very few elaborate on their definitions. The definitions of each of these model components for this study are presented next:

2.3.5.1 Domain

In terms of maturity models, a domain is defined as the “means of clustering attributes into an area of importance for the subject matter and model intent” (Caralli, et al., 2012, p.9). Domains are also typically referred to as “process areas” in the context of maturity models as they are a group of processes that make up a larger process or discipline (Caralli, et al., 2012, p.9). The definition of a domain within maturity model development is not consistently used and sometimes has interchangeable meanings between different publications. Some authors refer to domains as structural components of a maturity model while others fit the entire model into a specific domain.

For the purpose of this study, a *domain* is defined as an “area of particular interest, activity or type of knowledge” and represents a “cluster of attributes into an area of importance for the subject matter under consideration” – being lean leadership.

2.3.5.2 Dimension

According to Caralli, et al. (2012, p.7), the *dimension* that is being measured in a MM is a representation of the organisational capability surrounding a set of characteristics, indicators, attributes or patterns. These dimensions are important as they measure more than just the ability to perform simple or complex tasks, but also focuses on the *holistic* organisational capability that reflects the maturity of the culture and degree in which the maturity capabilities are embedded in the culture (Caralli, et al., 2012). These dimensions can be identified through an in-depth literature review in a mature domain such as lean leadership (De Bruin, et al., 2005).

2.3.5.3 Subdimension

One of the two layers for capability development is the organisational layer, where a maturity level captures the extent to which an organisation has consistently developed its capabilities (Forstner, et al., 2013). This maturity level results from combining the capability levels of all capability areas. In this study, the *organisational layer* will be represented by *subdimensions*, which serve as more detailed descriptors of the dimensions and are measured by the *maturity levels* of their corresponding *capability areas*. Each subdimension will be defined by a *purpose statement* which serves as an informative element that describes the purpose of the subdimension at a holistic level.

2.3.6 Maturity levels and Capabilities

Again, using the definition of leadership or management maturity as it applies to this study, the areas relevant to maturity levels and capabilities are formatted in bold:

*Maturity indicates a person’s ability to **respond appropriately** to the environment through **action, attitude and knowledge**, being aware of **the correct time and location to behave** and knowing **when to act** according to the circumstances and culture of the society one lives in.*

One common design feature of all MMs is the presence of *maturity levels* along an evolutionary scale. This scale describes the measurable transitions from one stage to another. These measurable transitions allow an organisation to define its current state, determine its more mature, desired state and identify the attributes to be realised before reaching the desired state (Caralli, et al., 2012).

Therefore, the current maturity level of an organisation represents its *capabilities* regarding a specific class of entities and *domain* of application and expresses attributes that can be measured by the model (Röglinger, et al., 2012; Caralli, et al., 2012). Even though Crosby (1979) was the first scholar to inspire the stage progression towards the desired maturity, the concept of *capability* was shaped by the introduction of the CMM families.

For a CMM, *capabilities* are used to characterise the state of an organisation's processes versus an individual process (Erasso & Linnenkamp, 2011). Organisations can either develop processes within a single process, which is often referred to as a *capability*, or simultaneously within multiple process areas, commonly referred to as *maturity* (Erasso & Linnenkamp, 2011). These capability levels are also often referred to as *criteria*, *common features*, *improvement measures* and *capability statements* (De Bruin, et al., 2005; Mettler, 2011; Schlichter, et al., 2010; Schutte & Van Dyk, 2013; Fraser, et al., 2002).

These capability levels also indicate the key activities or practices that, when addressed jointly, are required to accomplish the goals of a *process area* (Fraser, et al., 2002). *Capability areas*, which are similar to *process areas*, are the criteria that need to be satisfied to achieve the desired maturity level and should be theoretically justified (Blommerde & Lynch, 2016; De Bruin, et al., 2005; Forstner, et al., 2013). For each *capability area*, a capability level is assigned that expresses the extent to which the applicable capability has been developed (Forstner, et al., 2013). In this study, the capability levels will be expressed in terms of *capability statements* (van Dyk, 2013). They represent *how* maturity can be measured and should be mutually exclusive and collectively exhaustive (De Bruin, et al., 2005). The highest level of maturity often referred to as the *desired maturity*, will be expressed in terms of an *ideal statement*.

The definitions for each of these three concepts and how they apply to this study are indicated below:

Capability areas: "Groups of related lean leadership activities or behaviours associated with a specific combination of dimensions and subdimensions, covering all five maturity levels" - adopted from van Dyk (2013).

Capability statement: "A generic statement that serves as criteria or descriptor of a capability area as it applies to a specific maturity level" – adopted from van Dyk (2013).

Ideal statement: "The ideal lean leadership feature of a capability area within a specific combination of domain dimensions and subdimensions" – adopted from Nesensohn (2014)

2.3.7 Types of maturity models

In general, maturity models can be categorised as one of the following four types:

1. CMM-like models
2. Progression models
3. Maturity grids
4. Hybrid models
5. Likert-like models

2.3.7.1 CMM-like models

CMM-like models are more formal and complex in architecture and tend to organise each process area by common features that specify several key attributes to address a series of goals (Fraser, et al., 2002). Although more detailed, CMM-like models are greater in complexity due to the broad range of scales (or levels) and subscales required for the assessment of maturity (Mettler, et al., 2010). While the concept of maturity in CMM-like models usually emphasises processes, others have combined elements of good practise with less focus on processes (Fraser, et al., 2002). An advantage of CMM-like models is that they enable measurements of core competencies, provide a more precise measurement of capability and can create a path to quantitative measurement (Mehravari, 2013). However, CMM-like models can be difficult to understand and apply which could lead to high adoption costs, “maturity” does not necessarily translate into results and the potential for a false sense of achievement is always possible (Mehravari, 2013).

An example of a CMM-like model is the *CERT-RMM model*, an extract of which is presented in Figure 6 (Caralli, et al., 2016; Carnegie Mellon University Software Engineering Institute, 2017):

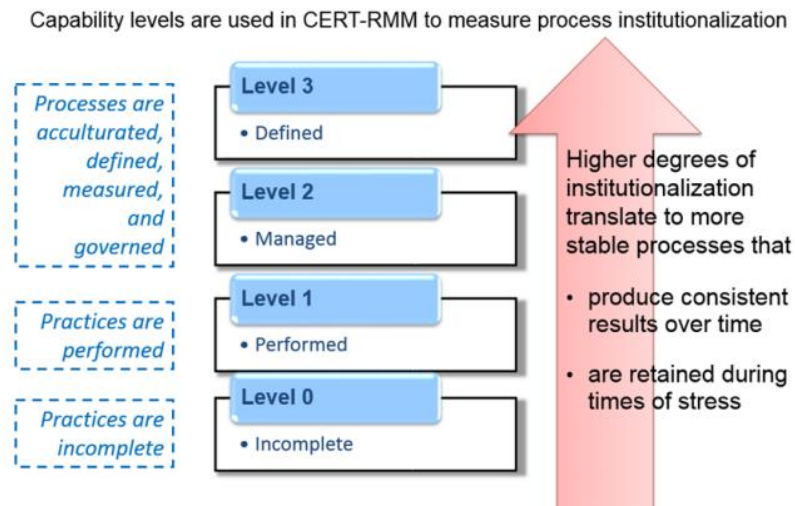


Figure 6: Extract of the capability levels used in the CERT-RMM ® (Carnegie Mellon University Software Engineering Institute, 2017)

2.3.7.2 Progression maturity models

The progression model represents a simple scale of a characteristic, attribute, indicator or pattern where an increase in maturity levels indicate a progression of the attribute maturity (Caralli, et al., 2012). These models aim to provide a roadmap for progression of improvement as expressed by increasingly mature versions of attributes as the levels progress and typically focus on the model attributes rather than those that specifically define maturity (Caralli, et al., 2012). The benefits of a progression maturity model are that it provides a roadmap for transformation, is simple to understand with low adoption costs and can be recalibrated easily when technologies and practices evolve (Mehravari, 2013). It is, however, limited by arbitrary definitions of maturity levels and the fact that achieving higher levels does not necessarily translate into “maturity” (Mehravari, 2013).

An example of progression models includes the *Smart Grid Maturity Model* ®, an extract which is presented in Figure 7 (Carnegie Mellon University Software Engineering Institute, 2018).

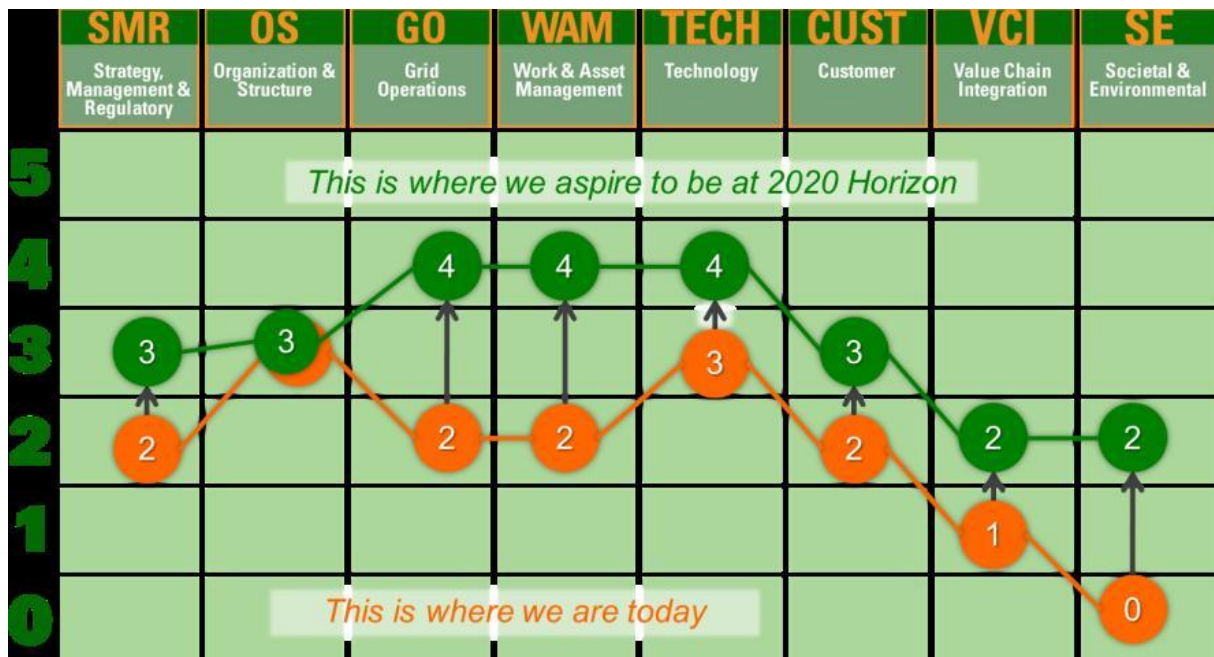


Figure 7: Extract of the Smart Grid Maturity Model ® (Carnegie Mellon University Software Engineering Institute, 2018)

2.3.7.3 Maturity Grids

According to Fraser, et al. (2002), maturity grids commonly contain descriptive text for each activity per maturity level which is moderately complex and require at least a few pages of text. Because of this descriptive text, the level of complexity of the tool increases as the number of maturity levels increase and, as a result, maturity grids only tend to contain 3 to 4 levels (Fraser, et al., 2002). These maturity levels, although somewhat arbitrary, relate to several aspects of the research domain (Correia, et al., 2017; Fraser, et al., 2002).

Maturity grids can also be used as both assessment- and improvement tools and are particularly appealing for organisations looking for inexpensive assessment methods that are quick to conduct (Maier, et al., 2012). They tend to be a simpler diagnostic and improvement tool and do not aim to provide (Maier, et al., 2012). A key characteristic of the assessment method for maturity grids is that, when scoring the relative performance of an organisation, only the top-level characteristics are described to the respondent (Fraser, et al., 2002). This maturity grid assessment can be used as a standalone assessment or as a subset of a wider improvement program (Maier, et al., 2012).

Crosby's (1979) *Quality Management Maturity Grid* (Figure 8) is an example of a popular maturity grid. The grid is a 5x6 matrix that displays the five different levels of maturity of the organisation's quality management (horizontal axis) against six unique quality management categories (vertical axis).

QUALITY MANAGEMENT MATURITY GRID					
Measurement categories	Stage 1: Uncertainty	Stage 2: Awakening	Stage 3: Enlightenment	Stage 4: Wisdom	Stage 5: Certainty
Management understanding and attitude	No comprehension of quality as a management tool. Tend to blame quality department for "quality problems".	Recognizing that quality management may be of value but not willing to provide money or time to make it all happen.	While going through quality improvement program learn more about quality management; becoming supportive and helpful.	Participating. Understand absolutes of quality management. Recognize their personal role in continuing emphasis.	Consider quality management an essential part of company system.
Quality organization status	Quality is hidden in manufacturing or engineering departments. Inspection probably not part of the organization. Emphasis on appraisal and sorting.	A stronger quality leader is appointed but main emphasis is still on appraisal and moving the product.	Quality department reports to top management, all appraisal is incorporated and manager has role in management of company.	Quality manager is an officer of company; effective status reporting and preventing action. Involved with consumer affairs and special assignments.	Quality manager is on board of directors. Prevention is main concern. Quality is a thought leader.
Problem handling	Problems are fought as they occur; no resolution; inadequate definition; lots of yelling and accusations.	Teams are set up to attack major problems. Long-range solutions are not solicited.	Corrective action communication established. Problems are faced openly and resolved in an orderly way.	Problems are identified early in their development. All functions are open to suggestion and improvement.	Except in the most unusual cases, problems are prevented.
Cost of quality as% of sales	Reported: unknown. Actual: 20%	Reported: 3% Actual: 18%	Reported: 8 % Actual: 12%	Reported: 6.5% Actual: 8%	Reported: 2.5% Actual: 20%
Quality improvement actions	No organized activities. No understanding of such activities.	Trying obvious "motivational" short-range efforts.	Implementation of the 14-step program with thorough understanding and establishment of each step.	Continuing the 14-step program and starting Make Certain.	Quality improvement is a normal and continued activity.
Summation of company quality posture	"We don't know why we have problems with quality."	"Is it absolutely necessary to always have problems with quality?"	"Through management commitment and quality improvement we are identifying and resolving our problems."	"Defect prevention is a routine part of our operation."	"We know why we do not have problems with quality."

Figure 8: Extract of the Quality Management Maturity Grid (Crosby, 1979)

2.3.7.4 Hybrid models

A hybrid maturity model can be created by combining the features of the progression model with the capability attributes from capability maturity models (Caralli, et al., 2012). This enables the measurement of evolution as per progression models and the ability to measure capability with the rigor of capability maturity models (Mehravari, 2013). The maturity levels of hybrid models reflect both progression and capability while transitions between levels are like that of a capability maturity model although architecturally, they reflect the features, patterns and attributes of a progression model (Mehravari, 2013). Hybrid maturity models are useful for

easily measuring core competencies and approximations of capabilities and can easily be adapted to accommodate the evolution of technologies and practices, meaning adoption costs are relatively low (Mehravari, 2013; Caralli, et al., 2012). On the downside, the concept of “maturity” is approximated, which makes it less rigorous than CMM-like models and the combination of features at each maturity level could be arbitrary (Mehravari, 2013).

An example of a hybrid maturity model is the *Electricity Subsector Cybersecurity Capability Maturity Model*® as presented in Figure 9 (Carnegie Mellon University Software Engineering Institute, 2014):

ES-C2M2 Structure

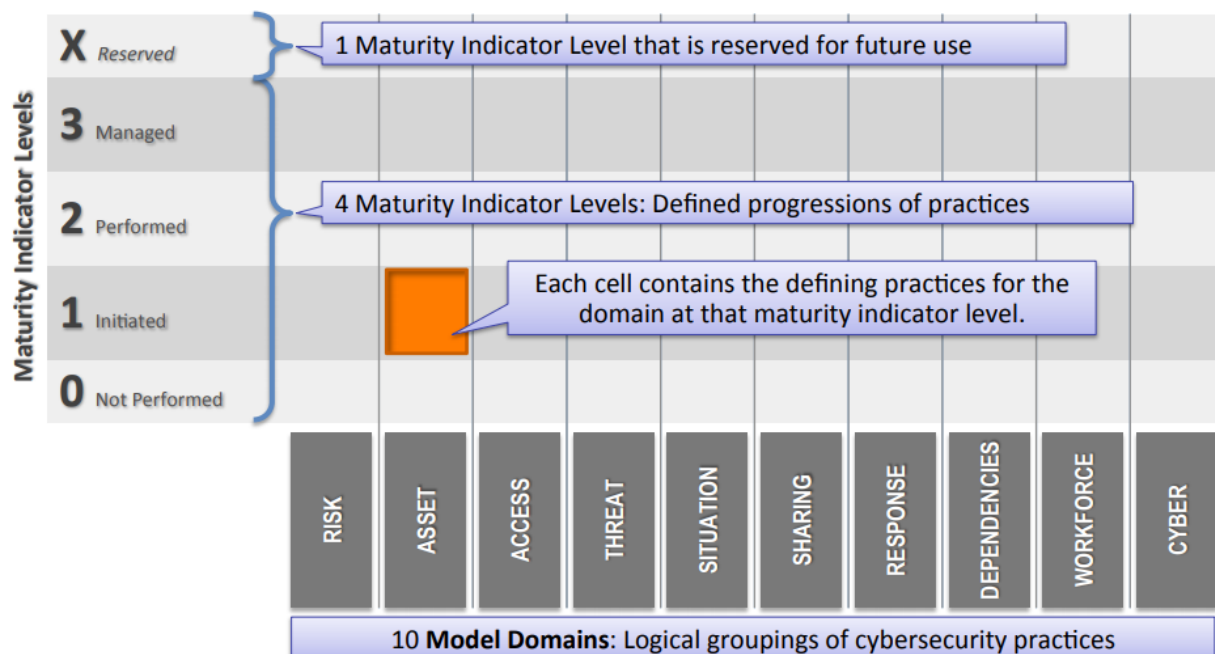


Figure 9: Extract of the Electricity Subsector Cybersecurity Capability Maturity Model® (Carnegie Mellon University Software Engineering Institute, 2014)

2.3.7.5 Likert-like models

Likert-like questionnaires with anchor phrases are comparable with maturity grids, with the top-level usually described explicitly and others implied by anchors such as “strongly disagree” (Fraser, et al., 2002). These questionnaires predominantly focus on assigning scores to specific statements of good practice rather than describing the overall maturity levels (Mettler, et al., 2010). The Likert-like questionnaires, as with progression models, are less complex when compared to models with CMM or hybrid structures and can be considered to be a simple form of maturity model if constructed in a specific way (Correia, et al., 2017; Fraser, et al., 2002).

An example of a Likert-like maturity model is the [ITIL® Maturity Model](#) (Axelos, 2013).

Based on the discussion above, the LLMM in this study is based on a combination of the rigour of the CMM with the descriptive nature of the maturity grid.

2.3.8 Reference model

A reference model is defined as a *generic conceptual model that formalise recommended practices for a certain domain* (Rosemann, 2003). Reference models also often capture reusable or common state-of-the-art practices. This is suitable for the LLMM development since it serves as a robust theoretical foundation by formalising repeatable, recommended practices of lean leadership. The main difference between a reference- and a maturity model is that a reference model does not provide a maturity scale according to which the relevant practices can be measured. For the purpose of this study, the LLMM will use the LLRM as the foundation for its development.

2.3.9 Maturity model purpose of use

As established earlier, a maturity model's basic purpose is to outline stages of maturation paths for a specific domain, which includes the characteristics of each stage and the relationship between them (Röglinger, et al., 2012). Practically, a MM's purpose of use can either be *descriptive*, *prescriptive* or *comparative* (De Bruin, et al., 2005).

Descriptive MMs can be applied to assess the as-is situation of a domain (De Bruin, et al., 2005). They contain enough detail to perform a maturity assessment but need to propose an assessment criteria for every maturity level and level of granularity applicable (Röglinger, et al., 2012; Mokgoantle, 2012). A purely descriptive model makes no provision for improving maturity or provides no relationships to performance (De Bruin, et al., 2005). Therefore, descriptive MMs inherently are only able to identify problems within a domain but cannot provide solutions or offer detailed guidelines to support practical adoption (Wißotzki & Koç, 2013). However, a model is first developed with a descriptive purpose of use, as this forms a sound foundation to guide the development of a model through the descriptive phases first, and then to allow the evolution to prescriptive and comparative phases within a domain (De Bruin, et al., 2005).

Prescriptive MMs not only assess the as-is state of maturity but also indicate how to identify desirable, future maturity levels and recommend guidelines, roadmaps or best practices on how to achieve this desired state (Wißotzki & Koç, 2013; Röglinger, et al., 2012; Maier, et al., 2012). It is only through a sound understanding of the as-is situation that repeatable and substantial improvements can be made, reiterating the importance of first developing a

descriptive maturity model (De Bruin, et al., 2005). Maturity models that provide prescriptive actions to improve maturity must have enough resources available to track interventions longitudinally and will be determined by the initial scoping of the model (De Bruin, et al., 2005).

A **comparative** model provides benchmarking of maturity across different industries or regions (De Bruin, et al., 2005; Röglinger, et al., 2012). The condition for this purpose of use is that the model is applied repeatably in a wide range of industries or regions to obtain enough data from many participants (Pöppelbuß & Röglinger, 2011). This enables the comparison of the maturity levels of similar business units and organisations (De Bruin, et al., 2005; Pöppelbuß & Röglinger, 2011).

The LLMM developed in this study will adopt a descriptive approach to describe and assess the *as-is* situation of lean leadership maturity. This will also set the foundation for further development of the model to evolve into a prescriptive and, ultimately, a comparative LLMM.

2.3.10 Maturity model development

Although maturity models have gained popularity in recent years, research on their development methods is limited (Becker, et al., 2009; Lasrado, et al., 2015; Pöppelbuß & Röglinger, 2011). Those few models that are based on a structured and scientifically demonstrated design process have often embraced Design Science Research (DSR) as a development approach (Becker, et al., 2009; Pöppelbuß & Röglinger, 2011; Lasrado, et al., 2015; Mettler, 2011; Helfert, et al., 2012).

This section explores the various maturity model development approaches and methods presented in the literature.

2.3.10.1 Maturity model development approaches

Some researchers have made significant efforts to standardise the development approaches of MMs (De Bruin, et al., 2005; Becker, et al., 2009; Solli-Sæther & Gottschalk, 2010; Lasrado, et al., 2015).

Becker, et al. (2009) propose a generic and consolidated 8-step procedure model for the design of MMs that is based on DSR: 1) **Problem definition**: Determine the scope, domain and target group of the applicable model; 2) **Comparison of existing models**: Compare the problem with existing maturity models and review whether there is a need to develop a new model; 3) **Determination of a development strategy**: Determine and justify the model's design structure; 4) **Iterative maturity model development**: selecting the design level, approach and dimensions iteratively; 5) **Conception of transfer and evaluation**: Determine

the different forms of result transfer for the communities; 6) **Implementation of transfer media:** Communication of model to the user community; 7) **Evaluation:** Validates the model in practice and; 8) **Rejection of maturity model:** Based on the evaluation outcome, the model is either removed from the market or improved continuously.

De Bruin, et al. (2005) explored various maturity models of different domains and propose a 6-phase development approach for maturity models as well as the concept of maturity model layers: 1) **Scope:** Determine the model focus and stakeholders; 2) **Design:** Determine the model's architecture, audience and method or driver for application; 3) **Populate:** Identifying the dimensions, subcategories, defining them in terms of statements; 4) **Test:** Determine relevance, rigour, reliability and validity of model construct and content and; 5) **Deploy:** Implement in phases while verifying the model's generalisability and; 6) **Maintain:** Design to handle evolution if the model is accepted.

Neff et al. (2014) developed a maturity model grounded the DSR approach and, to reduce the complexity of development, merged the procedure model of Becker et al. (2009) into a simplified four-step process. The *Determination of a development strategy* and *Iterative maturity model development* steps were merged into an *Iterative model development* step. *Conception of transfer and evaluation*, *Implementation of transfer media* and *Evaluation* were all merged into a final *Model evaluation* step. *Problem definition* and *Comparison of existing maturity models* remain as per Becker et al's, (2009) approach.

Similarly, van Steenberg, et al. (2013) propose a focus area model that also follows the design science paradigm. Their approach followed four main phases: 1) **Scoping:** Identify and scope the functional domain; 2) **Design model:** Determine focus areas, capabilities, dependencies and position capabilities in the matrix; 3) **Develop instrument:** Develop the assessment instrument and define actions for improvement and; 4) **Implement and exploit:** Implement and improve the model iteratively and, communicate results to communities.

Finally, Solli-Sæther with Gottschalk (2010) propose a process for modelling stage growth models: 1) **Suggested stage model:** Based on a literature review and perceptions of practitioners; 2) **Conceptual stage model:** Maturity levels are defined and content of stages are formulate iteratively. Empirical methods are adopted; 3) **Theoretical stage model:** Dimensions are theoretically derived and empirically validated. Theories explain stages, contents and evolution; 4) **Empirical stage model:** Each dimension is assigned a value and linked to a specific maturity level. Model is tested through a survey; 5) **Revised stage model:** Empirical stage model is revised based on survey results.

Table 9 illustrates these five different approaches for the development of maturity models:

Table 9: Five different design approaches pertaining to maturity models

8-step procedure model (Becker, et al., 2009)	6-phase development (De Bruin, et al., 2005)	4-phase adoption (Neff, et al., 2014)	4-phase focus area method (van Steenberg, et al., 2010)	5-step stage growth MM development (Solli-Sæther & Gottschalk, 2010)
1. Problem definition	1. Scope	1. Problem definition	1. Scoping	1. Suggested stage model
2. Comparison of existing models	2. Design	2. Comparison of existing models	2. Design model	2. Conceptual stage model
3. Development strategy	3. Populate	3. Iterative model development	3. Develop instrument	3. Theoretical stage model
4. Iterative MM development	4. Test	4. Model evaluation	4. Implement and exploit	4. Empirical stage model
5. Concept of transfer and evaluation	5. Deploy			5. Revised stage model
6. Implementation of transfer media	6. Maintain			
7. Evaluation				
8. Rejection of MM				

All five development approaches proposed by Becker, et al. (2009); De Bruin, et al. (2005); Neff, et al. (2014), van Steenberg, et al. (2010) and Solli-Sæther with Gottschalk (2010) follow an iterative approach for developing a maturity model. Both theoretical and empirical research are considered in these approaches and practical relevance is ensured through the operationalisation and validation of the models. Moreover, either a top-down or bottom-up approach can be utilised when developing a maturity model (De Bruin, et al., 2005; Maier, et al., 2012; Mettler & Rohner, 2009).

In a *top-down* approach, the definitions are first recorded where after measures or a set of practices are developed to fit into these definitions (Mettler & Rohner, 2009; Maier, et al., 2012). This approach works well in a relatively new domain where there is little to no evidence of what represents maturity (De Bruin, et al., 2005; Maier, et al., 2012). In this instance, the emphasis is firstly on *what* represents maturity and then *how* it can be measured. In this study, *what* represents maturity is characterised by the *dimensions, subdimensions and capability areas*. *How* it can be measured is determined by the *capability statements*.

For a *bottom-up* approach, the requirements and measures are first determined where after the definitions are written to reflect these (De Bruin, et al., 2005; Maier, et al., 2012). In a domain that is well established, the bottom-up approach is applicable as the focus would first be on *how* maturity is measured rather than *what* it represents (Lasrado, et al., 2015; De Bruin, et al., 2005).

Nonetheless, considering these two approaches, Solli-Sæther with Gottschalk (2010) propose a *progressive* process for the development of maturity models regardless of a domain's newness. This implies that no concrete rules exist when choosing a maturity model development approach.

2.3.10.2 Maturity model construction methods

From the previous sections, it was established that maturity models, although diverse, contain common components, and can be categorised into five main types with have three main purposes of use. Similarly, they also share common construction methods, which will be explored in the following section.

Lasrado, et al. (2015) conducted a study of maturity models and classified them according to the construction of dimensions and level. They classified four processes of building maturity model constructs, namely (1) conceptual, (2) qualitative, (3) quantitative and, (4) derivative.

Conceptual maturity models can be either generic or specific and derive dimensions through a theoretical approach - in this case, an SLR (Lasrado, et al., 2015; Wendler, 2012). To be classified in this category, the model construction requires a strong theoretical foundation and not just references to previous maturity models.

Qualitative maturity models are constructed using case studies, interviews or focus groups. They commonly use a qualitative empirical approach to derive dimensions and levels (Lasrado, et al., 2015). Usually, a literature study will be followed with a conceptual model, which is then tested and verified through Delphi techniques, focus groups and/or interviews before the instrument is operationalised (De Bruin, et al., 2005). These methods are used more frequently than quantitative techniques (Lasrado, et al., 2015).

Quantitative maturity models are generally constructed through a survey that is followed by quantitative techniques such as factor analysis and Rasch analysis (Lasrado, et al., 2015). They predominantly use a quantitative empirical approach to derive dimensions and levels. Quantitative techniques are used less frequently when constructing maturity models (Lasrado, et al., 2015).

Derivative maturity models are either generic or specific and are constructed without a theoretical foundation (Lasrado, et al., 2015). These models primarily use historical literature published on maturity models and fit applicable domain problems into their structure without strong empirical or theoretical foundations (Lasrado, et al., 2015; Wendler, 2012). Derivative maturity models are not targeted towards the academic audience and mainly focus on the practitioner's perspective of a domain.

This section then concludes the literature review on maturity models.

2.4 Research paradigms and methods relevant to the study

In the following section, the definitions, theories and concepts of the research methods used to address the research problem are discussed.

2.4.1 Design Science Research Paradigm

Design Science Research has been selected as the research paradigm for this study as it strives to develop artefacts such as constructs, models, methods and instantiations to overcome existing capability limitations and improve problem-solving capabilities of organisations (Hevner, et al., 2004; Pöppelbuß & Röglinger, 2011; Becker, et al., 2009). DSR also allows for multiple stakeholders to collaborate on addressing a problem (Hevner, 2007).

Design, according to Gregory (1966, p.11) is the process of selectively applying the complete spectrum of science and technology to obtain an end result which serves a valuable purpose. Therefore, design deals with creating something, like an artefact, that does not yet exist. An *innovative* design is applicable if the knowledge required to create such a new artefact is not available. This innovative design, therefore, requires the conduct of *research* to address a gap in knowledge that results in the publication and communication of knowledge (Vaishnavi & Kuechler, 2004).

The construction and evaluation of design solutions can be reflected on a generic level, where the focus is on the design research process and creating standards for its rigour, which is also referred to as the *science of design*, or, *design science* (Mettler & Rohner, 2009; Hevner, et al., 2004). Design science has its roots in the engineering, art & design, architecture, planning and information systems fields and was found as an alternative paradigm to the positivist paradigm of natural sciences and constructivist-interpretivist paradigm of behavioural sciences (Wilson, 2013). For positivism, it is assumed that reality is objectively comprehensible with measurable factors detached from the researcher, while interpretivism assumes the access to reality is subjective (Wahlgren, 2020). In design science, both positivism and interpretivism can be applied, and it is not unusual for both to be used (Wahlgren, 2020).

The main difference between design and design science is that design science seeks to produce and communicate knowledge of a domain (Wahlgren, 2020; Hansmann, 2017). It has three primary characteristics (Wilson, 2013): 1) It functions in the space between problems and solutions, both explored through research; 2) its main focus is on utility or being useful, profitable or beneficial and; 3) it is creative, iterative and evaluative.

As a research paradigm, design science has the potential to change the interface between research and practice. In other words, academic researchers would be addressing problems that are relevant and valuable to practitioners and the outcome of research conducted would be easily adopted in practice (Wilson, 2013). A research paradigm describes how a community perceives their field of study and is based on assumptions related to ontological, epistemological and methodological concerns (Wahlgren, 2020; Johannesson & Perjons, 2014). *Ontological* questions describe the nature of reality, *epistemological* questions describe how people obtain knowledge while *methodological* questions describe how reality is investigated (Wahlgren, 2020).

Considering that all research is based on underlying assumptions about the philosophical basis of the research validity and the suitability of a selected methodology, it is imperative to recognise the reality of certain philosophical assumptions when research is being conducted or evaluated (Nguyen, et al., 2019). This is especially true for DSR, where the philosophical basis must be respected in multi- and pre-pragmatic communities since the philosophical assumptions usually differ between natural sciences and social sciences (Nguyen, et al., 2019).

Therefore, the philosophical basis for DSR and how it applies to this study can be categorised as follows (adapted from Nguyen, et al. (2019, p.5756)):

- **Ontology:** Socio-technological, multiple, contextually situated alternative realities.
- **Epistemology:** Iterative circumscription offers new knowledge, constrained to innovative and developmental artefacts.
- **Methodology:** Development and evaluation of artefacts.

Furthermore, while design science focuses on the factors related to the development and evaluation of an artefact, design research focuses on a specific level, where the aim is to create artefacts to specific classes of applicable problems through rigorous scientific methods for their construction and evaluation (Hansmann, 2017; Hevner, et al., 2004; Mettler & Rohner, 2009).

Based on this, DSR can be considered as a problem-solving paradigm that aims to expand human and organisational capabilities through the development of new and innovative artefacts (Hevner, et al., 2004). These artefacts can fit into one of the following categories (Mettler & Rohner, 2009; March & Smith, 1995): (1) **Constructs** – which provide the language that defines problems and solutions, (2) **Models** – used to represent the problems identified and future solutions, (3) **Methods** – the process on how problems are solved and future solutions are developed and, (4) **Instantiations** – used to demonstrate the artefact's proof of

concept. DSR also allows the collaboration of key stakeholders (scholars, researchers, practitioners, consultants etc.) to address complex problems or opportunities related to a specific domain (Van de Ven, 2007).

Since maturity models can be understood as artefacts that aim at solving problems within a specific domain and lean leadership encompasses complex human and organisational dimensions, the development of the LLMM falls within the application area of DSR. The LLMM construction also follows the DSR approach to establish a sound theoretical foundation as current maturity models have been heavily criticised as lacking a solid theoretical base (De Bruin, et al., 2005; Lasrado, et al., 2015; McCormack, et al., 2009).

Hevner (2007) argues that the corresponding research cycle between design science and behavioural science must be engaged for research to make substantial contributions and to provide solutions for fundamental problems. They argue that any DSR project comprises of three main research cycles – the *relevance cycle*, the *design cycle* and, the *rigour cycle*.

Figure 10 illustrates this research framework by combining both behaviour-science and design-science:

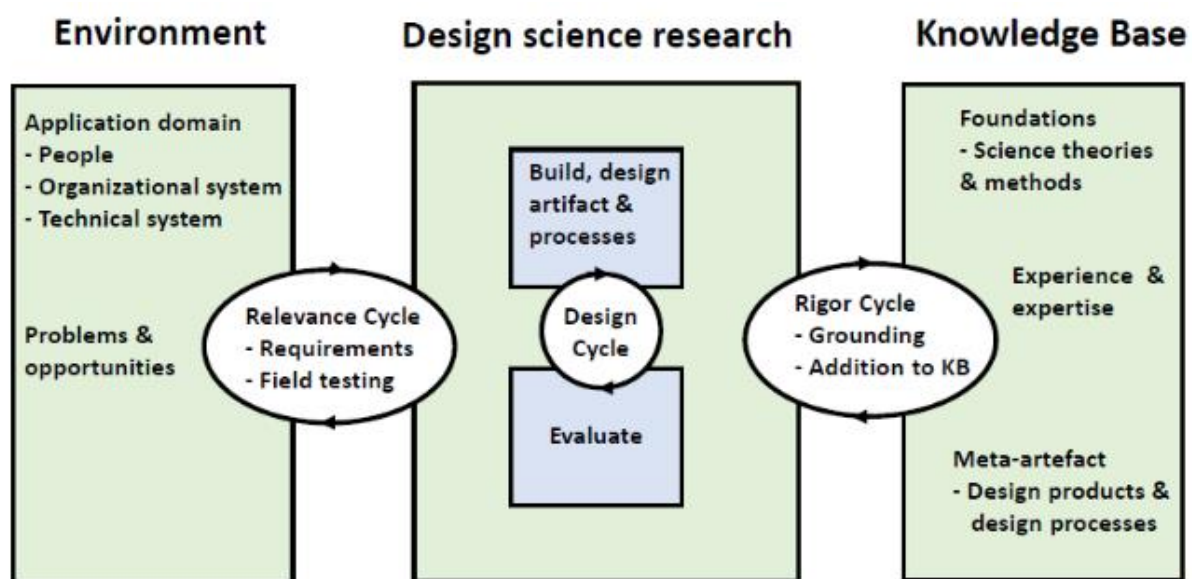


Figure 10: Design Science Research framework (Hevner, 2007)

Each of these cycles will be briefly discussed in the next section.

Relevance cycle: Simon (1996) states that, what motivates DSR, is the desire to improve the environment (which defines the problem space) by introducing new and innovative artefacts and processes. The environment contains the goals, tasks, problems and opportunities that define the business needs as perceived by the people of an organisation (Hevner, et al., 2004).

The application domain contains the people, technical- and organisational systems that interact together toward a goal (Hevner, 2007). Identifying and representing opportunities and problems in this actual application domain is often the starting point for good DSR (Hevner, 2007). The relevance cycle, therefore, initiates DSR within the application context that provides the requirements for the design cycle and also defines the acceptance criteria for the practical testing of the artefact (Hevner, 2007; Wahlgren, 2020). The output of a DSR study must be returned into the study environment and evaluation in the application domain through practical field testing. The results obtained from such field testing determines whether additional iterations to the relevance cycle are needed for the DSR project.

Rigour cycle: To ensure its innovation, the rigour cycle provides past knowledge to the research project. This knowledge base consists of experiences and expertise that define the state-of-the-art in the research's application domain alongside existing artefacts and processes (Hevner, 2007). To guarantee that the designs produced are novel contributions, researchers are expected to thoroughly research and reference the knowledge base.

In design science, the research rigour is based on the researcher's capable selection and application of appropriate methods and theories for constructing and evaluating the artefact (Hevner, 2007). Hevner (2007) further explains that it is often difficult to find kernel theories for the creative aspects of design research and to insist that all design research must be grounded in descriptive theories is unrealistic and can be harmful to the field. Hevner (2007) rather prefers that various sources of ideas be identified for the grounding of DSR, for example, opportunities/problems from the relevance cycle, existing artefacts, analogies/metaphors, and theories.

This cycle has an output (additions to the knowledge base) of any extensions to the original theories and methods, new meta-artefacts (design as products and processes), and experience gained from field-testing the artefact in the application environment.

Design cycle: At the heart of any DSR project is the design cycle (Hevner, 2007). This cycle iterates more rapidly between the artefact's construction, evaluation and feedback to refine the design further. As explained previously, the relevance cycle provides the requirements while the rigour cycle provides the design and evaluation theories and methods. Therefore, it is imperative to understand the design cycle's dependencies on the other two cycles while also recognising its relative independence during the actual extension of the research.

2.4.1.1 Primary activities in Design Science Research

According to Johannesson with Perjons (2014), a design science project can be divided into six main activities; 1) Explicate the problem; 2) Define requirements; 3) Design and develop; 4) Demonstrate artefact; 5) Evaluate artefact and; 6) Communicate artefact knowledge:

1. **Explicate the problem:** A practical problem of general interest is formulated. The knowledge base for this activity includes previous research on similar problems and their solutions. This activity also consists of three sub-activities namely:
 - a. *Define precisely:* The problem is precisely defined to be understood by others;
 - b. *Position and justify:* The problem is put into context, should be of general interest and importance and;
 - c. *Find root cause:* The root cause of the problem is identified through graphical tools that represent potential causes of the problem
2. **Define requirements:** Here, a solution in the form of an artefact is defined for the explicated problem. The knowledge base for this activity is the way the proposed solution differs from existing solutions. This activity is also divided into two sub-activities;
 - a. *Outline artefact:* The type of artefact that should be designed to solve the problem is selected and;
 - b. *Elicit requirements:* The requirements for the selected artefact are presented as *functional* – related to the function of the artefact; *structural* – concerns the artefact's structural qualities and; environmental – related to the artefact's environmental qualities such as usability and maintainability.
3. **Design and develop:** The artefact is constructed according to the defined requirements. The knowledge base related to this activity is the knowledge gained from existing artefacts. It also includes four main sub-activities:
 - a. *Imagine and brainstorm:* New ideas are produced, or existing ones improved;
 - b. *Assess and select:* The ideas are reviewed and one or more are selected for the artefact's development
 - c. *Sketch and build:* A conceptual sketch of the artefact is made before being developed and;
 - d. *Justify and reflect:* Design decisions are justified and reflection on the development of the artefact is conducted;
4. **Demonstrate artefact:** Here, the goal is to verify the developed artefact's feasibility. The knowledge base includes the case in which the artefact is used. It consists of two sub-activities:

- a. *Choose or design case:* A case in which the artefact can be applied is selected and;
 - b. *Apply artefact:* The artefact is applied within the case selected and the outcome is documented;
- 5. **Evaluate artefact:** The goal of this activity is to determine how well the artefact can solve the problem and satisfy the requirements. The knowledge base is dependent on the evaluation strategy selected. This activity consists of three sub-activities:
 - a. *Analyse evaluation context:* Resources available for the evaluation environment are analysed;
 - b. *Select goals and strategy:* To select appropriate research strategies and methods, the goals and strategy for evaluation are chosen and;
 - c. *Design and carry out the evaluation:* Detailed design of the evaluation;
- 6. **Communicate artefact knowledge:** The DSR results are communicated to both academic and professional audiences.

Not all DSR projects use all five of these activities, but instead rather focus on only one or two main activities. Wahlgren (2020) provided some examples of DSR projects with different types of focus:

- 1. **Problem-focused:** The root cause of the problem is identified and the requirements for an artefact formulated. The design is outlined, and demonstration and evaluation are not carried out.
- 2. **Requirements-focused:** The purpose is to collect requirements for existing problems, where the design is only outlined, and demonstration and evaluation is not carried out;
- 3. **Requirements- and development-focused:** The requirements are formulated, and the artefact developed. The artefact is also demonstrated with a basic evaluation being performed. No problem explication is done.
- 4. **Development- and evaluation-focused:** The artefact is developed, demonstrated and a thorough evaluation is carried out. No problem explication is done, and the requirements are not formulated.
- 5. **Evaluation-focused:** Only the evaluation of an artefact is performed and no new one is developed. This project must form part of a larger design science project that extends over a long period to be considered as design science.

2.4.1.2 Guidelines for Design Science Research

Inherently, DSR focuses on the knowledge and understanding of a design problem and its solution is required in the artefact's construction and application (Hevner, et al., 2004). Based

on this, Hevner, et al. (2004) developed seven guidelines to assist researchers, reviewers, editors and readers in understanding the requirements that constitute effective DSR:

1. **Design as an artefact:** The research must provide a feasible artefact in the form of a construct, model, method or instantiation;
2. **Problem relevance:** The research must be a solution to an important and relevant business problem;
3. **Design evaluation:** The design artefact's utility, quality and efficacy must be demonstrated through well-executed evaluation methods;
4. **Research contributions:** The research must provide clear and verifiable contributions in the areas of the design artefact, design foundations and/or design methodologies;
5. **Research rigour:** The research must apply rigorous methods in both the construction and evaluation of the design artefact;
6. **Design as a search process:** The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment and;
7. **Communication of research:** The research must be presented effectively in both the technology-oriented and management-oriented audiences.

At the end of this study, these guidelines will be evaluated against the maturity model development followed to demonstrate the validity of the research design.

As explained in Section 2.3.10, Becker, et al. (2009) developed an 8-step procedure model for the design of maturity models that is based on DSR and also the seven guidelines as presented by Hevner, et al. (2004) – which is the primary approach followed in this study.

The association between the seven guidelines for DSR presented by Hevner, et al. (2004) and the maturity model requirements presented by Becker, et al. (2009) is illustrated in Table 10:

Table 10: Association between Hevner, et al's. (2004) seven guidelines for DSR and Becker, et al's., (2009) maturity model requirements.

Guidelines for DSR (Hevner, et al., 2004)	Maturity model requirements (Becker, et al., 2009)
1. Design as an artefact	DR1: Comparison with existing models
2. Problem relevance	DR5: Identification of problem relevance DR6: Problem definition
3. Design evaluation	DR3: Evaluation
4. Research contributions	DR1: Comparison with existing models
5. Research rigour	DR4: Multi-methodological procedure
6. Design as a search process	DR2: Iterative procedure DR3: Evaluation
7. Communication of research	DR7: Targeted presentation of results DR8L Scientific documentation

2.4.1.3 Design Science Research Contribution Framework

Design Science Research can contribute in several different forms. Gregor with Hevner (2013) propose a knowledge contribution framework for DSR as illustrated in Figure 11. *Improvement* offers a solution that might be more efficient or safe than the existing solution. An *invention* offers a novel solution and is an innovation for an unknown problem. *Exaptation* is the adaptation of an existing solution to an unknown problem while a *routine design* aims at making minor adjustments to an existing solution for a problem that is well-known.

Only *improvement*, *invention* and *exaptation* can be accepted as research contributions, while *routine design* would rarely be considered as a research contribution. For any knowledge to be considered as a significant contribution to research, it has to be considered as significant concerning the current state of the knowledge in the applicable research area and must be considered interesting (Vaishnavi & Kuechler, 2004).

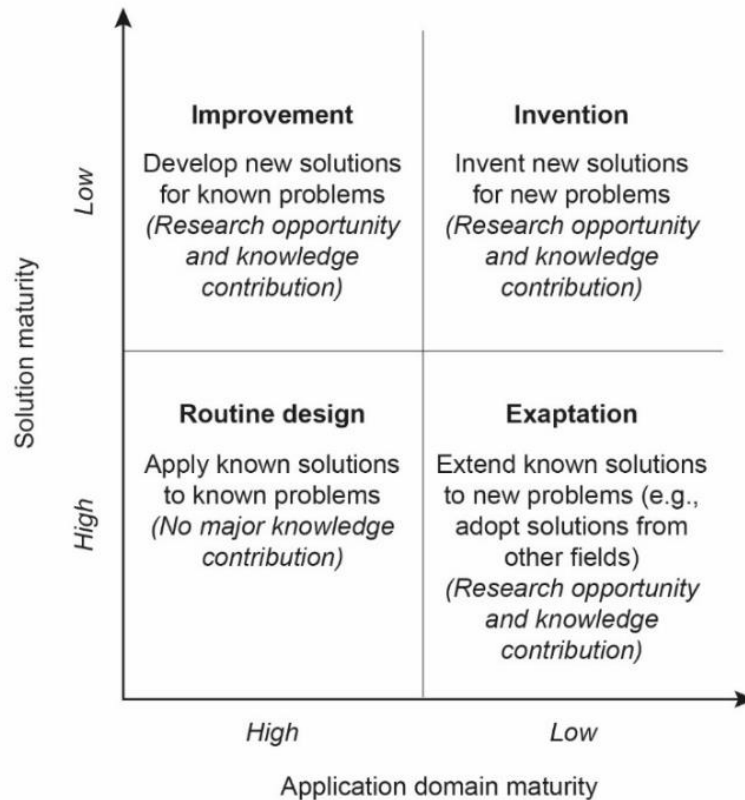


Figure 11: DSR knowledge contribution framework (Gregor & Hevner, 2013)

In Chapter 11, it will be argued that the LLMM developed in this study falls within the top-left, improvement quadrant, where a new solution is provided for a known problem in the field of Industrial Engineering.

2.4.2 Systematic literature review

To establish a sound theoretical foundation for the model development approach used in this study, a rigorous approach to identify, analyse and extract data from literature must be utilised.

Although literature reviews are commonly used in most research to synthesise and present data, they provide little scientific value if the review is not thorough and fair – which is the main rationale for undertaking a systematic literature review (Kitchenham & Charters, 2007). A systematic literature review (SLR) is a methodology used to identify, evaluate and interpret all relevant research pertaining to a specific research question, topic area or phenomenon of interest (Kitchenham & Charters, 2007). This methodology uses explicit and systematic methods to reduce bias and produce findings from which conclusions can be drawn and decisions made (Liberati, et al., 2009).

The SLR process utilised in this study is based on the guidelines for an SLR as proposed by Kitchenham with Charters (2007). It is based on three primary phases and provides a reliable

method for performing a comprehensive review of the literature. These three phases are (a) Planning; (b) Conducting and (c) Reporting.

During the *planning* phase, the need for a new review is first identified, which stems from the requirement to summarise all available information pertaining to a specific phenomenon in a thorough and unbiased manner (Kitchenham & Charters, 2007). Next, the research questions are specified, which is considered as the most important part of an SLR as it drives the entire methodology (Kitchenham & Charters, 2007). The final step of the planning phase is to develop the research protocol (Kitchenham & Charters, 2007). The research protocol states the methodologies used to undertake the SLR and helps reduce possible bias (Xiao & Watson, 2019; Kitchenham & Charters, 2007).

During the *conducting* phase, the primary studies are first identified (Xiao & Watson, 2019). Those individual studies that contribute to the systematic review are referred to as *primary studies* (Kitchenham & Charters, 2007). In this step, the aim is to identify as many primary studies as possible relating to the research questions or objectives (Kitchenham & Charters, 2007). Once potential studies have been identified, their actual relevance needs to be assessed. This is done through the study selection criteria, which is used to identify the primary studies that provide clear evidence of the research questions (Kitchenham & Charters, 2007; Xiao & Watson, 2019). An inclusion & exclusion criteria and study quality assessment based on the research questions is typically used for a study selection criteria to reduce the likelihood of bias (Kitchenham & Charters, 2007). Then, data is extracted from the primary studies, typically through a data extraction form, and synthesised either descriptively or quantitatively (Kitchenham & Charters, 2007).

Finally, during the *reporting* phase of the SLR, the findings from the literature review are disseminated and reported to interested parties (Kitchenham & Charters, 2007; Xiao & Watson, 2019).

2.4.3 Applied thematic analysis

Considering the explorative nature of this study, applied thematic analysis (ATA) is a fitting method to use for the extraction of data from the SLR as it aims to analyse data systematically and report themes (or patterns) contained within the data (Braun & Clarke, 2006; Guest, et al., 2012). ATA is also a rigorous and inductive set of procedures designed to identify and examine themes from textual data in a manner that is transparent and credible (Guest, et al., 2012). It consists of grounded theory, positivism, interpretivism and phenomenology, all combined into one methodological framework (Guest, et al., 2012).

ATA requires involvement and interpretation from the researcher and, in turn, transcends the typical *counting of words or phrases* approach to focus on identifying and describing implicit and explicit concepts contained within the data (Braun & Clarke, 2006). Central to ATA is a process called *coding*, where themes are systematically created through the development of codes and their specific application to segments of data potentially relevant to the research questions (Herzog, et al., 2019). The main difference between a *code* and a *theme* is that a *code* is “the single idea related to a specific piece of the data being examined and consists of labels that identify what is interesting about the data” (Braun & Clarke, 2019), while a *theme* is “a common, recurring pattern across a dataset, clustered around a central organising concept” (Braun & Clarke, 2019).

ATA also adopts qualitative techniques in combination with interpretive and other techniques to address the research problem (Guest, et al., 2012). The six phases of ATA adopted in this study are; 1) becoming familiar with the data, 2) generating the initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes and, 6) producing the report. All these phases and how they are applied to the study will be elaborated on in Chapter 6.

2.4.4 Delphi technique

According to Nordin, et al. (2012, p.3), validation is “a process where a judgement is made on whether a tool is fit for purpose”. There are also numerous validation methods available. For validating a framework, Inglis, (2008) proposes six different approaches; (1) reviewing the research literature; (2) seeking inputs from a panel of experts; (3) undertaking empirical research; (4) undertaking survey research; (5) conducting pilot projects and; (6) drawing on case studies.

For this study, input was obtained from a panel of experts on lean leadership by utilising the Delphi technique. The Delphi technique, which has its origin in the 1950’s Rand Corporation and was primarily developed by Dalkey with Helmer (1963), is a common and widely accepted method for achieving convergence of opinion regarding real-world knowledge obtained from experts within a specific domain (Hsu & Sandford, 2007). This consensus-building is achieved through the distribution of a series of questionnaires targeted at a panel of experts (Hsu & Sandford, 2007). The rationale for utilising the Delphi technique to validate the proposed LLMM is predicated on the fact that:

- There is no need for the panel to meet physically – which is unrealistic for a busy group of professionals and academics (Nordin, et al., 2012);
- Multiple iterations designed to obtain consensus regarding lean leadership are employed (Nordin, et al., 2012);

- Using a panel of experts significantly reduces the level of bias compared to only relying on one expert alone (Nordin, et al., 2012);
- It allows for the quantitative analysis and interpretation of data through the statistical aggregation of the panel's response (Skulmoski, et al., 2007) and;
- Due to anonymity, the Delphi participants can freely express their opinions without unwarranted social pressure to conform to other's in the group (Skulmoski, et al., 2007).

Skulmoski, et al. (2007) provides the following phases when using the Delphi technique, which will be elaborated on in the sections to follow:

1. Research sample (panel of experts);
2. Development of the research question;
3. Development of Delphi round one questionnaire;
4. Development of Delphi round two questionnaire;
5. Development of Delphi round three questionnaire;
6. Verify, Generalise and Document Research Results.

2.4.4.1 Research sample (panel of experts)

The panel of experts selected to participate in the survey should meet the following criteria (Skulmoski, et al., 2007):

- Knowledge and experience with the issues being investigated;
- Capacity and willingness to participate;
- Enough time to participate in the Delphi technique and;
- Effective communication skills.

Furthermore, concerning the panel size, representation is assessed by the *quality* of the panel rather than the *number* of participants (Nordin, et al., 2012). The Delphi technique does not call the panel of experts to be a representative sample but rather selects participants for their ability to answer the research questions (Nordin, et al., 2012; Skulmoski, et al., 2007). While there are no concrete rules for selecting a panel of experts, Skulmoski, et al. (2007) propose that the following points should be kept in mind;

- A smaller sample panel of between ten to fifteen participants should suffice where a group is homogeneous. For a heterogeneous group, a larger sample may be required, and several hundred people could participate;
- As a sample size increases, there is a reduction in group error or increase in the decision quality. However, once a certain threshold is reached, managing the Delphi

process and analysing the data becomes increasingly difficult and the advantages of a bigger sample become redundant;

- The results can be verified more convincingly with a larger panel and follow-up research will not be required. For a master's thesis, a single round of Delphi study will often suffice whereas, for a PhD, the Delphi should usually be verified with a follow-up study (Skulmoski, et al., 2007).

2.4.4.2 Development of the research question

The research question is formulated in several ways and is developed to determine the study's purpose (Skulmoski, et al., 2007)

2.4.4.3 Development of Round 1 questions

In theory, the Delphi technique can be iterated until consensus has been achieved (Hsu & Sandford, 2007). However, two to three iterations should be enough for collecting the required information in most research (Hsu & Sandford, 2007; Skulmoski, et al., 2007). In the first round, the research questions are used to develop the Delphi questionnaire, which is distributed to the participants, returned after a certain period and then analysed according to the research paradigm. It is important to develop the questions in a way that no ambiguity is present since it might confuse the participants who might, as a result, provide inappropriate answers or become frustrated with the process (Skulmoski, et al., 2007). The questions should be specific and seek agreement between the participants by means of rating or ranking techniques such as a Likert scale (Nordin, et al., 2012; Skulmoski, et al., 2007).

2.4.4.4 Development of Round 2 questions

The responses received from the first round form the foundation for the second-round questionnaire (Skulmoski, et al., 2007). Each participant from round 1 is first given the opportunity to verify that the answers initially submitted are a true reflection of their views. Then, the participants can either change or expand their responses from round 1 now that the opinions from other researchers are shared with them (Skulmoski, et al., 2007). Finally, as with round 1, the participants are requested to complete another round of questions, which is again solicited and analysed according to the research paradigm.

2.4.4.5 Development of Round 3 questions

Responses from round 2 are used to develop the questionnaire for round 3. However, additional questions are included to verify the results from the previous round, understand the research boundaries and where the results can be expanded (Skulmoski, et al., 2007). Round 3 also follows a similar process used to analyse the data in round 2. The participants are again

allowed to review and amend their answers as they deem appropriate and to comment on the emerging perspective of the panel. The process can stop once the research question is answered or consensus is reached.

2.4.4.6 Verify, generalise and document the results

In this phase, the results obtained from the Delphi technique are verified (which is usually done through continuous Delphi) and the generalisability of the results are also investigated (Skulmoski, et al., 2007). Once completed, the artefact can be presented.

This concludes an overview of the research methods and paradigms relevant to this study. In the next section, the research design followed throughout this study will be discussed.

2.5 Conclusion: Literature review

This chapter explored the characterisations, theories and approaches relevant to this study. First, the concept of lean leadership and core factors that sustain it was explored. Next, background was given to the concepts related to maturity models and an overview of the research methods and paradigms applicable to this study was provided. Through this chapter, the following research objectives are addressed:

- **Research Objective 1:** “Explore the concept of lean leadership and clarify the core factors that sustain it.”
- **Research Objective 2:** “Explore the concepts behind maturity models and outline the methods relevant to the study.”

This chapter also answered the following research questions:

- **Research Question 1.1:** “What are the characterisations and theories of lean and lean leadership?”
- **Research Question 2.1:** “What are the characterisations and theories of maturity models?”
- **Research Question 2.2:** “What are the different development approaches relevant to maturity models?”
- **Research Question 2.3:** “What research methods are relevant to this study?”

In the next chapter, the research design followed in this study will be explained.

CHAPTER 3: RESEARCH DESIGN

3.1 Introduction

In this chapter, the research design that was followed for this study is explained. For each phase of this study (and their respective chapters), the research methods used, research objectives addressed and research questions answered are summarised in Figure 12. Each of the phases to follow will stem from this research overview.

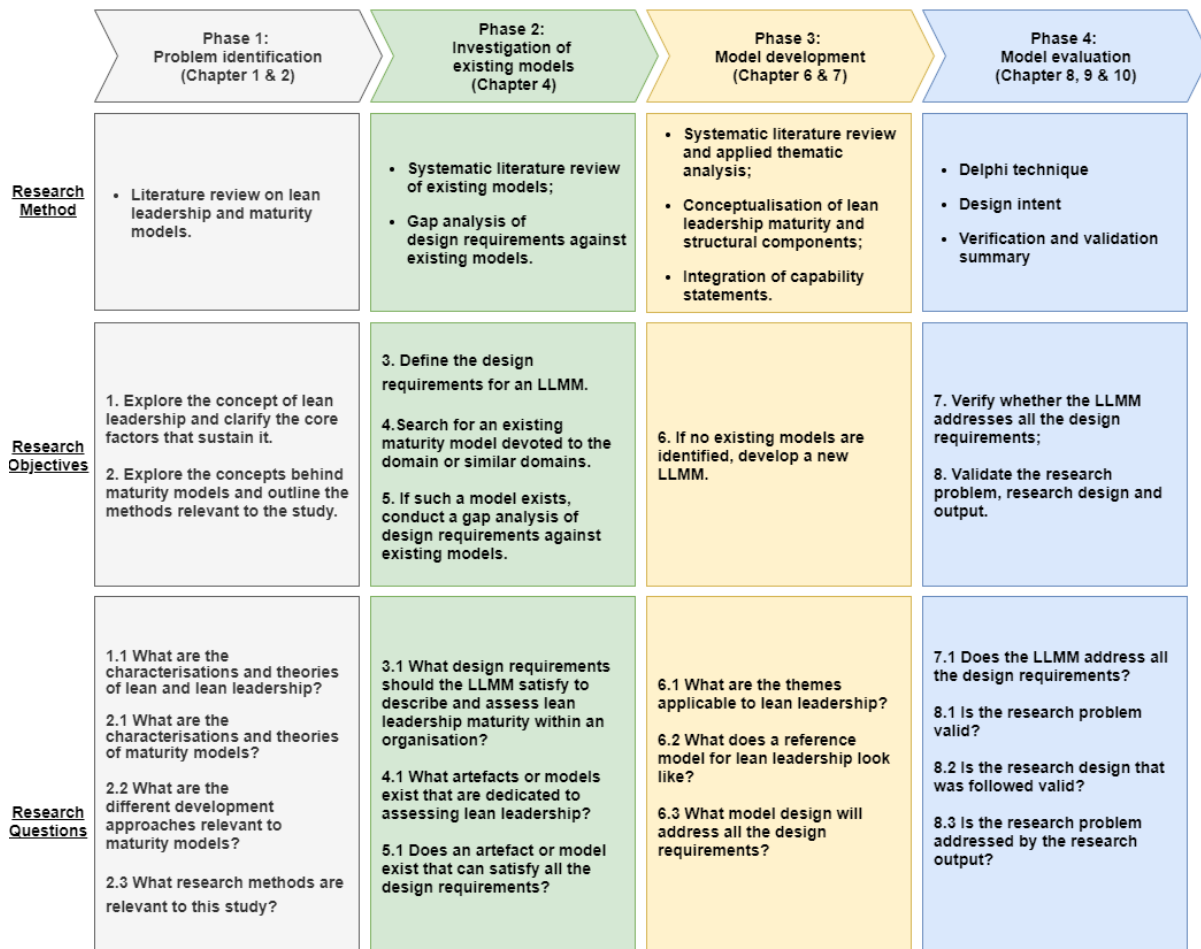


Figure 12: Overview of research phases and respective research methods, -objectives, and -questions

According to Cresswell with Plano Clark (2007, p.58), *research design* is the “procedures for collecting analysing, interpreting and reporting data in research studies”.

As indicated in Chapter 1, a need has been identified for an artefact that is dedicated to describing and assessing the maturity of lean leadership within an organisation, which could contribute towards more successful lean implementation. This can be addressed through the development of maturity models, which are artefacts that aim to solve problems within a

company by determining the existing state of its capabilities and deriving improvement measures therefrom (Becker, et al., 2009).

For the model development approach utilised in this study, a simplified version of Becker et al.'s (2009) procedure model is adopted - as proposed by Neff, et al. (2014). This approach is utilised mainly because of its foundation in DSR and popularity within the field of maturity model development. In Neff, et al.'s. (2014) approach, the procedure model of Becker et al. (2009) is condensed into a four-step process to reduce the complexity of the development process.

This comparison between Becker et al.'s. (2009) procedure model and the simplified approach by Neff, et al.'s. (2014) is also presented in Table 11. Each of the four steps presented by Neff, et al. (2014) will be adopted as "Phases" in this study.

Table 11: Comparison of the procedure models adopted in this study

Becker et al's. (2009) eight-step procedure model	Neff, et al's. (2014) simplified procedure model
1. Problem definition	1. Problem definition
2. Comparison of existing models	2. Comparison of existing models
3. Development strategy	3. Iterative model development
4. Iterative MM development	
5. Concept of transfer and evaluation	4. Model evaluation
6. Implementation of transfer media	
7. Evaluation	
8. Rejection (or acceptance) of MM	

Figure 13 illustrates how these four phases are adopted and merged as a research design for this study along with their respective research methods, chapters and objectives. The top-left quadrant (grey section) outlines the first phase of the research, namely *Problem identification*. The top-right quadrant (green section) outlines the *Investigation of existing models* phase while the bottom-right quadrant (blue section) indicates the *Model development* phase. Finally, the model development is concluded with the *Model evaluation* phase in the bottom-left quadrant (yellow section). Each of the blue circles indicates the chapter numbers relevant to that section. The white circles indicate the applicable research objective (as stated in Chapter 1).

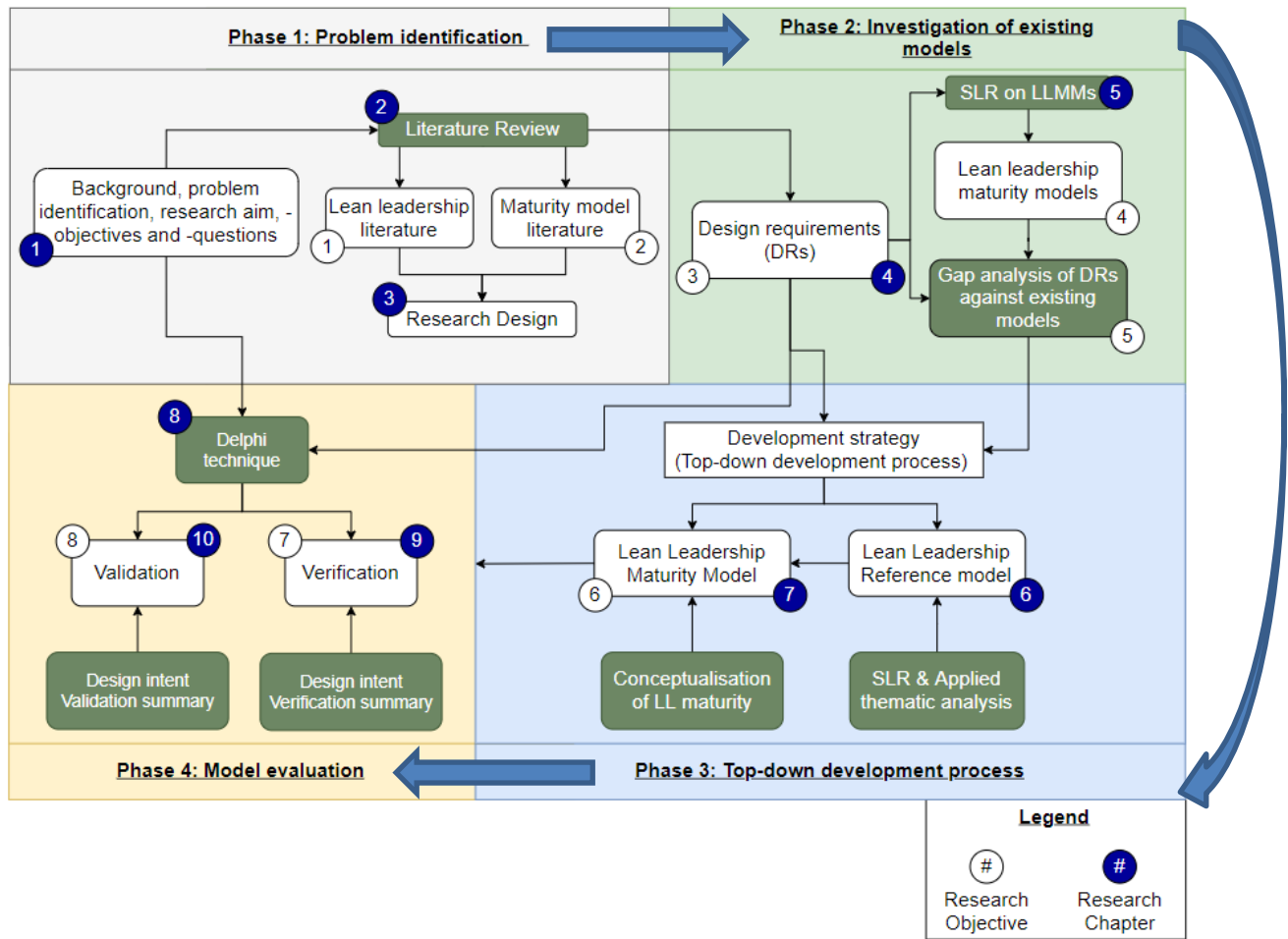


Figure 13: Research Design (Inspired by van Dyk, (2013))

The details of each phase of the development approach are discussed in the sections to follow.

3.2 Phase 1: Problem identification

Table 12 presents the research overview for the first phase of the LLMM development, namely *Problem identification*. Here, the objective was to define the focus of the model, which determined its specificity and extensibility (De Bruin, et al., 2005).

Table 12: Phase 1 research overview – Problem identification

Phase 1: Problem identification	
Research Method	Literature review.
Research Objectives	1. Explore the concept of lean leadership and clarify the core factors that sustain it. 2. Explore the concepts behind maturity models and outline the methods relevant to the study.
Research Questions	1.1 What are the characterisations and theories of lean and lean leadership? 2.1 What are the characterisations and theories of maturity models? 2.2 What are the different development approaches relevant to maturity models? 2.3 What research methods are relevant to this study?

In the first part of Phase 1 (Chapter 1), the research problem is stated, along with the practical relevance and justification of this study. This is followed by a literature review on the two primary research areas (lean leadership and maturity models) to explicate the problem, which is relevant to the second part of Phase 1 (Chapter 2).

For the literature review, current scientific literature was consulted to evaluate the state of the art and summarise the characterisations, theories and approaches relevant to this study. This included consulting peer-reviewed sources such as publications in journals and conference proceedings along with academic books, theses, dissertations and industry white papers from both research areas.

3.3 Phase 2: Investigation of existing maturity models

Table 13 presents the research overview for the second phase of the LLMM development, namely *Investigation of existing models*.

Table 13: Phase 2 research overview – Investigation of existing models

Phase 2: Investigation of existing models	
Research Method	• Systematic literature review. • Gap analysis of design requirements against existing models.
Research Objectives	3. Define the design requirements for an LLMM. 4. Search for an existing maturity model devoted to the domain or similar domains. 5. If such a model exists, conduct a gap analysis of design requirements against the identified model(s).
Research Questions	3.1 What design requirements should the LLMM satisfy to describe and assess lean leadership maturity within an organisation? 4.1 What artefacts or models exist that are dedicated to assessing lean leadership? 5.1 Does an artefact or model exist that can satisfy all the design requirements?

As the first input to Phase 2, a set of **design requirements** for an LLMM (Chapter 4) were developed based on the design requirements for a descriptive maturity model as presented by Pöppelbuß with Röglinger (2011). These design requirements are used as a central control mechanism to guide the rest of the study.

Next, a **systematic literature review** (Chapter 5) was conducted based on the guidelines of Kitchenham with Charters (2007) to search for any existing maturity models or artefacts related to lean leadership that seemed fitting to address the design requirements for an LLMM. Studies were selected using an inclusion-exclusion criteria in conjunction with a study quality assessment to ensure rigour.

Phase 2 contributes to the novelty of the LLMM as it provides the necessary controls to create a *unique* solution in the form of an artefact. It also serves as an input to the development strategy that will be discussed in the next phase.

3.4 Phase 3: Artefact design: Top-down model development

An SLR of the selected databases and review protocol presented in Phase 2 did not produce any lean leadership maturity models and, subsequently, none of the design requirements could be satisfied through this process. Based on the development approach proposed by Becker, et al. (2009) and Neff, et al. (2014), a new model had to be developed. This model is referred to as the lean leadership maturity model (LLMM). For this phase, a *Top-down model development* approach is utilised according to the research overview as outlined in Table 14:

Table 14: Phase 3 research overview – Top-down model development

Phase 3: Top-down model development	
Research Method	• Systematic literature review and applied thematic analysis; • Conceptualisation of lean leadership maturity and structural components; • Integration of capability statements.
Research Objectives	6. If no existing models are identified, develop a new LLMM.
Research Questions	6.1 What are the themes applicable to lean leadership? 6.2 What does a reference model for lean leadership look like? 6.3 What model design will address all the design requirements?

The scientific approaches followed in the model development resemble the frameworks of De Bruin, et al. (2005); Becker, et al. (2009); Solli-Sæther with Gottschalk (2010) and von Wangenheim, et al. (2010) as it accounts for the need to combine multiple research methods.

The LLMM was first theoretically conceptualised in terms of themes and subthemes related to the domain, which were identified through a **systematic literature review (SLR)** and **applied thematic analysis (ATA)**. This was used to develop a lean leadership reference model (LLRM) and establish the theoretical foundation of the LLMM (Chapter 6).

From the 17 studies selected, data were systematically extracted by utilising the applied thematic analysis technique to develop a list of themes and subthemes to establish a more comprehensive understanding of lean leadership maturity. As with the SLR conducted in Phase 2, eligible studies were selected using an inclusion-exclusion criterion in conjunction with a study quality assessment.

ATA was used for the data extraction as it serves as an effective method to identify, analyse and report specific patterns (themes) in qualitative data (Braun & Clarke, 2006). The utilisation

of an SLR and accompanying ATA in Chapter 6, therefore, play a crucial role in establishing a sound theoretical foundation for the LLMM.

Next, the LLMM was conceptualised in terms of its central constructs related to the application domain as outlined in Chapter 7. This, along with the approach followed in Chapter 6, was used to determine *what* represents lean leadership maturity. Thereafter, it is determined *how* maturity can be measured, where capability statements are formulated within the conceptual framework to form the model's assessment criteria (De Bruin, et al., 2005).

3.5 Phase 4: Model evaluation

Table 15 presents the research overview for the fourth and final phase of the LLMM development, namely *Model evaluation*.

Table 15: Phase 4 research overview – Model evaluation

Phase 4: Model evaluation	
Research Method	• Design intent • Delphi technique • Summary of verification & validation
Research Objectives	7. Verify whether the LLMM addresses all the design requirements. 8. Validate the research problem, research design and output.
Research Questions	7.1 Does the LLMM address all the design requirements? 8.1 Is the research problem valid? 8.2 Is the research design that was followed valid? 8.3 Is the research problem addressed by the research output?

Once the model was developed, its relevance and rigour needed to be tested. The model is considered complete and accurate once it is verified and validated with the intended scope and design requirements.

Verification and validation

The *verification* process is used to determine whether the LLMM addresses all the design requirements developed in Phase 2. To prove this, the verification process had three inputs (Chapter 9):

- **Design intent:** A retrospective review on the model design process is provided that indicates the initial intent of the design requirements while the LLMM was developed. Verification of the LLMM against the self-developed design requirements is done.
- **Delphi technique:** A summary of the verification results for each design requirement obtained through the Delphi technique is provided.

- **Verification Summary:** A summary is provided that confirms the adherence of all requirements relevant to this study.

The *validation* process is used to determine whether the study is based on a valid research problem, follows a valid research design and can confirm that the research output addresses the research problem. To prove this, the validation process has three inputs (Chapter 10):

- **Research problem:**
 - It is explained how the Delphi technique was used to validate the first aspect of the research problem, which is that “the success rate of lean implementation is highly dependable on the lean leadership capabilities of an organisation and, therefore, the lack of mature lean leadership creates a barrier to successful lean implementation”.
 - Next, it is explained how both the SLR in Chapter 5 and the Delphi technique were used to validate the second aspect of the research problem later identified in the study; which is that “no artefact currently exists that is solely dedicated to describing or assessing lean leadership within an organisation”.
- **Research design** – A retrospective review of the research process is provided to determine the validity of the research design. Here, the research design is evaluated against the guidelines for DSR.
- **Research output** – The validity of the research output is provided based on the Delphi technique.
- **Validation summary** – A summary of the validation requirements applicable to this study is presented.

3.6 Conclusion: Research Design

The aim of this study is to develop a lean leadership maturity model that can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders. Furthermore, the purpose of the LLMM is for organisations to assess their current lean leadership maturity, in order to determine the status quo and starting point of development.

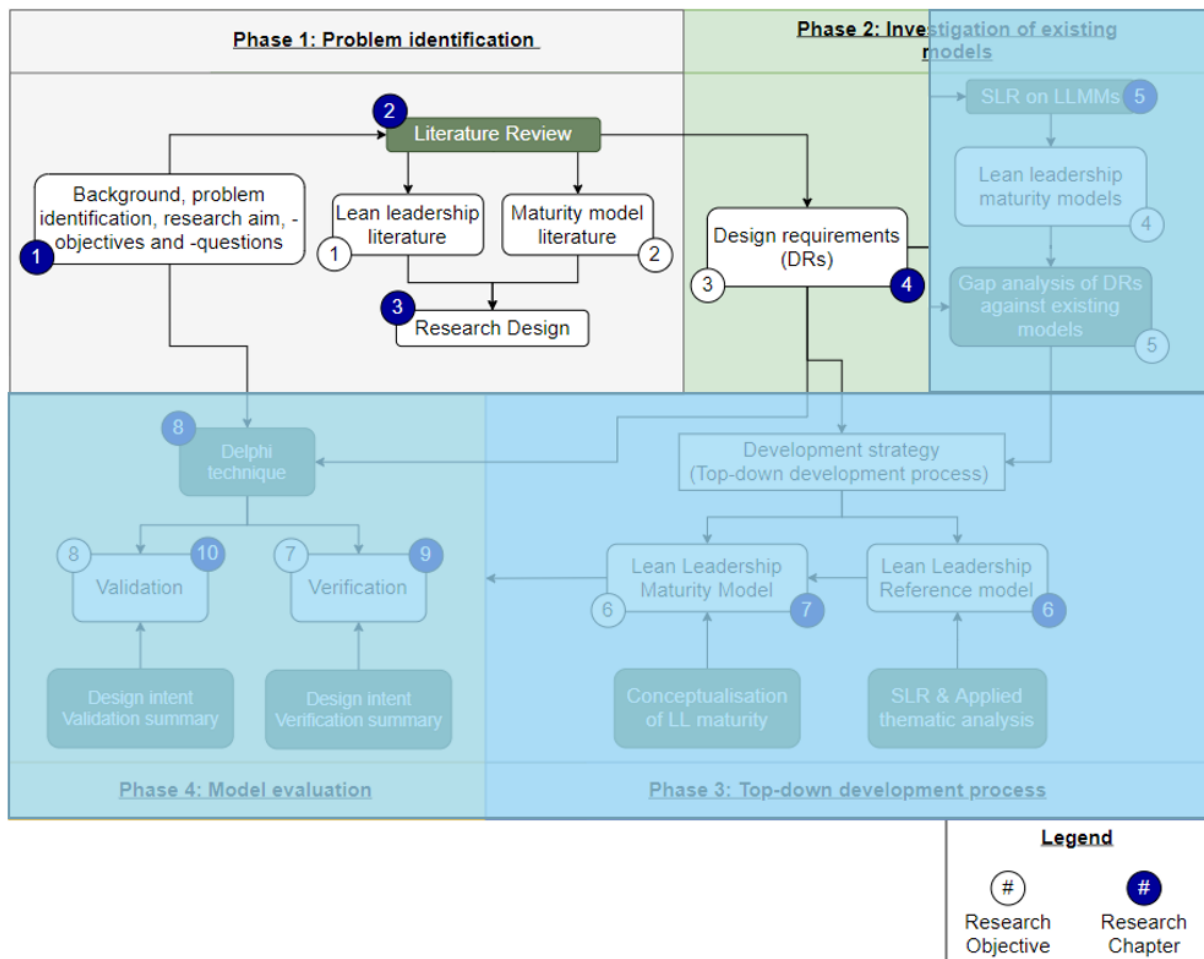
This chapter concludes the discussion on the research design followed to accomplish the research aim.

CHAPTER 4: DESIGN REQUIREMENTS FOR A LEAN LEADERSHIP MATURITY MODEL

4.1 Introduction

The design requirements for a LLMM are formulated in this chapter based on the foundation set by the literature review in Chapter 2. They form the control for further development and application are determined. In particular, the model design incorporates the needs of the envisioned audience, whether internal or external and how these needs will be addressed (De Bruin, et al., 2005). The needs of the stakeholders are signified in *why* they want to apply the model (driver of application), *how* the model can be applied throughout organisational structures and *what* can be achieved through the model's application (De Bruin, et al., 2005). Also, determining how the model will be reported to the stakeholders is also defined. Here, it is decided whether maturity will be represented by a series of one-dimensional stages or by layers that are represented by the domain, domain components and sub-components (De Bruin, et al., 2005). As noted in Chapter 2, a *descriptive approach* will be adopted for the LLMM's purpose of use, which will enable organisations to gain deeper insights into their current strengths and weaknesses related to the domain.

The first part of Phase 2 is done according to the green section indicated in the top-right of Figure 14. The transparent blue blocks indicate the sections of the research design that are still to be explored.



Furthermore, an overview of the research methods, -objectives, and -questions applicable to the first part of Phase 2 is presented in Table 16:

Phase 2: Investigation of existing models	
Research Method	N/A
Research Objectives	3. Define the design requirements for an LLMM.
Research Questions	3.1 What design requirements should the LLMM satisfy to describe and assess lean leadership maturity within an organisation?

Pöppelbuß with Röglinger (2011) propose general design principles for the development of maturity models based on an extensive literature review on the topic. Their study contributes to the rigour of maturity model development. Their principles are grouped into three main categories below, illustrating how they relate to this study. The first category includes the

design requirements related to the methodology, the second to the design requirements of the LLMM itself and the third to a descriptive purpose of use.

Design requirements related to the methodology

- Differentiation from related maturity models;
- Design;
- Definition of central constructs related to maturity, maturation and the application domain;
- Target group-oriented documentation.

Design principles related to the LLMM

- Prospective application domain and conditions for application;
- Purpose of use;
- Target group;
- Class of entities under consideration;
- Maturity dimensions;
- Maturity levels and maturation paths.

Design principles related to descriptive use

- Intersubjectively verifiable criteria for each level of maturity and granularity.

4.2.1 Prospective application domain and conditions for application

The focus of the LLMM's application is domain-specific and concerns leadership within organisations that have embarked or are considering embarking on the lean journey. Focusing the domain will enable the proposed model to be distinguished from existing models and determine its specificity and extensibility (De Bruin, et al., 2005).

This leads to the first design requirement for an LLMM:

Design Requirement 1: The LLMM describes lean leadership.

The application of the LLMM is also not restricted by the phase of lean implementation of the entity under consideration:

Design Requirement 2: The model can be applied any point in time regardless of the lean implementation phase.

4.2.2 Purpose of use

In the Section 2.3.9, the key differences between descriptive, prescriptive and comparative models were outlined. The LLMM is designed for *descriptive* use. It will first be developed as

a diagnostic tool used for descriptive purposes to describe the “ideal” domain state through a set of ideal statements. Thereafter, capability statements will be formulated for each maturity level to describe the “as is” situation. As explained in Section 2.3.9, a sound understanding of the as-is situation is first required before reputable and substantial improvements can be made – which emphasises the need to first develop a descriptive model before a prescriptive approach can be applied.

Design Requirement 3: The LLMM can function as a diagnostic tool of as-is lean leadership.

Contributing to the world of science, the LLMM should also be used to educate stakeholders on lean leadership.

Design Requirement 4: The LLMM can be used as a foundation for educating stakeholders.

4.2.3 Target group

Maturity models are primarily aimed at two target groups, one who applies the model (internal audience) and the other to whom the assessment results are reported to (internal- and external audience) (Pöppelbuß & Röglinger, 2011; De Bruin, et al., 2005). Both these audiences must have an interest in the organisation’s performance, either by being responsible for or benefiting from it.

The targeted internal audience of the LLMM pertains to all levels of organisational leadership as they possess the expertise and knowledge to assess their lean leadership capabilities and are usually directly responsible for the implementation of lean. These individuals must be accountable for organisational-wide activities or processes and may represent various functions such as manufacturing, product development, supply chain etc. Additionally, individuals not actively involved in the implementation of lean but who are often engaged in organisational change projects of the company under consideration, such as auditors and consultants, are also considered as internal audiences. Some or all of the internal audiences may be involved in the assessment process.

However, team collaboration from various functional areas within the organisation is encouraged during the assessment process as this will eliminate single-respondent bias and enable a cross-functional perspective of the assessment (Fraser, et al., 2002). This also promotes team building and consensus among staff and provides a platform for education and organisational learning.

The external target audience of the LLMM includes individuals in the academic environment that is interested in advancing lean leadership maturity.

Design Requirement 5: The model enables a self- or group-oriented assessment from individuals across multiple functional areas levels.

4.2.4 Class of entities under consideration

According to Rosemann, et al. (2004), “an entity to which the model is applied can be an entire organisation or subset of an organisation such as a geographical location, a division, a business unit or a subsidiary”. The entity to consider must be selected prior to the design in order to improve the model’s generalisability. The LLMM is not entity-specific, but can rather be applied to a broad scope:

Design Requirement 6: The model can be used to assess lean leadership maturity of multiple organisational entities and is not restricted by the size or location of the organisation under consideration.

4.2.5 Differentiation from related maturity models

The differences to related maturity models of the same or similar application domains need to be stated in order to allow the comparison of models. In Chapter 5, the aim is to search for maturity models of the same or similar applications, and a comparison framework is used to differentiate between “design” and “usability” facets of existing models (if any) of the same or similar domains.

Design Requirement 7: The design and usability facets of the LLMM clearly differs from existing models.

4.2.6 Model design

Based on DSR, the maturity model design should be easily understood by the target group (Pöppelbuß & Röglinger, 2011):

Design Requirement 8: The LLMM design can be understood by the audience.

4.2.7 Central constructs related to maturity and maturation

According to Pöppelbuß with Röglinger (2011), the central constructs of maturity and maturation paths concerning the class of entities and application domain under consideration must be clearly defined. This includes the underlying concept of maturity along with its capability areas and maturity levels. Such explication can either be one-dimensional or multi-dimensional.

Design Requirement 9: The LLMM operationalises maturity in a multi-dimensional manner.

Maturity levels are central components of maturation paths and are depicted by several levels or stages, where the higher number builds on the characteristics of the lower levels (Pöppelbuß & Röglinger, 2011; Mettler & Rohner, 2009).

Design Requirement 10: The LLMM follows a unidirectional and linear path of cumulative stages from lower- to higher maturity. The stage progression is logical.

4.2.8 Central constructs related to the application domain

In addition to constructs related to maturity and maturation, maturity models also must include definitions of central constructs related to the application domain (Pöppelbuß & Röglinger, 2011):

Design Requirement 11: The LLMM includes definitions of central constructs related to the application domain.

4.2.9 Intersubjectively verifiably criteria for each maturity level and level of granularity

An assessment criteria for each maturity level and level of granularity must be proposed for maturity models that follow a descriptive approach (Pöppelbuß & Röglinger, 2011). Also, maturity models that use multiple dimensions to operationalise maturity can refer to these dimensions for deducing and structuring the assessment criteria (Pöppelbuß & Röglinger, 2011). For the LLMM, the assessment criteria will consist of various capability statements, each describing the capability areas as they apply to a specific maturity level:

Design Requirement 12: The capability statements are mutually exclusive.

Design Requirement 13: The capability statements are collectively exhaustive

4.3 Conclusion: Design requirements

In this chapter, the design requirements for a LLMM were formulated based on the theoretical foundation provided by the literature review and the general design principles for the development of maturity models as proposed by Pöppelbuß & Röglinger (2011). The following research objective was addressed by this chapter:

- **Research Objective 3:** “Define the design requirements for an LLMM.”

Furthermore, this chapter also answered research question 3.1:

- **Research Question 3.1:** “What design requirements should the LLMM satisfy to describe and assess lean leadership maturity within an organisation?”

The next chapter aims to investigate if an artefact exists that is dedicated to assessing lean leadership and, if so, whether an artefact exists that can satisfy all the design requirements developed in this chapter.

CHAPTER 5: INVESTIGATION OF EXISTING MODELS

5.1 Introduction

In the previous chapters, a literature review of lean leadership and maturity models was conducted to determine the underlying theories related to this study. Also, a set of design requirements for an LLMM were formulated. These design requirements are used to compare different design and usability facets of models investigated in this chapter to ultimately determine if a model exists that can satisfy all the LLMM design requirements. If no suitable model is identified, a brand-new model must be developed. The section of the research design related to the second part of Phase 2 is presented in Figure 15. The transparent blue blocks indicate the sections of the research design that are still to be explored.

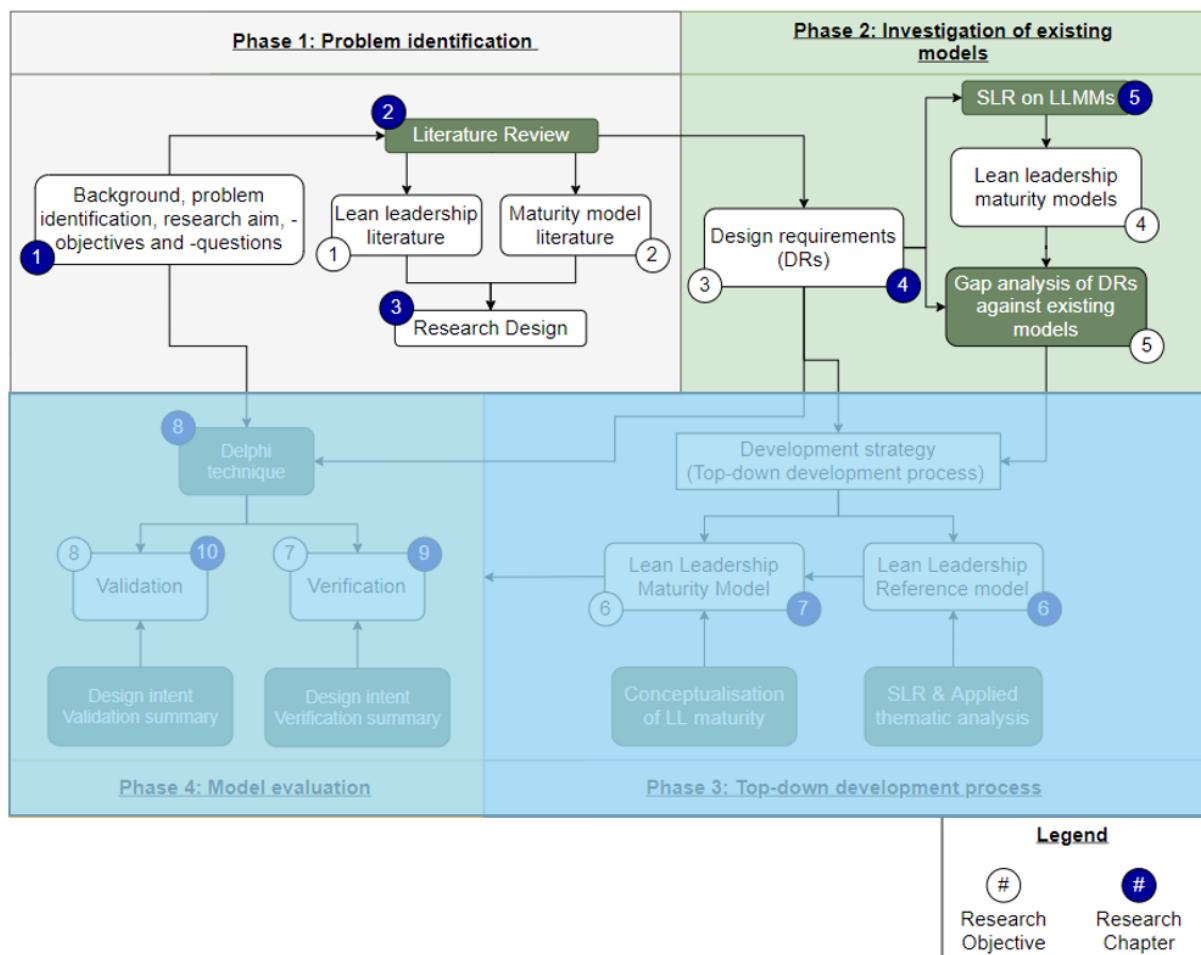


Figure 15: Section of the research design relevant to the second part of Phase 2

Furthermore, an overview of the research methods, -objectives, -questions and design requirements applicable to the second part of Phase 2 is presented in Table 17:

Table 17: Overview of research methods, -objectives, -questions and design requirements applicable to the second part of Phase 2

Phase 2: Investigation of existing models	
Research Method	• Systematic literature review. • Gap analysis of design requirements against existing models.
Research Objectives	4. Search for an existing maturity model devoted to the domain or similar domains. 5. If such a model exists, conduct a gap analysis of design requirements against the identified model(s).
Research Questions	4.1 What artefacts or models exist that are dedicated to assessing lean leadership? 5.1 Does an artefact or model exist that can satisfy all the design requirements?
Applicable design requirements	DR 7: The design and usability facets of the LLMM clearly differs from existing models.

5.2 Systematic literature review: Lean leadership maturity models

The investigation of existing maturity models was done through a systematic literature review (SLR) as it aims to identify studies relevant to the problem, assess their quality and to comprehensively summarise their findings by making use of a scientific method. In this study, the guidelines used to perform an SLR as developed by Kitchenham with Charters (2007) will be adopted as depicted in Figure 16:

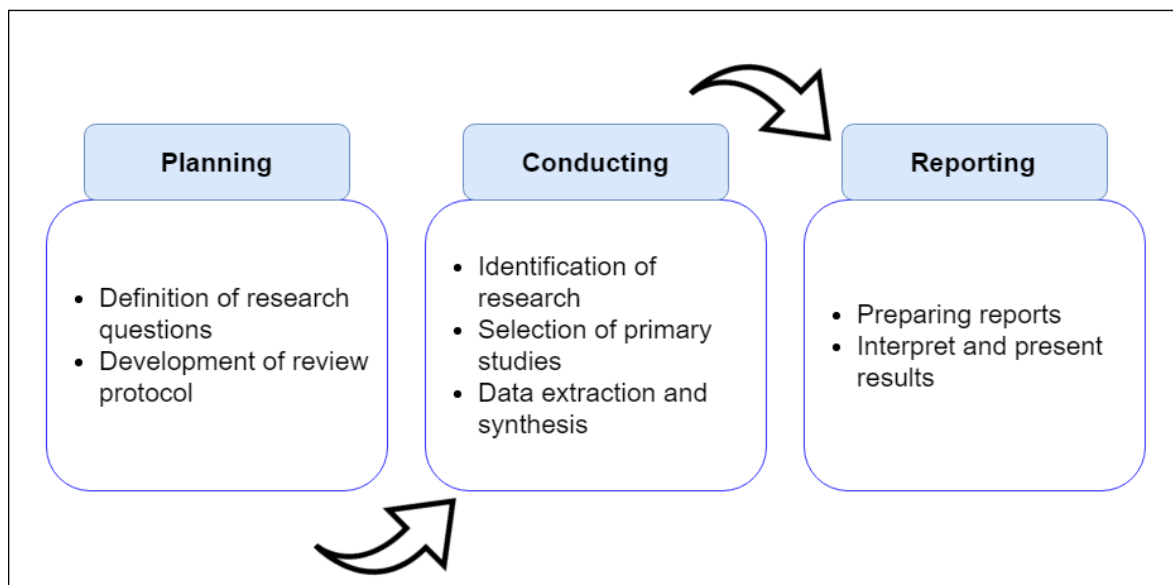


Figure 16: Process for performing an SLR (Kitchenham & Charters, 2007)

5.2.1 Step 1: Definition of research questions

The review questions are formulated in the planning phase of the SLR. These questions serve as the most important element of an SLR as they drive the entire systematic review process for the following reasons (Kitchenham & Charters, 2007):

- The research questions must be addressed through the primary studies identified in the search process;
- The data extraction process must deliver data that answers the research questions;
- In the data analysis phase, data must be synthesised in such a way that the research questions can be answered.

5.2.2 Step 2: Development of review protocol

The review protocol describes the data sources used, search strategy, the process used to select the primary studies, the development of the inclusion/exclusion (I/E) criteria and the study quality assessment used for screening of publications. The intent of the study screening criterion (I/E criteria and quality assessment) is to ultimately identify studies that provide clear evidence about the research questions (Kitchenham & Charters, 2007).

The quality of each study must be assessed as it provides a more detailed inclusion and exclusion criteria, reduces the risk of bias and allows a means to measure each study's relevance (Kitchenham & Charters, 2007). Although no agreed definition of study "quality" exists, both the *Cochrane Reviewer's Handbook* and *Centre of Reviews and Dissemination (CRD)* propose that quality is determined by the extent in which a study reduces bias and enhances internal and external validity (Kitchenham & Charters, 2007). Bias, in this case, is defined as a "tendency to produce results that depart systematically from the 'true' results". (Kitchenham & Charters, 2007)

Reputable Electronic Database Sources (EDS's) such as *Emerald Insight*, *Web of Science*, *Science Direct*, *EBSCOhost*, *Scopus* and *Taylor & Francis Online* are selected for this review. These EDS's cover a broad scope of scientifically validated and peer-reviewed literature and offer journals that publish meaningful articles on lean management and -leadership. All EDS's were systematically searched using their *Advanced Search* function to identify publications related to LLMMs. To ensure a broad as possible search scope is covered, *leadership* and *management* were considered as similar terms since the literature may use these two words interchangeably, and both were included in the keywords. Using Google as a platform to identify relevant literature is excluded from this study since the search could provide poor-quality, non-scientifically validated literature or lead to selection bias.

The initial abstract search comprised of the search strings, exactly as they were entered into the database: (“Lean leadership maturity” OR “Lean management maturity”) AND (model OR framework OR instrument OR matrix). The search process was conducted between October – December 2019.

The general process used to conduct the initial abstract search is indicated in Figure 17.

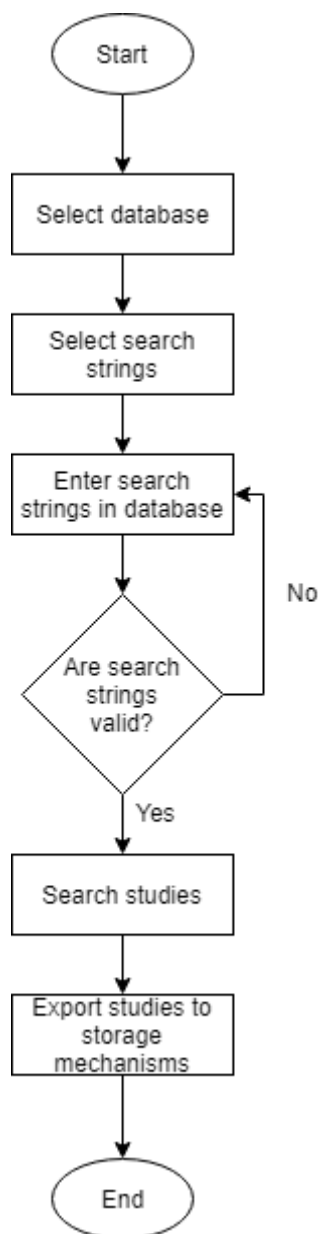


Figure 17: Process used to conduct the initial abstract search

The I/E criteria are used to govern the selection of primary studies. This is demonstrated in Table 18 and was developed based on the predefined research questions.

Table 18: Inclusion & exclusion criteria for the investigation of existing models

Inclusion Criteria	Exclusion Criteria
- Articles are written in English or Afrikaans - Sets out to develop a model, framework, matrix, instrument or self-assessment tool.	- Any language other than English or Afrikaans Uses an existing model, framework, matrix, instrument or self-assessment tool as an exploratory method to survey or assess external organisations. - Literature review on different models, frameworks, matrices, instruments or self-assessment tools
Lean <i>management</i> implying the <i>leadership</i> or <i>managerial</i> aspect of lean as described in Chapter 2.	Lean <i>management</i> implying the <i>continuous improvement</i> philosophy or <i>lean manufacturing</i>.
Peer-reviewed publications, journals, conferences proceedings, PhD theses, government publications and dissertations.	Grey literature (editorials, books, book reviews, essays, opinions, presentations).
Lean philosophy as defined in Chapter 2 is the underlying premise of the study.	- Lean is used in conjunction with other CI initiatives such as <i>Six Sigma</i>; <i>TQM</i>; <i>TPM</i>; or <i>JIT</i>. - Lean refers to a diet or physical appearance
Full text available.	Only abstracts or partial text is available.

Grey literature was intentionally excluded from the I/E criteria since it does not qualify as a reliable proxy for quality and, unlike the peer-reviewed factor, is not necessarily an indicator of scientifically validated knowledge (Adams, et al., 2017). In addition, the search- and data synthesis process is also made more manageable by only focusing on publications that are adjudicated and accessible through esteemed electronic database sources. The literature that is typically recognised as grey literature include editorials, books, book reviews, essays opinions and presentations (Bellefontaine & Lee, 2013; Benzies, et al., 2006; Conn, et al., 2003; Adams, et al., 2017).

Furthermore, since this study sets out to develop purely a lean leadership maturity model, lean's relationship with other continuous improvement initiatives is also excluded from the SLR process. This is done to ensure the output of this study, which is the LLMM, is purely based on lean leadership capabilities and not influenced by the potentially unique leadership capabilities that are demanded by other initiatives such as Six Sigma, TQM, TPM or JIT.

The quality of selected studies is assessed by applying the quality criteria checklist (Table 19) as proposed by Kitchenham with Charters (2007). Studies that passed the I/E criteria were reviewed for the second round of screening. A weight of 1 point is assigned to each “Yes” answer and 0 points to each “No” answer of the quality criteria. The maximum score a primary study can obtain is 4 points, with a minimum requirement of 2 (50% of 4) allowed for the study to be considered as a viable piece of data. The sum of each article’s quality score is rated from 0 (very poor) to 4 (excellent) and any study scoring below the minimum threshold of 2 was excluded from the final list of primary studies.

Table 19: Study quality assessment for the investigation of existing models

Question	Answer
Is a valid maturity model development process followed, and if so, does the article present a detailed description of the model development process?	Yes/No
Is the primary domain focus of the model on lean leadership?	Yes/No
Does the model include an assessment instrument and/or assessment questions?	Yes/No
Is the model evaluated or tested empirically?	Yes/No

5.2.2.1 Review protocol evaluation

A checklist (Table 20) based on the guidelines as defined by the Centre of Reviews and Dissemination (CRD) was utilised by the co-researcher to evaluate the review protocol. This process was reviewed and evaluated by the co-author in October 2019 to ensure any risk of bias was eliminated.

Table 20: Checklist to evaluate the SLR review protocol (adapted from the Centre of Reviews and Dissemination)

Guidelines	Value
Definition of review rationale/objective.	Yes
Definition of research questions.	Yes
Definition of the search strategy.	Yes

Definition of study selection criteria and procedures (inclusion, exclusion).	Yes
Definition of quality assessment checklist and procedures.	Yes
Definition of a data extraction strategy.	Yes
Definition of data synthesis strategy and differentiation between selected studies.	Yes

5.2.3 Step 3: Identification of research

Throughout this phase, the search strings defined in the review protocol were used to systematically search for studies in various EDS's.

5.2.4 Step 4: Selection of studies

Primary studies were identified by first screening the abstracts of the initial search papers using the I/E criteria. Those sources that met the I/E criteria were then downloaded into the Mendeley® application, where duplicates were removed automatically. This was followed by screening the full text of each study using the quality assessment.

5.2.5 Step 5: Data extraction and synthesis

Finally, once all studies were identified, the data required to answer the review questions were extracted where after the results are synthesized.

A data extraction form is utilised to accurately capture the information collected throughout the review and an excel template is created in which the elements of the data extraction form are captured for each study identified (Kitchenham & Charters, 2007). The elements of the extraction form were used to primarily answer Research Question 4.1 (Do any dedicated LLMMs exist?) are:

- Model name/acronym;
- Name of author(s);
- Year of publication;
- Purpose;
- Assessment scope;
- Presence of lean leadership;

Furthermore, a comparison framework is defined to answer Research Question 5.1 (Do LLMMs exist that satisfies all the design requirements?). This allows for an accurate method of collecting attributes related to the basic structure of the identified maturity model's *design*

and its *usage*, which are used for comparison with the design requirements defined earlier in this study. *Design* and *usage* facets (Figure 18) are defined for the comparison framework as inspired by Mettler, et al. (2009). For the design facet, components such as the domain, capabilities and dimensions are considered. For the usage facet, components such as the purpose of use, audience applicable and assessment criteria are considered.

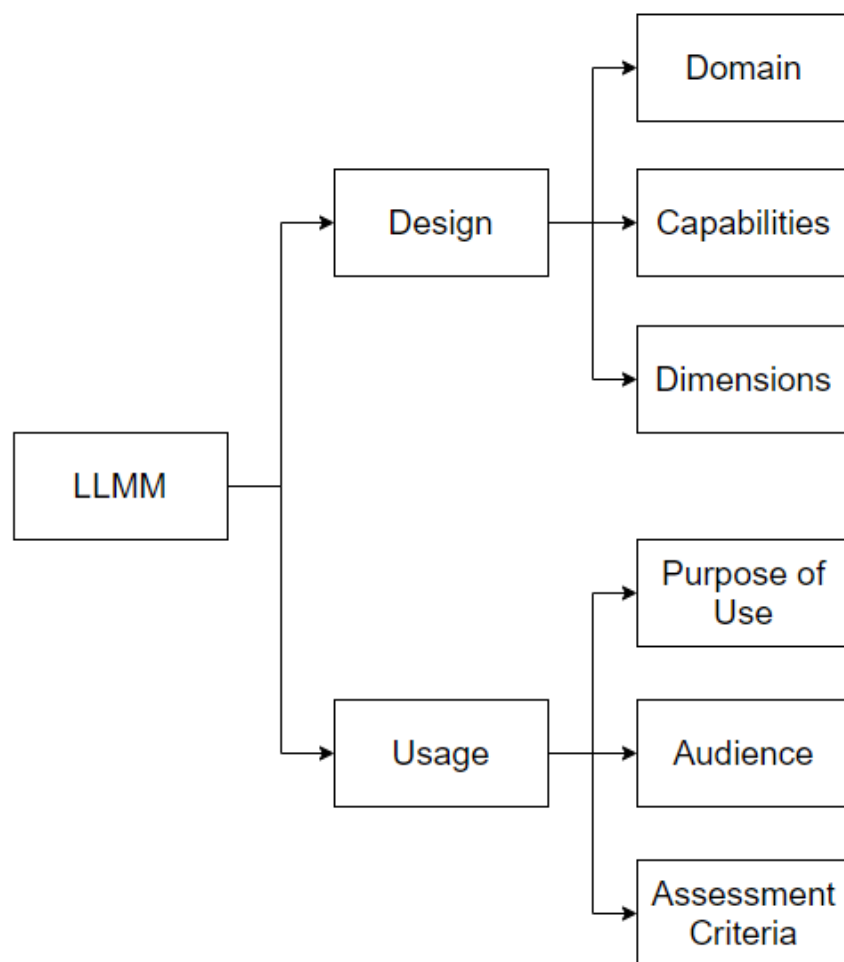


Figure 18: Comparison framework for *design* and *usability* facets of maturity models - inspired by Mettler, et al., (2009)

5.3 Findings

Following the initial keyword search, a total of 42 eligible studies were identified as indicated in Table 21.

Table 21: Findings of initial keyword search per EDS

String A	String B	Emerald Insight	Web of Science	EBSCO-host	Science Direct	Scopus	Taylor & Francis	Total per phrase
Lean leadership maturity	Model	1	0	0	0	1	0	2
	Framework	1	0	0	0	1	0	2
	Instrument	1	0	0	0	1	0	2
	Matrix	0	0	0	0	0	0	0
Lean management maturity	Model	1	0	1	2	12	0	16
	Framework	1	0	0	2	9	0	12
	Instrument	0	0	1	1	3	0	5
	Matrix	1	0	0	0	2	0	3
Total per EDE		6	0	2	5	29	0	42

The I/E criteria were then systematically applied to the abstracts of studies identified in their respective databases. No studies were able to successfully pass the I/E criteria, as indicated in Table 22.

For example, Urban's (2015) Lean Management Maturity Self-assessment Tool Based on Organizational Culture Diagnosis was one of two articles identified through entering the search string "Lean management maturity" AND model in *Science Direct*. Although this article seemed promising at first, following the application of the I/E criteria, it was clear that the model presented by Urban (2015) referred to *lean management* as the lean improvement philosophy rather than the managerial (leadership) aspect of lean – immediately disqualifying it from the list. When studying the model further, it was clear that *leadership* was not the primary focus and only represents a very small component of the overall maturity model as it is used in conjunction with other elements such as *associated value streams* and *operational improvement*.

Similar exclusions were witnessed for the majority of the studies, where most did not refer to *lean management* in the context presented by this study or the article did not set out to develop a model.

Table 22: Findings after application of I/E criteria

String A	String B	Emerald Insight	Web of Science	EBSCO-host	Science Direct	Scopus	Taylor & Francis	Total per phrase
Lean leadership maturity	Model	0	0	0	0	0	0	0
	Framework	0	0	0	0	0	0	0
	Instrument	0	0	0	0	0	0	0
	Matrix	0	0	0	0	0	0	0
Lean management maturity	Model	0	0	0	0	0	0	0
	Framework	0	0	0	0	0	0	0
	Instrument	0	0	0	0	0	0	0
	Matrix	0	0	0	0	0	0	0
Total per EDE		0	0	0	0	0	0	0

Based on these findings, it is evident that maturity models explicitly dedicated to assessing lean leadership could not be identified. This means that, according to Becker et al's. (2009) proposal for model development strategies stated in Section 3.3, "enhancing an existing model", "combining several models into a new model" and, "transferring structures and contents from existing models into new application domains" cannot be used as a development strategy for the LLMM. The only remaining approach left is to completely design a new model.

5.4 Conclusion: Investigation of existing models

This study stems from the research problem as stated in Chapter 1: Lean is a well-established continuous improvement methodology that has the potential to enhance all aspects of business performance. However, the success rate of lean implementation is highly dependable on the lean leadership capabilities of an organisation and, therefore, the lack of mature lean leadership creates a barrier to successful lean implementation.

This chapter set out to investigate if a maturity model devoted to the domain or similar domain of lean leadership exists and if so, to conduct a gap analysis of design requirements against existing models to determine if the identified model/s can address all the design requirements for an LLMM. Using a rigorous SLR to identify an artefact that can address the gap, it can be concluded that a maturity model explicitly dedicated to assessing lean leadership was not identified through the applicable review protocol and selected databases.

Consequently, this chapter addresses the following research objectives:

- **Research Objective 4:** "Search for an existing maturity model devoted to the domain or similar domains."

Since no models could be identified through the SLR of selected databases, Research Objective 5 is automatically addressed and no gap analysis was required.

- **Research Objective 5:** "If such a model exists, conduct a gap analysis of design requirements against the identified model(s)."

Also, the answers to the following research questions are:

- **Research Question 4.1:** "What artefacts or models exist that are dedicated to assessing lean leadership? – None
- **Research Question 5.1:** "Does an artefact or model exist that can satisfy all the design requirements?" – No

Furthermore, the following design requirement is addressed in this chapter:

- **Design Requirement 7:** “The design and usability facets of the LLMM clearly differs from existing models.”

Therefore, the next two chapters are dedicated to addressing this gap through the development of a new, lean leadership maturity model (LLMM).

CHAPTER 6: LEAN LEADERSHIP REFERENCE MODEL

“The biggest gap in capabilities in the lean movement, and the root cause of failure on many lean programs, is in leadership.” - Liker with Convis, (2012, p.13)

6.1 Introduction

This study aims to find or develop a LLMM that can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders. The purpose of the LLMM is for organisations to assess their current lean leadership maturity to determine the status quo and the starting point of development.

From the previous chapter, it could be concluded that no maturity models devoted to the domain of lean leadership or similar domains currently exist and, therefore, none of the design requirements could be addressed by a single model. Based on this finding, the next objective is to develop a new LLMM that will be able to address the design requirements for an LLMM as was developed in Chapter 4 (Becker, et al., 2009).

According to Lasrado, et al. (2015), one of the three common criticisms of maturity models is the lack of solid theoretical foundations where the structure (Dimensions, maturity levels etc.) is not grounded in literature.

To address the gap that maturity models are rarely grounded in a solid theoretical foundation, a lean leadership reference model will first be developed based on an in-depth systematic literature review and applied thematic analysis. According to De Bruin et al. (2005), for a relatively mature domain, an extensive literature review will be enough for the identification of maturity model domain components. This is also in accordance with a top-down model development approach (De Bruin, et al., 2005).

The section of the research design applicable to the first part of Phase 3 is illustrated in the bottom-right section (light blue) of Figure 19. The transparent blue blocks indicate the sections of the research design that are still to be explored.

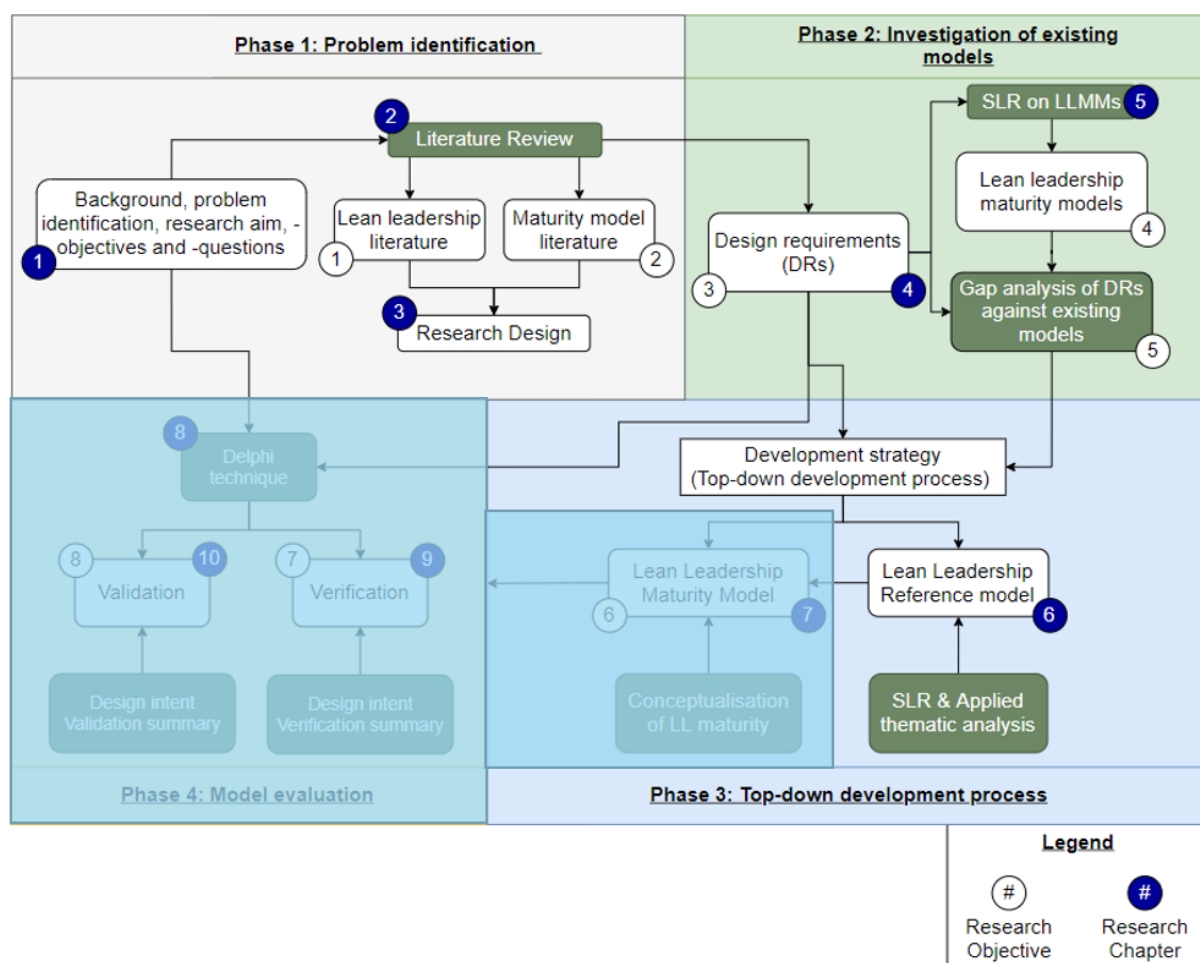


Figure 19: Section of the research design relevant to the first part of Phase 3

Furthermore, an overview of the research methods, -objectives, -questions and design requirements applicable to the first part of Phase 3 is presented in Table 23:

Table 23: Overview of research methods, -objectives, -questions and design requirements applicable to the first part of Phase 3

Phase 3: Top-down model development	
Research Method	Systematic literature review and applied thematic analysis;
Research Objectives	6. If no existing models are identified, develop a new LLMM.
Research Questions	6.1 What are the themes applicable to lean leadership? 6.2 What does a reference model for lean leadership look like?
Applicable design requirements	- DR 2: The model can be applied any point in time regardless of lean implementation phase. - DR 4: The LLMM can be used as a foundation for educating stakeholders. - DR 6: The model can be used to assess lean leadership maturity of multiple organisational entities and is not restricted by the size or location of the organisation under consideration.

6.2 Systematic Literature Review: Lean leadership

Similar to Chapter 5, this SLR will adopt the guidelines developed by Kitchenham with Charters (2007) to identify primary studies relevant to the research questions presented in this chapter.

6.2.1 Step 1: Definition of research questions

The research questions applicable to this section are stated in Table 23.

6.2.2 Step 2: Development of review protocol

Again, the EDS's selected for this review include *Emerald Insight*, *Web of Science*, *Science Direct*, *EBSCOhost*, *Scopus* and *Taylor & Francis Online* as they cover a broad scope of peer-reviewed literature and offer journals that publish meaningful articles on lean management and leadership. These EDS's were also systematically searched using their *Advanced Search* function to identify quantitative, qualitative and mixed-method publications related to lean leadership. The initial abstract search comprised of the search strings: ("Lean leadership") AND ("capabilities" OR "dimensions" OR "practices").

As stated in Section 5.2.2, Google is excluded as a search platform for relevant literature due to the uncertainties surrounding the quality and consistency of its search results.

Upon completion of the initial searches, abstracts were screened using the I/E criteria in Table 24:

Table 24: Inclusion & exclusion criteria for the development of a lean leadership reference model

Inclusion Criteria	Exclusion Criteria
Articles are written in English or Afrikaans since these are the author's native and second languages	Any language other than English and Afrikaans
Full text available	Only abstract or preview is available
Article published between 2000 and 2019	Article published before 2000
Peer-reviewed publications journals, conferences proceedings, PhD theses, government publications, industry reports, white papers and dissertations.	Grey literature (editorials, books, book reviews, essays, opinions, presentations).
Literature includes both <i>lean</i> and <i>leadership</i> or <i>management</i> in either their title, abstract or keywords – with <i>management</i> referring to a position of authority within an organisation (supervisor, executive, middle manager etc.)	<i>Lean management</i> referring to the continuous improvement philosophy (similar to lean manufacturing) and has nothing to do with an individual's position of authority or organisational hierarchy. Leadership/management styles or other leadership theories in conjunction with lean (transformational, transactional, directive, empowering, servant.)
Lean philosophy is the central continuous improvement paradigm of the study.	Lean is used in conjunction with other CI initiatives: (Six Sigma, TPM, JIT, agile, etc.)
Purpose of the study focuses primarily on lean leadership	The study focuses on other factors or barriers of lean – with lean leadership being an element thereof; Lean leadership AND <i>any other theory or practice</i>

As with Section 5.2.2, grey literature was excluded from the search criteria to maintain a reliable proxy for quality and ensure manageability of the SLR process. Also explained in section 5.2.2, other CI initiatives are excluded from the criteria since the main CI paradigm of

this study is lean and not its correlation with other initiatives. This is done to ensure that the output of this study (a LLMM) is controlled by the input of this SLR.

The quality of selected studies is assessed by applying the quality criteria checklist (Table 25) as proposed by Kitchenham with Charters (2007). A weight of 1 point is assigned to each “Yes” answer and 0 points to each “No” answer. The maximum score a primary study can obtain is therefore 4 points, with a minimum requirement of 2 allowed. The sum of each article’s quality score can therefore be rated from 0 (very poor) to 4 (excellent) and any study scoring below the minimum threshold of 2 was excluded from the final list of primary studies.

Table 25: Study quality assessment for the development of a lean leadership reference model

Question	Answer
The study provides at least five unique lean leadership characteristics. This is to ensure enough unique data can be extracted from all the literature to make up the components of the LLMM.	Yes/No
A brief explanation or example of each lean leadership characteristic is given and is not just mentioned individually as part of a list.	Yes/No
Lean leadership characteristics either have empirical inputs, feedback, testing or validation from more than one functionally and demographically distributed organisation (such as a case study of a single company) or respondent.	Yes/No
Lean leadership characteristics are ranked/weighted	Yes/No

In this case, it is noteworthy to highlight that no restrictions were placed on the industry, domain or demography of a sample group since this study argues that lean leadership principles do not differ between industries but can rather be applied to any specific industry or organisation, regardless of size or location. This makes provision for the following design requirement:

- **Design Requirement 6:** The model can be used to assess lean leadership maturity of multiple organisational entities and is not restricted by the size or location of the organisation under consideration.

No restrictions were placed on the phase of lean implementation which an organisation is in. This study takes a standpoint that the lean leadership capabilities, principles, behaviours or

attitudes (as with lean principles) remain constant throughout all phases of lean implementation. This is controlled by the following design requirement:

- **Design Requirement 2:** The model can be applied at any point in time regardless of the lean implementation phase.

Furthermore, the rigour of the SLR in combination with the ATA synthesises a large amount of in scattered information available on lean leadership into a focused and coherent dataset. This will enable the education of stakeholders within both the academic and professional communities, making provision for the following design requirement:

- **Design Requirement 4:** The LLMM can be used as a foundation for educating stakeholders.

6.2.2.1 Review protocol evaluation

A checklist (Table 26) based on the guidelines as defined by the *Centre of Reviews and Dissemination* is utilised by the co-author to evaluate the review protocol. This process was reviewed by the co-researcher to ensure any risk of bias was eliminated.

Table 26: Checklist to evaluate the SLR review protocol (adapted from the Centre of Reviews and Dissemination)

Guidelines	Value
Definition of review rationale/objective.	Yes
Definition of research questions.	Yes
Definition of the search strategy.	Yes
Definition of study selection criteria and procedures (inclusion, exclusion).	Yes
Definition of quality assessment checklist and procedures.	Yes
Definition of a data extraction strategy.	Yes
Definition of data synthesis strategy and differentiation between selected studies.	Yes

6.2.3 Step 3: Identification of research

Throughout this phase, the search strings defined in the review protocol are used to systematically search for studies in various electronic database sources (EDS). The “Advanced” search function in the selected EDS’s was used to conduct the search process.

6.2.4 Step 4: Selection of studies

Studies were identified by first screening the abstracts of the initial search papers using the I/E criteria. Those sources that met the I/E criteria were then downloaded into the Mendeley® application, where duplicates were removed automatically. This was followed by screening the full text of each study using the quality assessment

6.2.5 Step 5: Data Extraction & Synthesis

Data were extracted systematically by utilising the Applied Thematic Analysis (ATA) technique as it serves as an effective method to identify, analyse and report specific patterns (themes) in qualitative data (Braun & Clarke, 2006).

The six-phase framework for thematic analysis as developed by Braun with Clarke (2006) is followed in this study as explained in the following section.

6.2.5.1 Phase 1: Becoming familiar with the data

To establish a general overview of the data and core underlying concepts, the entire data set was actively read once while taking general notes on initial themes that could potentially emerge. Next, the sections within the primary studies pertaining to lean leadership were highlighted within the Mendeley® application. The highlighted data was read and re-read in order to become familiar with various patterns that occur.

6.2.5.2 Phase 2: Generating initial codes

During this phase, the data extracts were arranged into meaningful groups through a coding process. The main concern was with addressing the research questions defined earlier in this chapter and the data was, therefore, analysed with this in mind. Initial coding was done through a deductive rather than inductive approach, where each segment of data relevant to the research question highlighted in phase 1 was coded instead of coding every piece of text line-by-line. As a starting point for developing themes, “in-vivo” coding was done, assigning a label to each section of data by using a phrase or word taken from that data section.

Emphasis was placed on the organisational leader’s specific *tasks*, *behaviours*, the effect of the *tasks* or *behaviours*, *intentions* and *understanding* that contributed to lean.

For example, the following piece was extracted from Aij, et al. (2015, p.126)

“A Lean leader trusts their staff and not only dares to delegate responsibility to the work floor but also considers it part of their own role to coach the people there to enhance their problem-solving abilities”

From this excerpt, a lean leadership *behaviour* can be identified as “trusting their staff” while *tasks* such as “delegating responsibility” and “coach the people there (at the work floor)” are highlighted. The *intention* of coaching at the shop floor is “to enhance their people’s problem-solving abilities” – which is the effect of an observable action. Also, by “delegating responsibility to the work floor”, it can be implied that leaders demonstrate that they “trust their staff”.

Consider another example based on a piece extracted from Dombrowski with Mielke (2014, p.569):

“Managers can develop their employees directly at the Gemba and do not need any exemplary tasks or training material”

Again, an observable action is highlighted as the “development of employees”. This development is done “at the Gemba” (otherwise known as the place where actual work is done) and does not require “any exemplary tasks or training material”. In other words, this extract implies that the development of people is done on the shop floor and learning is done by doing, solving actual rather than conceptual problems.

Based on these two extracts from different authors, the following codes were developed:

- Delegate responsibility;
- Trust staff.
- Coach at the Gemba;
- Learn by doing.

It can then be reasoned that the underlying aim of these codes is to *develop people* – which could potentially form a theme or subtheme.

All of this was done using the qualitative analysis software ATLAS. ti to create a list of unique words relevant to the research questions. Those codes with no semantic value were excluded to ensure that only groups relevant to the research questions remained.

The outcome of this phase was a comprehensive list of codes on how the data answers the research question(s).

6.2.5.3 Phase 3: Searching for themes

Once all data was coded, collated and a list of codes with semantic value had been developed, phase 3 was initiated (Braun & Clarke, 2006). Here, the analysis was refocused on a wider level of themes. Various codes were arranged into potential themes and all relevant coded

data sets grouped within the identified themes (Braun & Clarke, 2006). This grouping was done through a hierarchical framework as illustrated in Figure 20:

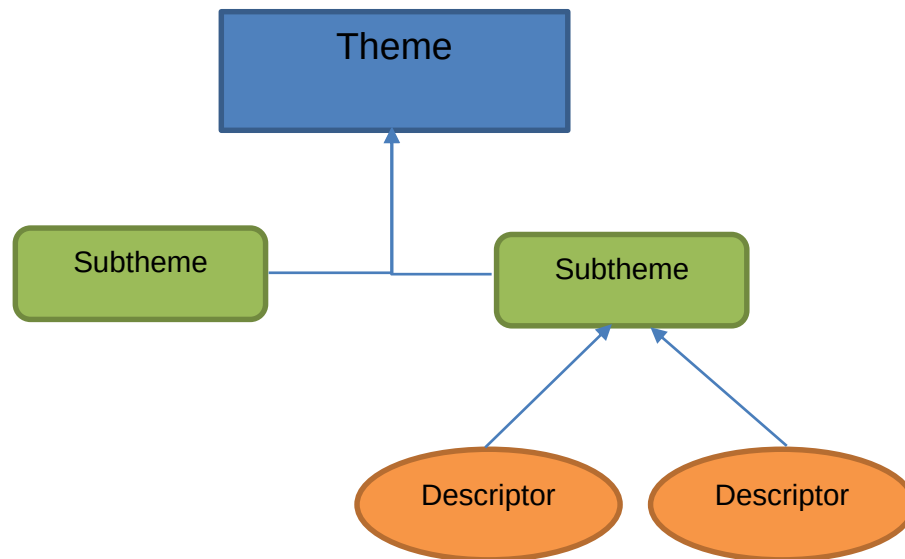


Figure 20: Hierarchical framework for themes, subthemes and descriptors

For example, by grouping the codes developed earlier, the following potential themes, sub-themes and descriptors could be identified;

1. Potential Theme: Coaching People
 - a. Subtheme 1: Training
 - i. Descriptors:
 1. Learn by doing;
 2. Gemba.
 - b. Subtheme 2: Enablement
 - i. Descriptors:
 1. Delegate responsibility;
 2. Trust staff.

Braun with Clarke (2019, p.2) state that a theme “tends to describe the different facets of a pattern across a dataset”. Similarly, according to Braun with Clarke (2019, p.2), subtheme “shares the same central organising concept as the theme but focuses on one notable specific element”.

This implies that a subtheme must consist of sections of fundamental *elements* that relate to and define the theme. These *elements* will later be defined as *capability areas*.

The candidate themes identified were primarily descriptive in nature, meaning that they described patterns in the data related to the research questions. Based on this, an initial thematic map of the themes and subthemes was developed.

6.2.5.4 Phase 4: Reviewing themes

During this stage, all candidate themes and subthemes were reviewed and modified iteratively (Braun & Clarke, 2006). According to Braun with Clarke (2006), there should be a meaningful coherence between the data within the themes as well as clear distinctions between final themes – supporting mutual exclusivity.

This phase was done in two levels:

Firstly, the extracts that fit into each theme were re-read to determine whether the candidate themes formed a coherent pattern. Thereafter, candidate themes initially developed in the previous stage were revised to improve the mutual exclusivity of the data.

Secondly, the validity of individual themes in relation to the entire data set was considered along with whether the initial thematic map is an accurate representation of the meanings evident in the dataset (Braun & Clarke, 2006). Wherever the relationships between the themes did not reflect the meaning of the entire dataset, phase 3 (searching for themes) and phase 4 (reviewing themes) were repeated until a satisfactory thematic map of the data is created.

6.2.5.5 Phase 5: Defining names and themes

In phase 5, each of the themes was defined and further refined, identifying the essence of the theme and what aspect of the data it captures (Braun & Clarke, 2006). The data extracts for each theme were organised into an internally consistent and coherent account with a complementing narrative. Consequently, a final thematic map was developed which, for this study, will be referred to as the lean leadership reference model.

Furthermore, a detailed analysis was written for each theme to not only describe what story it tells, but also how it fits into the broader, overall “story” that is being told about the data. In other words, each lean leadership theme was described in terms of its respective subtheme and how the combination of them all relate to the application domain.

6.2.5.6 Phase 6: Producing the report

The final phase of the ATA is dedicated to the writing of the report and ultimately, a description of the results, which will be discussed in Section 6.3.

6.3 Findings

In the following section, the findings from the SLR and ATA will be reported respectively.

6.3.1 Systematic literature review: Lean leadership

The search process for applicable studies was conducted over two weeks from 2020/01/12 – 2020/01/27 and followed the selection process as depicted in Figure 21:

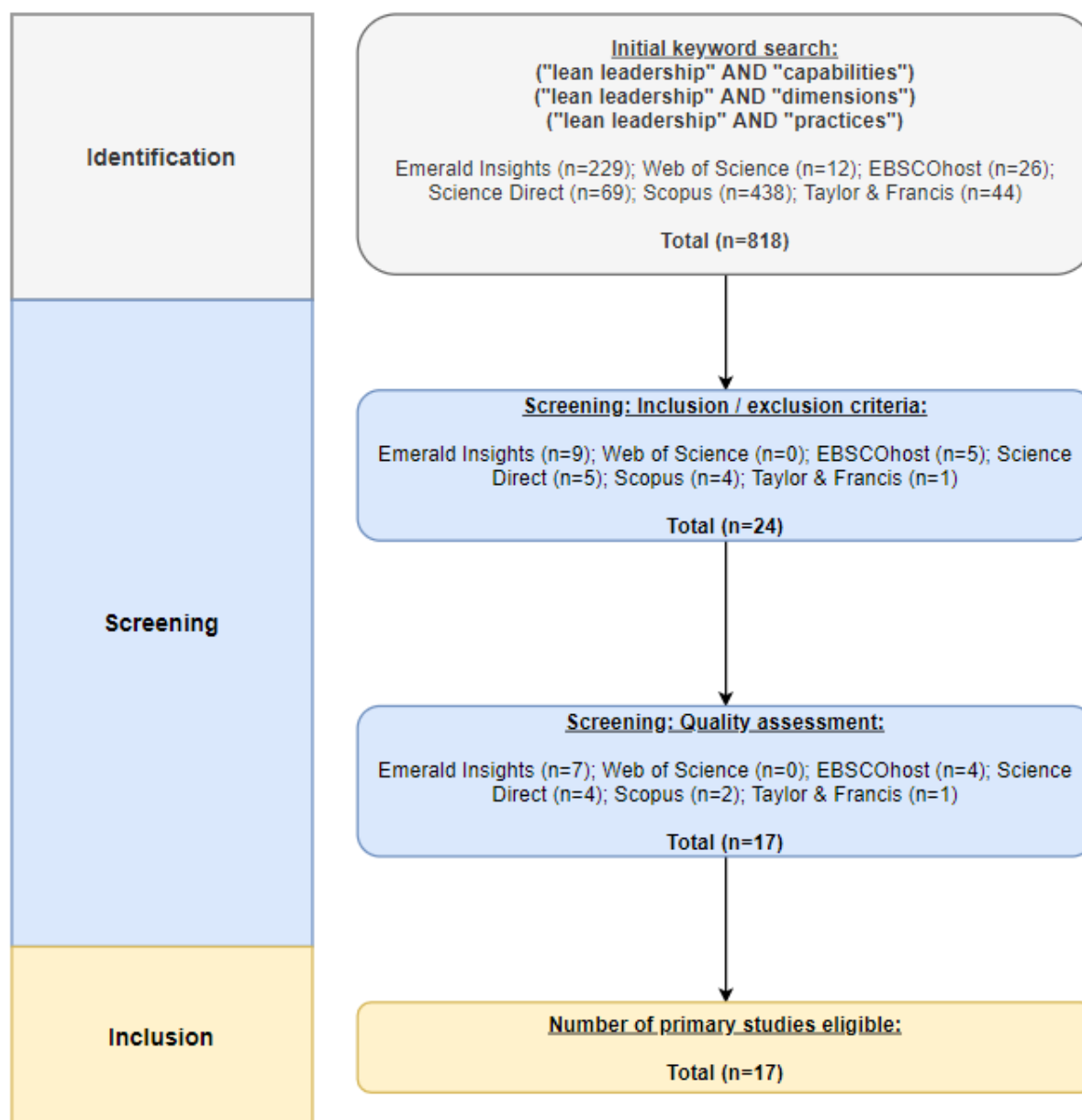


Figure 21: Selection process for identifying primary studies

During the identification phase and, following the initial keyword search, a total of 818 eligible studies were identified. The number of studies identified for each combination of search strings as they related to a specific EDS is summarised in Table 27. The EDS, *Scopus*, yielded the

highest number of studies (438), while *Web of Science* yielded the lowest (12). In addition, the search string *Lean leadership practices* yielded the highest number of studies (504), while *Lean leadership dimensions* yielded the lowest (140).

Table 27: SLR findings on lean leadership from initial keyword search

String A	String B	Emerald Insight	Web of Science	EBSCO-host	Science Direct	Scopus	Taylor Francis	Total per phrase
Lean leadership	capabilities	68	1	3	9	83	10	174
	dimensions	55	1	1	13	59	11	140
	practices	106	10	22	47	296	23	504
	Total per EDS	229	12	26	69	438	44	818

The inclusion and exclusion criteria were then systematically applied to the abstracts of studies identified in their respective databases. Next, those studies successfully meeting the criteria were downloaded into the Mendeley® application, where duplicates were removed automatically. After applying these two steps, 24 studies remained.

Considering the large number of initial results yielded (818), very few studies focused exclusively on the lean philosophy as the central paradigm of the study and in many cases, lean was used in conjunction with other CI initiatives such as Six Sigma, TPM or JIT – hence a large number of studies were removed after the I/E criteria were applied. Moreover, lean leadership was often a secondary topic of most studies, being either only singled-out as a critical success factor or as an essential, but a poorly defined element to support lean implementation.

Finally, the study quality assessment was applied to the fulltext of those studies that passed the I/E screening. Based on this, a total of 17 studies managed to score ≥ 2 according to the scoring criteria defined earlier – resulting in the final list of primary studies.

Of these 17 primary studies, 13 provided an exhaustive list of 5 or more unique lean leadership dimensions with the rest only listing between 3 and 4. A total of 14 studies managed to either comprehensively describe or provide examples of the lean leadership dimensions identified. Furthermore, 10 studies had empirical validation, inputs, feedback or testing of lean leadership characteristics and only 4 were able to rank characteristics.

Significant differences between research approaches, research focus, sectors and primary contributions of primary studies were also observed, as illustrated in Table 28:

Table 28: Primary studies identified with their respective research approach, focus, sector and contribution

No.	Title	Author (s)	Research approach	Focus	Sector	Primary contribution
1	Lean leadership attributes: a systematic review of the literature	(Aij & Teunissen, 2017)	SLR	Applicable attributes of lean leaders.	Healthcare	Development of a new framework that describes leadership attributes within lean healthcare.
2	The Role of Leadership in Implementing Lean Manufacturing	(Alefari, et al., 2017)	Literature review & survey	Lean leadership principles and practices that can sustain improvement of employee performance	Manufacturing	A deeper understanding of the characteristics and qualities of a lean leader.
3	Modelling management behaviours in lean production environments	(Camuffo & Gerli, 2018)	Field research/case studies	Management behaviours associated with lean adoption	Various	Practical guidance for lean system implementation, suggesting a catalogue of management behaviours of lean-practising companies.
4	Lean Leadership fundamental principles and their application	(Dombrowski & Mielke, 2013)	Literature study & survey	Lean leadership principles and applications	Automotive, machinery and plant engineering, chemical or pharmaceutical, electrical industry.	Empirical evidence of lean leadership principles and practices across various industries.
5	Lean Leadership – 15 Rules for a sustainable Lean Implementation	(Dombrowski & Mielke, 2014)	Mixed method	Lean leadership rules to sustain lean implementation	Various	Framework of rules that supports daily efforts of lean leaders toward true continuous improvement
6	Managerial Practices that Support Lean and Socially Sustainable Working Conditions	(Håkansson, et al., 2017)	Mixed method	Managerial practices that support socially sustainable working conditions during lean transformation	Manufacturing	Provides an understanding of how managerial practices can support social sustainability within lean
7	Successful Implementation of Lean as a Managerial Principle in Health Care: A Conceptual Analysis from Systematic Literature Review	(Maijala, et al., 2018)	SLR & content analysis	Leadership and management characteristics associated with successful lean thinking	Healthcare	Provides a framework that could support the education of lean leadership skills required for lean transitions in healthcare
8	The Missing Link: Lean Leadership	(Mann, 2009)	Literature review	Leadership	Health Services	Discusses the missing link in lean, which the author considers to be lean leadership.
9	Demystifying lean leadership	(Netland, et al., 2019)	Theoretical	Lean leadership practices at various hierarchical levels	Unspecified	Offers a new perspective for researchers studying lean leadership and helpful advice to companies pursuing lean transformations.

10	The daily work of Lean leaders – lessons from manufacturing and healthcare	(Poksinska, et al., 2013)	Case studies	Lean leadership characteristics	Manufacturing, service and healthcare	Offers a better understanding of leadership and managerial practices in lean organisations
11	Lean leadership competencies: a multi-method study	(Seidel, et al., 2017)	Mixed method	Individual lean leadership competencies	Manufacturing	Identified competencies can be used as a basis for lean leadership development programs and may also support the design of tools that can assess the competencies of leadership in lean companies.
12	How can general leadership theories help to expand the knowledge of lean leadership?	(Seidel, et al., 2019)	Theoretical mixed method	General leadership theories to help expand lean leadership	Unspecified	Findings improve the possibility of using different general leadership theories as a lens to study lean leadership. Provides a practical framework for practitioners looking to develop lean leadership
13	Lean production system development through leadership practices	(Toledo, et al., 2018)	Case study	Lean leadership practices	Manufacturing	Offers activities that could be implemented by the leadership of organisations aiming to sustain lean.
14	Leadership behaviours during lean healthcare implementation: a review and longitudinal study Guilherme	(Tortorella, et al., 2019)	Mixed method	Lean leadership behaviours	Healthcare	Helps healthcare organisations with more successful lean implementation
15	Values and behaviours of effective lean managers: Mixed-methods exploratory research	(van Dun, et al., 2017)	Mixed method, exploratory	Lean values and behaviours of effective lean managers	Unspecified	Proposing lean leadership values and behaviours that may help managers perform more effectively in pursuing the purpose of lean.
16	Walking around the pyramids: Managers' shop-floor activities in Lean-inspired organisations Economic	(Vänje & Brännmark, 2017)	Mixed method	Leadership activities from shop-floor workers' perspectives	Manufacturing	Provides a deeper contextual understanding of how social structures created during change would positively affect the leadership practices in lean and workers' participation
17	Lean leadership: an ethnographic study	(Aij, et al., 2015)	Case study	Leadership behaviours	Healthcare	Offers a lean leadership model that would support professionals with a leading role in implementing lean

6.3.2 Applied thematic analysis

Based on the ATA conducted, patterns of lean leadership behaviours or actions that emerged from the data and were used to develop themes and subthemes pertaining to lean leadership.

6.3.2.1 Initial thematic map

The initial thematic map that was developed, as explained in Section 6.2.5.3, is presented in Figure 22. A total of 5 candidate themes and 17 candidate subthemes were initially identified that described patterns related to the research questions. However, after several rounds re-analysing the extracts, it was determined that the candidate themes and subthemes did not form a clear coherent pattern and that the initial thematic map was not an accurate representation of the meanings presented in the dataset. This meant that phase 3 (searching for themes) and phase 4 (reviewing themes) was reiterated several times until the final thematic map was determined.

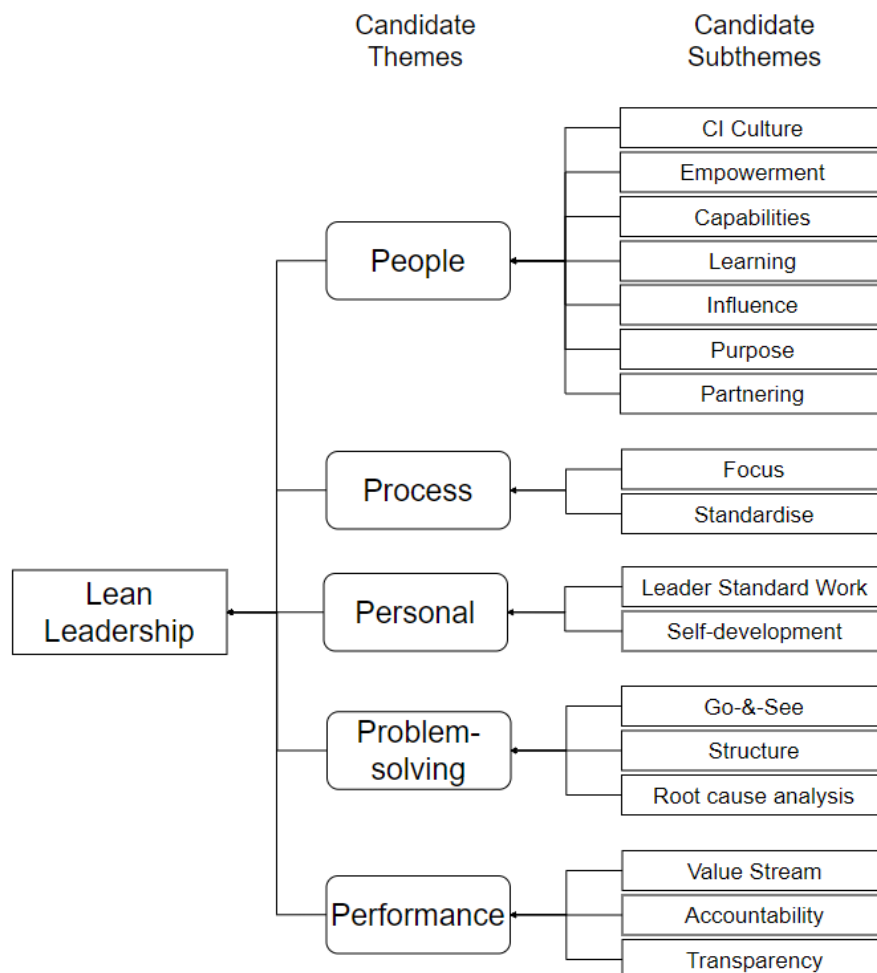


Figure 22: Preliminary thematic map of lean leadership themes and subthemes

6.3.2.2 Final thematic map

Once the candidate themes and subthemes of the initial thematic map were determined to be satisfactory, they were organised into a consistent and coherent account.

As a result, the final thematic map that emerged consists of 4 themes and 11 subthemes as presented in Figure 23. The subthemes were all grouped into respective themes according to their distinctive context. This detailed explication of each theme and subtheme will be presented in Section 7.2.2 and 7.2.3 respectively.

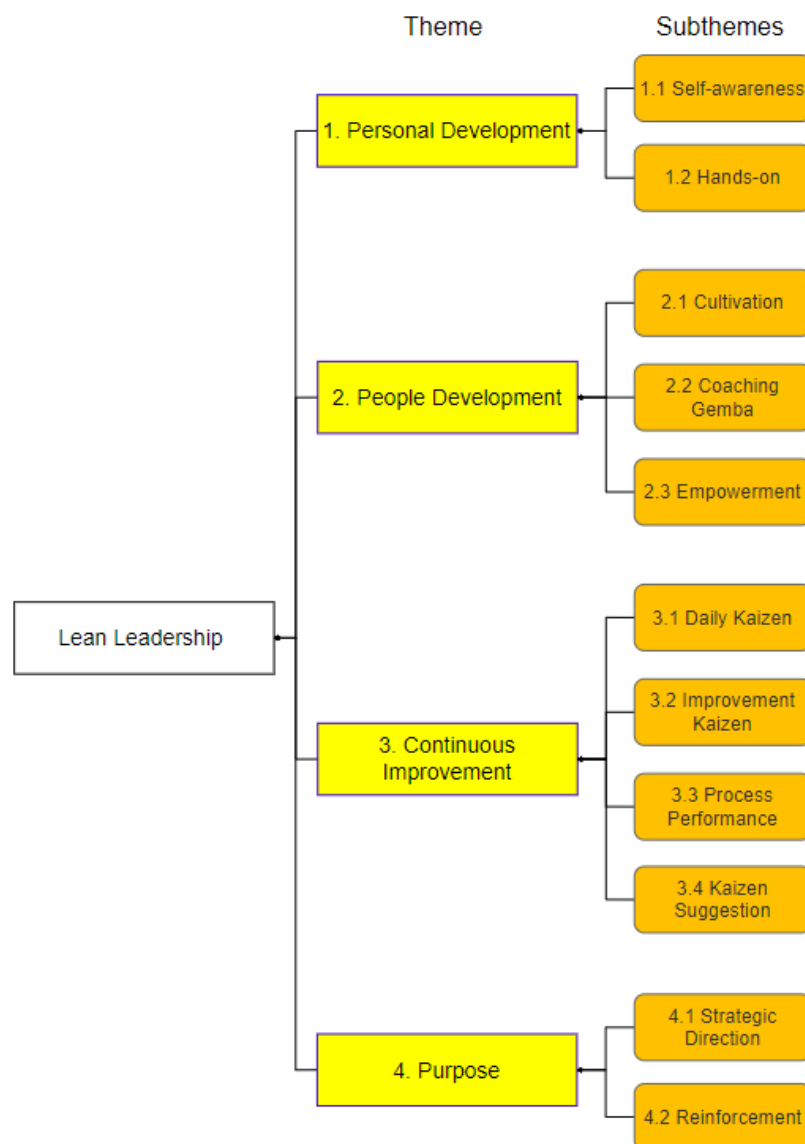


Figure 23: Final thematic map of lean leadership themes and subthemes

6.4 Conclusion: Lean readership reference model

This chapter was a steppingstone towards addressing the sixth objective of this study, which is to develop a new LLMM. The final LLMM is explained in the next chapter.

Following the top-down model development approach, this chapter established *what* represents lean leadership maturity by identifying themes and subthemes relevant to lean leadership to ultimately develop a lean leadership reference model. These themes and subthemes identified in this chapter will form the dimensions and subdimensions of the LLMM developed in the next Chapter. This chapter also addresses one of the main criticisms of maturity models, which is the lack of a solid theoretical foundation used for their development (Lasrado, et al., 2015). The following research questions were answered in this chapter:

- **Research Question 6.1:** “What are the themes applicable to lean leadership?”
- **Research Question 6.2:** “What does a reference model for lean leadership look like?”

Furthermore, provision was made for design requirements 2 and 6 in Section 6.2.2:

- **Design Requirement 2:** “The model can be applied any point in time regardless of the lean implementation phase.”
- **Design Requirement 4:** “The LLMM can be used as a foundation for educating stakeholders.”
- **Design Requirement 6:** “The model can be used to assess lean leadership maturity of multiple organisational entities and is not restricted by the size or location of the organisation under consideration.”

CHAPTER 7: THE LEAN LEADERSHIP MATURITY MODEL

7.1 Introduction

This chapter combines and discusses the outcomes of the research undertaken to develop a LLMM. The model design process follows a top-down approach (De Bruin, et al., 2005). This means the LLMM is first conceptualised in terms of its central constructs related to the application domain where after capability statements are formulated within the framework to form the assessment criteria. The section of the research design applicable to the second part of Phase 3 is illustrated in the bottom-right section (light blue) of Figure 24. The transparent blue blocks indicate the sections of the research design that are still to be explored.

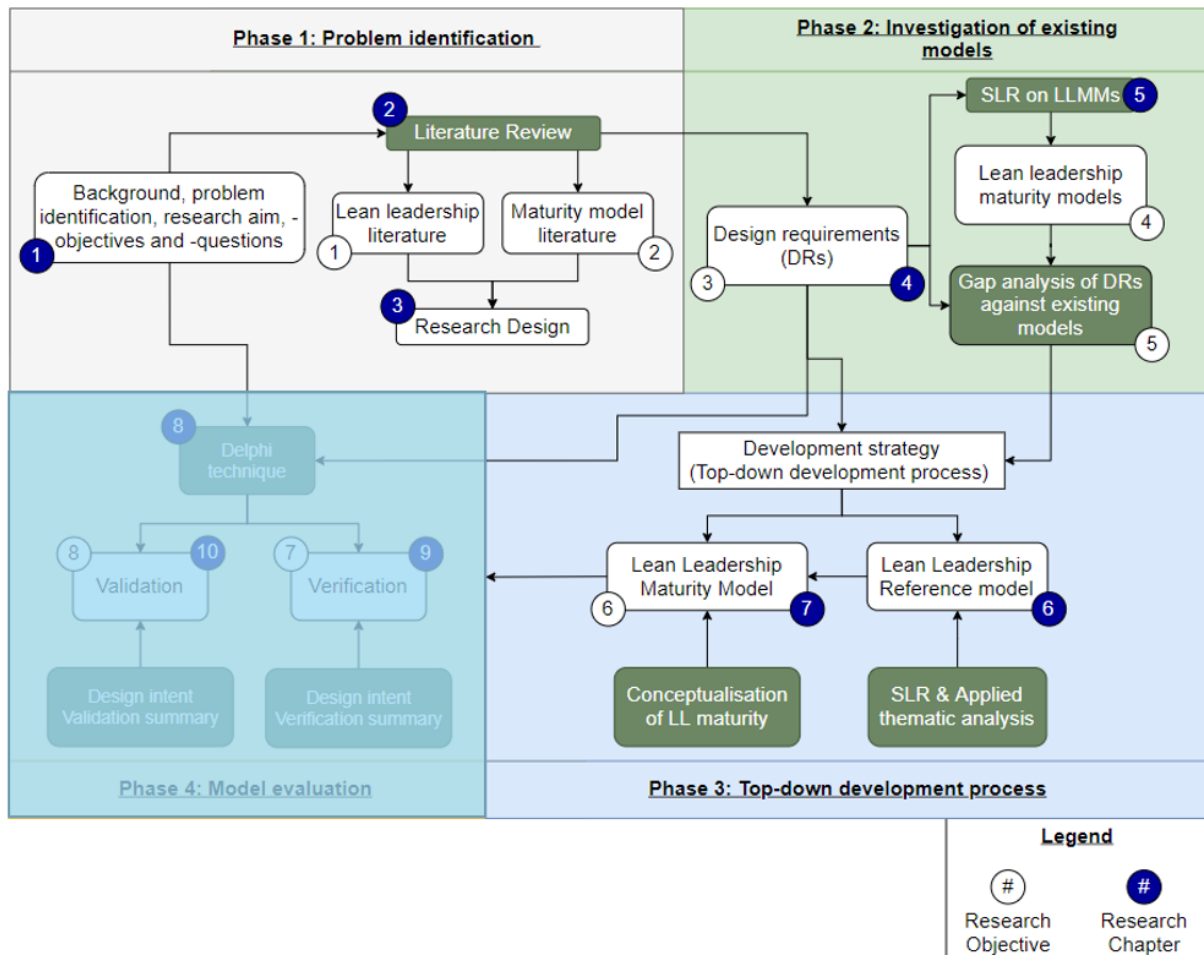


Figure 24: Section of the research design relevant to the second part of Phase 3

Furthermore, an overview of the research methods, -objectives, -questions and design requirements applicable to the second part of Phase 3 is presented in Table 29:

Table 29: Overview of research methods, -objectives, -questions and design requirements applicable to the second part of Phase 3

Phase 3: Top-down model development	
Research Method	• Conceptualisation of lean leadership maturity and structural components; • Integration of capability statements.
Research Objectives	6. If no existing models are identified, develop a new LLMM.
Research Questions	6.3 What model design will address all the design requirements?
Applicable design requirements	• DR 1: The LLMM describes lean leadership. • DR 3: The LLMM can function as a diagnostic tool of as-is lean leadership. • DR 5: The model enables a self- or group-oriented assessment from individuals across multiple functional areas and levels • DR 8: The LLMM design can be understood by the audience. • DR 9: The LLMM operationalises maturity in a multi-dimensional manner. • DR 10: The LLMM follows a unidirectional and linear path of cumulative stages from lower- to higher maturity. The stage progression is logical. • DR 11: The LLMM includes definitions of central constructs related to the application domain. • DR 12: The capability statements are mutually exclusive. • DR 13: The capability statements are collectively exhaustive

In Section 7.2 of this chapter, the model incorporates the previously-addressed objectives of this study and elaborates on the themes and subthemes identified earlier to develop the central constructs related to the application domain. These constructs are contained within a maturity grid for each **dimension** and consists of a set of **subdimensions**, **maturity levels**, **capability areas**, **capability statements** and **ideal statements**. They form part of the structural components of the LLMM and will define *what* ideally characterises lean leadership maturity in the frame of the LLMM. The outcome of this section is a capability matrix that describes the ideal lean leadership maturity for each dimension.

In Section 7.3 of this chapter, the **capability statements** for each **capability area** of the LLMM are formulated to define the model's assessment criteria. These **capability statements** provide a scale where a quantitative value can be assigned to an intangible concept, such as maturity. The significance and practicality of these statements are supported with evidence from the literature. Once the assessment criteria are formulated, the artefact can be considered as maturity *model* since an intersubjectively verifiable criteria for each maturity level and level of granularity is defined (Pöppelbuß & Röglinger, 2011; Röglinger, et al., 2012)

7.2 Central constructs of the LLMM

Throughout this section, each of the central constructs of the LLMM and their position within the model's structure will be discussed. When combining these constructs for a specific dimension, a maturity grid is formed according to which lean leadership maturity of a specific

dimension can be described. The basic structure of this maturity grid is aligned with the generic design structure of maturity models as identified by Lasrado, et al. (2015).

The following design requirements apply to this section of the model development:

- **Design Requirement 8:** The LLMM design can be understood by the audience.
- **Design Requirement 11:** The LLMM includes definitions of central constructs related to the application domain.

7.2.1 Overview of the LLMM

The LLMM consists of different components as indicated in Figure 25. The yellow cells of the model represent a lean leadership **dimension**. These dimensions are defined by one or more **subdimensions**, represented by the orange cells. These subdimensions enable a more focused measurement of lean leadership maturity through unique **capability areas**, represented by the turquoise cells. They are all measured according to five cumulative **maturity levels** as illustrated by the red cells. Each maturity level describes their respective capability areas through distinctive **capability statements** that are characteristic of those capability areas, as represented by the light blue cells. The highest maturity level of each capability area is defined by an **ideal statement** and is represented by the green cells.

		Maturity levels					Ideal statements
		Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained	
1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection 1.1.2 Role model 1.1.3 Behavioural accountability 1.1.4 Aptitude 1.1.5 Qualification	1.1.1.1 1.1.1.2 1.1.1.3 1.1.1.4 1.1.1.5	1.1.1.2 1.1.1.3 1.1.1.4 1.1.1.5	1.1.1.3 1.1.1.4 1.1.1.5	1.1.1.4 1.1.1.5	1.1.1.5
	1.2 Hands-on Approach	1.2.1 Teaching-learning Gemba 1.2.2 Leader standard work	1.2.1.1 1.2.1.2	1.2.1.2 1.2.1.3	1.2.1.3 1.2.1.4	1.2.1.4 1.2.1.5	1.2.1.5
2. People Development	2.1 Cultivation	2.1.1 Long-term commitment 2.1.2 Development programs 2.1.3 Nurturing environment	2.1.1.1 2.1.1.2 2.1.1.3	2.1.1.2 2.1.1.3 2.1.1.4	2.1.1.3 2.1.1.4 2.1.1.5	2.1.1.4 2.1.1.5	2.1.1.5
	2.2 Coaching Gemba	2.2.1 Setting 2.2.2 Respectful interaction 2.2.3 Structured problem-solving	2.2.1.1 2.2.1.2 2.2.1.3	2.2.1.2 2.2.1.3 2.2.1.4	2.2.1.3 2.2.1.4 2.2.1.5	2.2.1.4 2.2.1.5	2.2.1.5
	2.3 Empowerment	2.3.1 Responsible autonomy 2.3.2 Choice autonomy 2.3.3 Engagement	2.3.1.1 2.3.1.2 2.3.1.3	2.3.1.2 2.3.1.3 2.3.1.4	2.3.1.3 2.3.1.4 2.3.1.5	2.3.1.4 2.3.1.5	2.3.1.5
3. Continuous Improvement	3.1 Daily Kaizen	3.1.1 Problem-management routine 3.1.2 Problem gathering routine 3.1.3 Proactive support 3.1.4 Go-see-fix 3.1.5 Problem to opportunity 3.1.6 Root cause problem solving	3.1.1.1 3.1.1.2 3.1.1.3 3.1.1.4 3.1.1.5 3.1.1.6	3.1.1.2 3.1.1.3 3.1.1.4 3.1.1.5 3.1.1.6	3.1.1.3 3.1.1.4 3.1.1.5 3.1.1.6	3.1.1.4 3.1.1.5	3.1.1.5
	3.2 Improvement Kaizen	3.2.1 Value stream mapping 3.2.2 LSO committee 3.2.3 PR&A panel 3.2.4 Focused improvement 3.2.5 Partnering 3.2.6 Horizontal flow of value	3.2.1.1 3.2.1.2 3.2.1.3 3.2.1.4 3.2.1.5 3.2.1.6	3.2.1.2 3.2.1.3 3.2.1.4 3.2.1.5 3.2.1.6	3.2.1.3 3.2.1.4 3.2.1.5 3.2.1.6	3.2.1.4 3.2.1.5	3.2.1.5
	3.3 Process performance	3.3.1 Adherence 3.3.2 Standardise, stabilise 3.3.3 Yield 3.3.4 Process management 3.3.5 Visual feedback	3.3.1.1 3.3.1.2 3.3.1.3 3.3.1.4 3.3.1.5	3.3.1.2 3.3.1.3 3.3.1.4 3.3.1.5	3.3.1.3 3.3.1.4 3.3.1.5	3.3.1.4 3.3.1.5	3.3.1.5
	3.4 Kaizen suggestion	3.4.1 Structured system 3.4.2 Reward-recognition 3.4.3 Kaizen stimulation	3.4.1.1 3.4.1.2 3.4.1.3	3.4.1.2 3.4.1.3 3.4.1.4	3.4.1.3 3.4.1.4 3.4.1.5	3.4.1.4 3.4.1.5	3.4.1.5
4. Purpose	4.1 Strategic direction	4.1.1 Policy deployment 4.1.2 Long-term consistency 4.1.3 Operational alignment 4.1.4 Customer alignment	4.1.1.1 4.1.1.2 4.1.1.3 4.1.1.4	4.1.1.2 4.1.1.3 4.1.1.4	4.1.1.3 4.1.1.4 4.1.1.5	4.1.1.4 4.1.1.5	4.1.1.5
	4.2 Reinforcement	4.2.1 Change culture 4.2.2 Transparency 4.2.3 Participation	4.2.1.1 4.2.1.2 4.2.1.3	4.2.1.2 4.2.1.3 4.2.1.4	4.2.1.3 4.2.1.4 4.2.1.5	4.2.1.4 4.2.1.5	4.2.1.5

Figure 25: The Lean leadership maturity model

Furthermore, Figure 26 is a representation of a generic maturity grid for a nonspecific dimension.

Maturity Grid			Maturity Levels				
			Level 1	Level 2	Level 3	Level 4	Level 5
Dimension 1	Subdimension 1.1	Capability Area 1.1.1	Capability Statement 1.1.1.1	Capability Statement 1.1.1.2	Capability Statement 1.1.1.3	Capability Statement 1.1.1.4	Ideal Statement 1.1.1.5
		Capability Area 1.1.2	Capability Statement 1.1.2.1	Capability Statement 1.1.2.2	Capability Statement 1.1.2.3	Capability Statement 1.1.2.4	Ideal Statement 1.1.2.5
		Capability Area 1.1.3	Capability Statement 1.1.3.1	Capability Statement 1.1.3.2	Capability Statement 1.1.3.3	Capability Statement 1.1.3.4	Ideal Statement 1.1.3.5
	Subdimension 1.2	Capability Area 1.2.1	Capability Statement 1.2.1.1	Capability Statement 1.2.1.2	Capability Statement 1.2.1.3	Capability Statement 1.2.1.4	Ideal Statement 1.2.1.5
		Capability Area 1.2.2	Capability Statement 1.2.2.1	Capability Statement 1.2.2.2	Capability Statement 1.2.2.3	Capability Statement 1.2.2.4	Ideal Statement 1.2.2.5
		Capability Area 1.2.3	Capability Statement 1.2.3.1	Capability Statement 1.2.3.2	Capability Statement 1.2.3.3	Capability Statement 1.2.3.4	Ideal Statement 1.2.3.5

Figure 26: Generic lean leadership maturity grid

Crucially, when all the maturity grids for each **dimension** are combined, a Lean leadership maturity model is created. The following section describes how each of these central constructs is defined to ultimately form the LLMM.

7.2.2 Domain dimensions

The LLMM consists of **4 dimensions**, each relating to the application domain as indicated by the yellow cells in Figure 27. In this LLMM, the “measurement” is done by an assessment criteria and the “something” being measured is lean leadership capability.

In addition, the following design requirement is applicable to this section of the model development:

- **Design Requirement 9:** The LLMM operationalises maturity in a multi-dimensional manner.

Dimensions	Subdimensions	Capability areas	Level 1 Initial	Level 2 Managed	Level 3 Defined	Level 4 Predictable	Level 5 Sustained
1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection	1.1.1.1	1.1.1.2	1.1.1.3	1.1.1.4	1.1.1.5
		1.1.2 Role model	1.1.2.1	1.1.2.2	1.1.2.3	1.1.2.4	1.1.2.5
		1.1.3 Behavioural accountability	1.1.3.1	1.1.3.2	1.1.3.3	1.1.3.4	1.1.3.5
		1.1.4 Aptitude	1.1.4.1	1.1.4.2	1.1.4.3	1.1.4.4	1.1.4.5
		1.1.5 Qualification	1.1.5.1	1.1.5.2	1.1.5.3	1.1.5.4	1.1.5.5
2. People Development	1.2 Hands-on Approach	1.2.1 Teaching-learning Gemba	1.2.1.1	1.2.1.2	1.2.1.3	1.2.1.4	1.2.1.5
		1.2.2 Leader standard work	1.2.2.1	1.2.2.2	1.2.2.3	1.2.2.4	1.2.2.5
	2.1 Cultivation	2.1.1 Long-term commitment	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5
		2.1.2 Development programs	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5
		2.1.3 Nurturing environment	2.1.3.1	2.1.3.2	2.1.3.3	2.1.3.4	2.1.3.5
	2.2 Coaching Gemba	2.2.1 Setting	2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4	2.2.1.5
		2.2.2 Respectful interaction	2.2.2.1	2.2.2.2	2.2.2.3	2.2.2.4	2.2.2.5
		2.2.3 Structured problem-solving	2.2.3.1	2.2.3.2	2.2.3.3	2.2.3.4	2.2.3.5
	2.3 Empowerment	2.3.1 Responsible autonomy	2.3.1.1	2.3.1.2	2.3.1.3	2.3.1.4	2.3.1.5
		2.3.2 Choice autonomy	2.3.2.1	2.3.2.2	2.3.2.3	2.3.2.4	2.3.2.5
		2.3.3 Engagement	2.3.3.1	2.3.3.2	2.3.3.3	2.3.3.4	2.3.3.5
3. Continuous Improvement	3.1 Daily Kaizen	3.1.1 Problem-management routine	3.1.1.1	3.1.1.2	3.1.1.3	3.1.1.4	3.1.1.5
		3.1.2 Problem gathering routine	3.1.2.1	3.1.2.2	3.1.2.3	3.1.2.4	3.1.2.5
		3.1.3 Proactive support	3.1.3.1	3.1.3.2	3.1.3.3	3.1.3.4	3.1.3.5
		3.1.4 Go-see-fix	3.1.4.1	3.1.4.2	3.1.4.3	3.1.4.4	3.1.4.5
		3.1.5 Problem to opportunity	3.1.5.1	3.1.5.2	3.1.5.3	3.1.5.4	3.1.5.5
		3.1.6 Root cause problem solving	3.1.6.1	3.1.6.2	3.1.6.3	3.1.6.4	3.1.6.5
	3.2 Improvement Kaizen	3.2.1 Value stream mapping	3.2.1.1	3.2.1.2	3.2.1.3	3.2.1.4	3.2.1.5
		3.2.2 LSO committee	3.2.2.1	3.2.2.2	3.2.2.3	3.2.2.4	3.2.2.5
		3.2.3 PR&A panel	3.2.3.1	3.2.3.2	3.2.3.3	3.2.3.4	3.2.3.5
		3.2.4 Focused improvement	3.2.4.1	3.2.4.2	3.2.4.3	3.2.4.4	3.2.4.5
		3.2.5 Partnering	3.2.5.1	3.2.5.2	3.2.5.3	3.2.5.4	3.2.5.5
		3.2.6 Horizontal flow of value	3.2.6.1	3.2.6.2	3.2.6.3	3.2.6.4	3.2.6.5
	3.3 Process performance	3.3.1 Adherence	3.3.1.1	3.3.1.2	3.3.1.3	3.3.1.4	3.3.1.5
		3.3.2 Standardise, stabilise	3.3.2.1	3.3.2.2	3.3.2.3	3.3.2.4	3.3.2.5
		3.3.3 Yield	3.3.3.1	3.3.3.2	3.3.3.3	3.3.3.4	3.3.3.5
		3.3.4 Process management	3.3.4.1	3.3.4.2	3.3.4.3	3.3.4.4	3.3.4.5
		3.3.5 Visual feedback	3.3.5.1	3.3.5.2	3.3.5.3	3.3.5.4	3.3.5.5
	3.4 Kaizen suggestion	3.4.1 Structured system	3.4.1.1	3.4.1.2	3.4.1.3	3.4.1.4	3.4.1.5
		3.4.2 Reward-recognition	3.4.2.1	3.4.2.2	3.4.2.3	3.4.2.4	3.4.2.5
		3.4.3 Kaizen stimulation	3.4.3.1	3.4.3.2	3.4.3.3	3.4.3.4	3.4.3.5
4. Purpose	4.1 Strategic direction	4.1.1 Policy deployment	4.1.1.1	4.1.1.2	4.1.1.3	4.1.1.4	4.1.1.5
		4.1.2 Long-term consistency	4.1.2.1	4.1.2.2	4.1.2.3	4.1.2.4	4.1.2.5
		4.1.3 Operational alignment	4.1.3.1	4.1.3.2	4.1.3.3	4.1.3.4	4.1.3.5
		4.1.4 Customer alignment	4.1.4.1	4.1.4.2	4.1.4.3	4.1.4.4	4.1.4.5
	4.2 Reinforcement	4.2.1 Change culture	4.2.1.1	4.2.1.2	4.2.1.3	4.2.1.4	4.2.1.5
		4.2.2 Transparency	4.2.2.1	4.2.2.2	4.2.2.3	4.2.2.4	4.2.2.5
		4.2.3 Participation	4.2.3.1	4.2.3.2	4.2.3.3	4.2.3.4	4.2.3.5

Figure 27: Lean leadership maturity grid with dimensions

Considering the findings in Chapter 6, each of the 4 themes identified will serve as the 4 **dimensions** for the LLMM respectively, all of which will be discussed next.

7.2.2.1 Dimension 1: Personal Development

Since lean's success requires a significant change in the organisational mindset, behaviour and skills necessary to sustain implementation, leadership is naturally required to adapt and maintain the development of their mindset, behaviour and skills accordingly (Ashtiani, et al., 2017; Mann, 2009). Some of these new skills are innate and naturally relate to the leader's personality or character, while others must be learned and developed over time (Aij & Teunissen, 2017; Dombrowski & Mielke, 2013).

Based on the findings in the previous chapter, it is evident that leadership's commitment to *personal development* is a requirement for the success of lean implementation in any organisation and serves as the foundation for the development of others as well as continuous improvement, making it the first dimension of the LLMM (Dombrowski & Mielke, 2013; Majjala, et al., 2018; Seidel, et al., 2019).

Aij with Teunissen (2017) highlights that the leadership factors necessary for personal development include “visualising greatness” (p.718), where successful leaders visualise a positive future like “an athlete visualises himself/herself crossing a finish line” (p.721). The same authors also indicate that leadership development programs focusing on integrating emotional intelligence and coaching is important for developing the human elements of leadership.

7.2.2.2 Dimension 2: People Development

The second dimension, *People Development*, is considered as the one distinguishable characteristic of lean when compared to other traditional approaches and asks that lean leaders commit to the long-term development of their employees and their continuous learning (Aij & Teunissen, 2017; Dombrowski & Mielke, 2014). Developing qualified and capable people is crucial for their ability to continuously improve their environment and participate in daily- and improvement Kaizen (Dombrowski & Mielke, 2013; Toledo, et al., 2018; Aij, et al., 2015).

7.2.2.3 Dimension 3: Continuous Improvement

The third dimension, *Continuous improvement*, is provoked by the people, especially at the front line, and leaders need to understand these people are important and active participants in the continuous improvement process, together with whom a collective interest is pursued (van Dun, et al., 2017; Dombrowski & Mielke, 2013). Dombrowski & Mielke, (2013) describes lean leadership as the cooperation between people and leaders in their mutual (and continuous) striving for perfection. The proactive commitment of employees towards engaging in continuous incremental improvement is vital for long-term traction within an organisation and highlights an essential role of a good lean leader (Aij & Teunissen, 2017).

7.2.2.4 Dimension 4: Purpose

The fourth and final dimension, *Purpose*, is concerned with connecting the comprehensive organisational strategy established through policy deployment (hoshin-kanri) to specific goals and deep purpose adopted by the people, ensuring that everything done in the lean organisation is focused on a collective drive towards delivering precisely what the customer values more effectively. It ultimately aims to develop a sense of value and meaning that people require in order to sustain motivation to consider a transformation such as lean implementation.

7.2.3 Subdimensions

The LLMM also contains **11 subdimensions** as indicated by the orange cells in Figure 28.

Dimensions	Subdimensions	Capability areas	Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection	1.1.1.1	1.1.1.2	1.1.1.3	1.1.1.4	1.1.1.5
		1.1.2 Role model	1.1.2.1	1.1.2.2	1.1.2.3	1.1.2.4	1.1.2.5
		1.1.3 Behavioural accountability	1.1.3.1	1.1.3.2	1.1.3.3	1.1.3.4	1.1.3.5
		1.1.4 Aptitude	1.1.4.1	1.1.4.2	1.1.4.3	1.1.4.4	1.1.4.5
		1.1.5 Qualification	1.1.5.1	1.1.5.2	1.1.5.3	1.1.5.4	1.1.5.5
2. People Development	1.2 Hands-on Approach	1.2.1 Teaching-learning Gemba	1.2.1.1	1.2.1.2	1.2.1.3	1.2.1.4	1.2.1.5
		1.2.2 Leader standard work	1.2.2.1	1.2.2.2	1.2.2.3	1.2.2.4	1.2.2.5
	2.1 Cultivation	2.1.1 Long-term commitment	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5
		2.1.2 Development programs	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5
		2.1.3 Nurturing environment	2.1.3.1	2.1.3.2	2.1.3.3	2.1.3.4	2.1.3.5
	2.2 Coaching Gemba	2.2.1 Setting	2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4	2.2.1.5
		2.2.2 Respectful interaction	2.2.2.1	2.2.2.2	2.2.2.3	2.2.2.4	2.2.2.5
		2.2.3 Structured problem-solving	2.2.3.1	2.2.3.2	2.2.3.3	2.2.3.4	2.2.3.5
	2.3 Empowerment	2.3.1 Responsible autonomy	2.3.1.1	2.3.1.2	2.3.1.3	2.3.1.4	2.3.1.5
		2.3.2 Choice autonomy	2.3.2.1	2.3.2.2	2.3.2.3	2.3.2.4	2.3.2.5
		2.3.3 Engagement	2.3.3.1	2.3.3.2	2.3.3.3	2.3.3.4	2.3.3.5
3. Continuous Improvement	3.1 Daily Kaizen	3.1.1 Problem-management routine	3.1.1.1	3.1.1.2	3.1.1.3	3.1.1.4	3.1.1.5
		3.1.2 Problem gathering routine	3.1.2.1	3.1.2.2	3.1.2.3	3.1.2.4	3.1.2.5
		3.1.3 Proactive support	3.1.3.1	3.1.3.2	3.1.3.3	3.1.3.4	3.1.3.5
		3.1.4 Go-see-fix	3.1.4.1	3.1.4.2	3.1.4.3	3.1.4.4	3.1.4.5
		3.1.5 Problem to opportunity	3.1.5.1	3.1.5.2	3.1.5.3	3.1.5.4	3.1.5.5
		3.1.6 Root cause problem solving	3.1.6.1	3.1.6.2	3.1.6.3	3.1.6.4	3.1.6.5
	3.2 Improvement Kaizen	3.2.1 Value stream mapping	3.2.1.1	3.2.1.2	3.2.1.3	3.2.1.4	3.2.1.5
		3.2.2 LSO committee	3.2.2.1	3.2.2.2	3.2.2.3	3.2.2.4	3.2.2.5
		3.2.3 PR&A panel	3.2.3.1	3.2.3.2	3.2.3.3	3.2.3.4	3.2.3.5
		3.2.4 Focused improvement	3.2.4.1	3.2.4.2	3.2.4.3	3.2.4.4	3.2.4.5
		3.2.5 Partnering	3.2.5.1	3.2.5.2	3.2.5.3	3.2.5.4	3.2.5.5
		3.2.6 Horizontal flow of value	3.2.6.1	3.2.6.2	3.2.6.3	3.2.6.4	3.2.6.5
	3.3 Process performance	3.3.1 Adherence	3.3.1.1	3.3.1.2	3.3.1.3	3.3.1.4	3.3.1.5
		3.3.2 Standardise, stabilise	3.3.2.1	3.3.2.2	3.3.2.3	3.3.2.4	3.3.2.5
		3.3.3 Yield	3.3.3.1	3.3.3.2	3.3.3.3	3.3.3.4	3.3.3.5
		3.3.4 Process management	3.3.4.1	3.3.4.2	3.3.4.3	3.3.4.4	3.3.4.5
		3.3.5 Visual feedback	3.3.5.1	3.3.5.2	3.3.5.3	3.3.5.4	3.3.5.5
	3.4 Kaizen suggestion	3.4.1 Structured system	3.4.1.1	3.4.1.2	3.4.1.3	3.4.1.4	3.4.1.5
		3.4.2 Reward-recognition	3.4.2.1	3.4.2.2	3.4.2.3	3.4.2.4	3.4.2.5
		3.4.3 Kaizen stimulation	3.4.3.1	3.4.3.2	3.4.3.3	3.4.3.4	3.4.3.5
4. Purpose	4.1 Strategic direction	4.1.1 Policy deployment	4.1.1.1	4.1.1.2	4.1.1.3	4.1.1.4	4.1.1.5
		4.1.2 Long-term consistency	4.1.2.1	4.1.2.2	4.1.2.3	4.1.2.4	4.1.2.5
		4.1.3 Operational alignment	4.1.3.1	4.1.3.2	4.1.3.3	4.1.3.4	4.1.3.5
		4.1.4 Customer alignment	4.1.4.1	4.1.4.2	4.1.4.3	4.1.4.4	4.1.4.5
	4.2 Reinforcement	4.2.1 Change culture	4.2.1.1	4.2.1.2	4.2.1.3	4.2.1.4	4.2.1.5
		4.2.2 Transparency	4.2.2.1	4.2.2.2	4.2.2.3	4.2.2.4	4.2.2.5
		4.2.3 Participation	4.2.3.1	4.2.3.2	4.2.3.3	4.2.3.4	4.2.3.5

Figure 28: Lean leadership maturity grid with dimensions and subdimensions

Similar to the **dimensions**, these **subdimensions** were also derived from the findings in Chapter 6 and serve as more detailed descriptors of the lean leadership domain dimensions. They enable a more focused measurement of lean leadership maturity through the definition of **capability areas**, which will be defined later in this chapter. The details of each **subdimension** and how they relate to specific **dimensions** will be discussed next.

7.2.3.1 Subdimensions related to Personal Development

For the first **dimension**, *Personal Development*, two **subdimensions** apply and, based on the findings in Chapter 6, will be elaborated on in the section to follow.

7.2.3.1.1 Subdimension 1.1 - Self-awareness

Crucially, for leaders to identify capabilities required for further personal development, a sense of *self-reflection* (Hansei) is required. The term, *Hansei*, is an important part of the Japanese culture and broadly refers to the “continuous reflection on past mistakes, outlining lessons learned and pledging implementation of those lessons” (Roy, 2016).

This means that leaders can only direct their continuous personal development if they can understand their current strengths and, more importantly, potential weaknesses (Dombrowski & Mielke, 2014). The willingness to *self-reflect* and become *self-aware* is also mentioned as a prerequisite for lean leadership (Dombrowski & Mielke, 2013).

Based on this, leaders must be open and devoted to the kind of *self-awareness* required to continuously advance their personal and professional evolution, which should align with the company's true north values (Håkansson, et al., 2017; Aij & Teunissen, 2017; Tortorella, et al., 2019; Aij, et al., 2015; Poksinska, et al., 2013; Maijala, et al., 2018; Dombrowski & Mielke, 2014).

Furthermore, people are unlikely to change unless their leaders do, which requires lean leaders to commit themselves as *role models* of the desired behaviour, demonstrate values of being open to change and support the improvement culture by setting the example – all forming part of personal development (Aij & Teunissen, 2017; Håkansson, et al., 2017; Maijala, et al., 2018; Dombrowski & Mielke, 2014; Dombrowski & Mielke, 2013; Netland, et al., 2019; Seidel, et al., 2017; Tortorella, et al., 2019; Vänje & Brännmark, 2017). As with personal and professional evolution, these behaviours must also be harmonious with the values and culture of the organisation, embodying its vision and true north (Poksinska, et al., 2013; Dombrowski & Mielke, 2014; Toledo, et al., 2018).

Aligning these behaviours with the true north implies that leaders must understand the heart of each value, internalising them so that they become a part of who they are and the way they think. It also suggests that leaders have accountability towards, not only themselves but also their colleagues, since the example being set will influence those around them. *Self-awareness*, then, implies *accountability* towards behaviour, actions and attitude. In other words, lean leaders need to consciously choose how they present themselves to others, which reflects the leader's ability to maintain self-awareness of their behaviours, emotions and thinking (Aij & Teunissen, 2017).

In addition to being role models of the desired behaviours, lean leaders also need to exhibit demonstrated *knowledge* and *understanding* of not only their work, people and processes, but also on the job principles or practices of lean (Aij & Teunissen, 2017; Poksinska, et al., 2013; Camuffo & Gerli, 2018). Guidance through the change required by a lean transformation is ultimately the leader's responsibility, which requires them to have a thorough understanding the complexity of the changes involved and what formal and informal system rules are successful for creating the desired change (Alefari, et al., 2017; Aij, et al., 2015; Maijala, et al., 2018).

Being familiar with the underlying work processes within their organisation also emphasises that lean leaders can distinguish between what is truly important and what is not (Dombrowski & Mielke, 2014; Aij, et al., 2015). This means that lean leaders should ideally have worked their way up the hierarchy from the process levels over years, which is the only way deep process knowledge about the organisation and its fundamental problem-solving process can evolve (Dombrowski & Mielke, 2014).

Also, since learning requires reflection and reflection requires feedback, lean leaders need the guidance of people who have experience in lean implementation and should ideally be coached by a sensei (mentor) at first, until considered qualified (Dombrowski & Mielke, 2014). Coaches can help increase the lean leader's self-awareness by giving frequent feedback on the development of new behaviours and practices (Aij & Teunissen, 2017). Lean leaders, therefore, need coaches to develop themselves and need to become coaches to develop other, all of which will be discussed later in this chapter.

7.2.3.1.2 Subdimension 1.2 - Hands-on Experience

Personal development of lean leaders can be done through various approaches, including formal training through seminars or courses, but more importantly, through coaching and *hands-on* experience gained over many years (Aij & Teunissen, 2017). Hands-on experience includes learning through observation of their people's learning, which is embedded in personally observing daily activities at the Gemba (Håkansson, et al., 2017). In other words, as their teams solve problems, the leaders are expected to interpret their conclusions from a holistic perspective, which benefits them through engagement in the active and experimental learning about lean principles (Mann, 2005).

In this way, lean leaders can reinforce lean management practices and gain the benefit of engaging him or her in the challenges being faced when implementing them (Mann, 2009). Learning to manage from the Gemba is an essential part of gaining hands-on experience as it allows the leader to make critical decisions based on self-gained facts since they can gain an understanding of the actual situation at the place where work is being done (Dombrowski & Mielke, 2014; Dombrowski & Mielke, 2013; Toledo, et al., 2018; Maijala, et al., 2018).

To further the support of personal development at the Gemba, a standardised and structured problem-solving routine should be adopted (Dombrowski & Mielke, 2014). This approach is based on the systematic utilisation of the plan-do-check-act (PDCA) method in short learning cycles and can be used in conjunction with the development of others (Dombrowski & Mielke, 2014; Dombrowski & Mielke, 2013). Gemba is therefore seen as a routine *teaching-learning* model for the self-development of lean leaders (Mann, 2005).

A powerful mechanism that can be used to support routine aspects of personal development such as Gemba walks, is *leader standard work (LSW)*. This is a structured and strategic management approach that translates the specific activities or tasks to be done by lean leaders into daily routines (Aij, et al., 2015; Poksinska, et al., 2013; Seidel, et al., 2019). LSW ultimately defines what a leader should do daily and primarily encompasses the development of others, maintaining the daily momentum of continuous improvement and reinforcing purpose, all of which will be discussed later in this chapter (Aij, et al., 2015; Poksinska, et al., 2013). In addition, LSW also ensures the faithful execution of improvements and standardised practices while maintaining accountability towards performance-tracking data, problem-solving and continuous improvement (Mann, 2009).

7.2.3.2 Subdimensions related to People Development

For the second **dimension**, *People development*, three **subdimensions** apply and, based on the findings in Chapter 6, will be elaborated on in the section to follow.

7.2.3.2.1 Subdimension 2.1 - Cultivation

To enable *people development*, leaders must strive to establish an organisation of people that are constantly identifying problems, learning and sharing knowledge with others, all while supporting them in their self-discovery (Aij, et al., 2015; Tortorella, et al., 2019; Toledo, et al., 2018; Majjala, et al., 2018; Poksinska, et al., 2013). This deep investment towards everyone in the organisation is done not because it is expected of lean leaders, but because they should truly believe that their people are their most valuable resources and recognise them as resources need to be developed and expanded. (Aij, et al., 2015; Poksinska, et al., 2013). This, in turn, requires the establishment of plans, policies, guidelines, and opportunities aimed at the development of all employees, not only *individually*, but also *collectively* as a group (Aij & Teunissen, 2017; Dombrowski & Mielke, 2014; Poksinska, et al., 2013). The goal of the lean leader is to enable their followers to become lean leaders themselves (Aij & Teunissen, 2017).

Ultimately, organisations cannot change unless their people do, which supports leadership's commitment to continuously create an environment that not only challenges people but nurtures their growth, creativity, knowledge and experience (Poksinska, et al., 2013). Lean leaders, however, should recognise that throughout this development process, their role is to be facilitators and coaches, not controllers (Poksinska, et al., 2013).

Employee development focuses on two main competencies; *technical knowledge*, which helps support the implementation of organisational changes; and *lean thinking*, which establishes an understanding of waste and, ultimately, continuous improvement (Toledo, et al., 2018). For

measuring employee development, Toledo, et al. (2018) propose that lean leaders should adjust their current skill management model to the *Shu Ha Ri* cycle. The adoption of this cycle supports the leader in identifying their employees' maturity with regards to their level of reflection on processes and its problems (Toledo, et al., 2018).

Shu – Signifies the period where the employee in training is accompanied by a facilitator while performing each process, until the point when work can be performed without guidance;

Ha – The process is performed without the support of training material or a facilitator and the employee is aware of the potential consequences by incorrect execution of the process. At this training stage, the employee starts internalising the reason and importance of each action being performed;

Ri – Signifies the stage where employees are actively starting to question the process and to perform improvements. At this stage, employees start their training in problem-solving through a scientific method to deepen their process knowledge.

7.2.3.2.2 Subdimension 2.2 - Coaching Gemba

Organisational learning is a crucial element for sustainable lean implementation and employee development (Seidel, et al., 2017; Vänje & Brännmark, 2017; Toledo, et al., 2018). In a traditional environment, coaching and development of employees usually happen in training rooms and through exemplary tasks (Dombrowski & Mielke, 2014). However, in a lean *setting*, development, training and coaching of people occur at the place where work is done (*Gemba*), since the *Gemba* is a place for action and learning and helps to promote people's problem-solving skills (Aij & Teunissen, 2017; Dombrowski & Mielke, 2013; Aij, et al., 2015; Netland, et al., 2019).

This approach is done by solving actual, realistic problems, and the simulated or artificial problems traditionally used for teaching and learning are deemed redundant (Dombrowski & Mielke, 2014). Furthermore, this learning is also done in short cycles to enable rapid feedback from leadership and, therefore, quick successes in learning, which contributes to the employees' autonomous problem-solving abilities and continuous improvement (Dombrowski & Mielke, 2014). Therefore, lean leaders need to ensure that everyone adopts the company's problem-solving process as well as the role of "master problem solver" to support a culture of continuous improvement (Aij & Teunissen, 2017; Dombrowski & Mielke, 2014).

A common misconception in traditional environments is when leaders solve problems on their employees' behalf instead of supporting them through the process (Dombrowski & Mielke,

2014). People can only benefit from a problem-solving process if they've made it through the entire routine solely by themselves (Dombrowski & Mielke, 2014). Therefore, lean leaders are expected to promote and facilitate the problem-solving process and not the solution itself (Dombrowski & Mielke, 2014; Poksinska, et al., 2013). Rather than instantly jumping to a solution and solving the problem themselves, the lean leader is constantly asking questions that promote problem-solving to cultivate the employee's problem-solving creativity (Aij, et al., 2015; Poksinska, et al., 2013; Dombrowski & Mielke, 2014). This implies that lean leaders need to focus on asking the right questions rather than providing the right answers.

Ironically, leadership is often the first to argue and enforce their ideas or solutions, yet, they are generally the ones furthest from the point of value creation (Aij, et al., 2015). Therefore, leaders must accept that people closest to the problem generally understand it best and that they themselves may not possess the required knowledge to do the job at hand but can support the person concerned to analyse the problem and formulate solutions (Aij, et al., 2015; Aij & Teunissen, 2017).

The previously-mentioned problem-solving process is also managed through a *structured*, standardised and scientific approach, using, for instance, the A3 method or PDCA (plan-do-check-act) cycle (Netland, et al., 2019; Poksinska, et al., 2013; Dombrowski & Mielke, 2014; Seidel, et al., 2017; Poksinska, et al., 2013). Seidel, et al., (2019) highlights the personal attributes of lean leaders that could promote the adoption of standardised problem-solving, which includes discipline, communication, and persuasion.

Additionally, coaching at the Gemba should focus on fostering the leader-employee relationship and *respectfully* obtaining inputs from people through philosophical questioning, which is important for maintaining trust (Aij & Teunissen, 2017; Poksinska, et al., 2013). This implies that trust is enabled through confidence and reliance in the leader-employee relationship (Aij & Teunissen, 2017).

This increased interaction with people also leads to improved identification of problems and errors in processes, further developing the people's problem-solving abilities (Aij & Teunissen, 2017). Furthermore, lean leaders also need to demonstrate care, positive recognition, commitment, and respect toward the people's work when practising the coaching Gemba - which will make people more susceptible to influence (Aij & Teunissen, 2017; Håkansson, et al., 2017; Netland, et al., 2019; Poksinska, et al., 2013; Vänje & Brännmark, 2017).

It is natural for people to feel that the work they do, or role they represent, requires respect (van Dun, et al., 2017). Therefore, when leaders demonstrate respectful interaction by visiting them at the Gemba, it reinforces their value and validates the work they do (Vänje &

Brännmark, 2017). In turn, people are more likely to be responsive to the organisational and customer needs when they feel valued and their performance is acknowledged (Aij & Teunissen, 2017). This implies that Gemba can be used as an influence mechanism for people's development (Seidel, et al., 2019).

Coaching at the Gemba also helps lean leaders discover the true individual potential of their people and enables them to identify skills, capabilities, and knowledge that have not yet been fully developed (Aij & Teunissen, 2017; Håkansson, et al., 2017; Netland, et al., 2019; Poksinska, et al., 2013; Vänje & Brännmark, 2017). However, to pay attention to every single employee, leading at the Gemba usually requires a small leader-to-staff ratio which, will typically range from 1:5 – 1:9 (Dombrowski & Mielke, 2014).

7.2.3.2.3 Subdimension 2.3 - Empowerment

Capability development rests on empowering leadership (Aij & Teunissen, 2017). Empowerment of people has also been shown to lead to increased job satisfaction – which is associated with cultural changes and ultimately successful lean transformation (Aij, et al., 2015). Lean leaders must, therefore, have the necessary skills to inspire, motivate, and stimulate others (as discussed in *Dimension 1 – Personal development*), all of which are essential to their core work of *empowering* people (Aij & Teunissen, 2017). Consequently, people are more likely to make the changes necessary for lean implementation whenever lean leaders apply these skills (Aij & Teunissen, 2017).

Empowerment is also synonymous with *autonomy* (Aij & Teunissen, 2017). According to Poksinska, et al. (2013), two types of autonomy exist in people. The first being the extent to which people have responsibilities and decision-making power, called *responsible autonomy*, and the second being the extent to which people have experimental freedom towards their work procedures, which is referred to as *choice autonomy* and supports the principle of self-discovery (Poksinska, et al., 2013).

Lean leaders can foster autonomy by distributing and sharing authority and training self-managed teams, empowering them to actively partake in the decision-making process (Aij, et al., 2015; Poksinska, et al., 2013; Toledo, et al., 2018; Vänje & Brännmark, 2017; Aij, et al., 2015). Poksinska, et al., (2013) also emphasises the connection of self-managed teams to lean leadership, highlighting leadership's new role as facilitators rather than controllers for the development of these teams.

Self-managed teams, however, are not established overnight but is rather a long-term process that requires a sustained investment of effort and resources (Poksinska, et al., 2013). By

supporting autonomy, leaders also enable people to feel connected to the team, helping them succeed and to not accept complacency in the workplace (Aij & Teunissen, 2017).

Furthermore, whenever leaders delegate responsibilities to lower levels, they establish a sense of trust in their people's capabilities and skills, which is essential for the long-term relationship between leader and subordinate (Aij, et al., 2015; Håkansson , et al., 2017). Also, people are provided increased responsibility, which enables a sense of ownership and accountability towards their work and allows leadership to allocate more time focusing on strategy and direction rather than micromanaging their people (Aij & Teunissen, 2017).

More practically, in a lean environment, information related to each person's work is communicated through visual tools, which provides transparency and, in turn, also gives employees a high degree of ownership and accountability towards their area of responsibility (Poksinska, et al., 2013). Other methods to achieve increased accountability includes short, standardised daily meetings and two-way flow of communication – all of which will be discussed later in this study (Poksinska, et al., 2013).

Another way to support the sustainability of lean is through conscious employee *engagement* in the transformation (Håkansson , et al., 2017). This engagement is considered a product of empowerment and occurs when people are guided by empowering leadership (Poksinska, et al., 2013; Netland, et al., 2019; Mann, 2009; Håkansson , et al., 2017; Alefari, et al., 2017). Leaders encourage participation in lean at all levels and provide people with structured opportunities to be involved according to their individual skills, abilities, and maturity (Håkansson , et al., 2017).

Employee engagement in lean is also largely dependent on the leader's ability to listen actively and make people feel heard – i.e. giving them a voice in the lean transformation (Aij & Teunissen, 2017; van Dun, et al., 2017). Consequently, engagement creates opportunities for feedback on changes and allows the leader to understand how changes are implemented, ultimately helping them identify areas of potential resistance (Aij & Teunissen, 2017).

Aij with Teunissen (2017), however, highlight the importance of lean leaders being supportive in their communication to increase employee engagement. Leaders also need to understand that people have valuable knowledge about their jobs, which they were encouraged to engage and share with others (Håkansson , et al., 2017; Dombrowski & Mielke, 2014).

7.2.3.3 Subdimensions related to Continuous Improvement

For the third **dimension**, *Continuous improvement*, four **subdimensions** apply and, based on the findings in Chapter 6, will be elaborated on in the section to follow.

7.2.3.3.1 Subdimension 3.1 - Daily Kaizen

Daily Kaizen relates to continuously looking at the current operational environment within an organisation and actively changing things to support people in creating more customer value daily. To support and promote daily Kaizen, Toledo, et al. (2018) suggest that leaders should adopt two proactive approaches, which is to establish a *problem-management routine* and a *problem-gathering routine*.

During the *problem-management routine*, people (under the coordination of their area managers) are gathered and encouraged to report on common problems in their processes, which are then captured, summarised and classified by the leader (Toledo, et al., 2018). This is then followed by the establishment of a countermeasure or action plan for each open point that should be addressed (Toledo, et al., 2018).

These type of routines are similar to *stand-up* meetings often used in lean organisations, where representatives from each function and organisational level participate in a brief, standardised daily *stand-up* meetings to remain familiar with the current status of operations (Netland, et al., 2019; Seidel, et al., 2019; Vänje & Brännmark, 2017; Poksinska, et al., 2013).

Through these meetings, a daily accountability process established, which allows lean leaders to practice problem-management and escalate non-conforming issues affecting performance up the hierarchy to have information shared efficiently throughout the organisation (Netland, et al., 2019; Vänje & Brännmark, 2017). Performance is, therefore, evaluated by referring to the current state of the processes that the leader is responsible for, ensuring rapid and frequent feedback loops with the next level of management (Camuffo & Gerli, 2018).

Daily accountability also provides a platform for following up on task assignments across all levels of the organisational hierarchy that were made in response to improvement opportunities or emerging problems (Poksinska, et al., 2013; Netland, et al., 2019). Kaizen forms part of the agenda of these daily meetings, where improvement projects or activities are monitored and time and resources are allocated to support daily Kaizen (Poksinska, et al., 2013).

The second approach as proposed by Toledo, et al. (2018), the *problem-gathering routine*, requires lean leaders to establish a routine Gemba walk for the identification of problems. Here, leaders focus on auditing processes and standardised work procedures to ensure that defined processes are followed and working as intended by verifying their execution at the task level (Mann, 2009; Toledo, et al., 2018). This includes verifying the main purpose of a process, which is being customer-focused (Dombrowski & Mielke, 2013). Another important aspect of this routine is for leaders to provide daily support to the team and actively remove any

obstacles that may prevent them from adding value (Mann, 2009; Aij, et al., 2015; Aij & Teunissen, 2017; Maijala, et al., 2018).

Interestingly enough, Dombrowski with Mielke (2013) highlights that leaders themselves do not necessarily add value, but rather set the stage for their employees to add customer value to the product or service most productively and effectively (Alefari, et al., 2017; Camuffo & Gerli, 2018). They, therefore, perceive themselves at the service of value-creating work by identifying and managing problems (Camuffo & Gerli, 2018).

Both the *problem-management* and *problem-gathering* routines proposed by Toledo, et al. (2018) are proactive approaches toward problem-solving. Dombrowski with Mielke (2013) and Aij with Teunissen (2017), however, describe a common problem-solving routine that is focused on a *reactive* rather than *proactive* approach and is practised through the following five golden rules (for the purpose of this study, this routine will be referred to as the “Go-see-fix routine”):

1. Once a problem arises, go to the place where the work is done.

Leaders go and see problems with their own eyes, observing it at the source to gain an understanding of the actual situation (Seidel, et al., 2017; Seidel, et al., 2019; Tortorella, et al., 2019; Aij, et al., 2015). This ultimately enables the leader to make decisions based on self-gained facts instead of focusing on only the measurements of outcome parameters or KPIs (Dombrowski & Mielke, 2014; Dombrowski & Mielke, 2013; Toledo, et al., 2018; Maijala, et al., 2018).

2. Observe and inquire about all possible elements that may be involved in the problem (*Gimbetsu*). This could include people, products, processes, equipment etc.

3. Take temporary countermeasures that will satisfy the customer’s needs immediately.

4. Identify and address the *root cause* to ensure the problem will not re-occur.

Instead of focusing on quick solutions, lean leaders recognise that problems that are not completely solved will inevitably return (Mann, 2009; Maijala, et al., 2018; Alefari, et al., 2017; Dombrowski & Mielke, 2013). Rather, a focus on solving the root cause of the problem should be adopted to ensure that people do not have to revisit or rework a problem, which in turn avoids more waste being created (Poksinska, et al., 2013; Dombrowski & Mielke, 2014). A true understanding of the root cause of problem-solving can only occur where leaders put themselves in the shoes of the people who do the work, which is at the Gemba (Dombrowski & Mielke, 2014).

5. Standardise once the root cause has been identified to ensure permanent countermeasures can be taken.

In addition, lean leaders are also expected to establish an organisational-mindset where problems are recognised as *opportunities* for continuous improvement and learning, ensuring that all individuals are involved in identifying the root causes of failures daily without blaming others (Aij & Teunissen, 2017; Aij, et al., 2015; Dombrowski & Mielke, 2013). This is often referred to as a “no-blame” culture (Dombrowski & Mielke, 2013). They must, however, understand that problems will always occur but their consequences (defects) should be avoided (Dombrowski & Mielke, 2014).

7.2.3.3.2 Subdimension 3.2 - Improvement Kaizen

As explained in Chapter 2, Womack with Jones (1996) developed five lean principles. The first is to define value from the customer’s perspective. The second is to identify and map the value stream and the third calls for the continuous elimination of interruptions that may prevent the flow of value to the customer (Womack & Jones, 1996). In many organisations, most of the value stream processes are carried horizontally across multiple functional and departmental boundaries – all of whom contribute to improving (and often hindering) the flow value (Mann, 2009).

Improvement Kaizen, therefore, aims at establishing cross-functional teams that centre around identifying, creating and managing continuous improvement projects that focus on the value-producing processes (Mann, 2009; Poksinska, et al., 2013). These projects can holistically be described in terms of isolated but focused improvements in cost, quality, delivery, safety and the environment (Mann, 2009; Poksinska, et al., 2013).

For managing improvement projects, Mann (2009) suggests a lean governance process, which provides system-level support for a *value stream* perspective. This process consists of two main elements – the first being a *lean steering and oversight (LSO) committee*, which consists of individuals at top management levels (Mann, 2009). The purpose of this LSO committee is to call for, approve, support and oversee value stream improvement projects (Mann, 2009).

The second element of the lean governance process is found at the project level and consists of a *project resource and accountability (PR&A) panel* that is comprised of leaders from functions or departments targeted by value stream improvement projects (Mann, 2009). In short, the PR&A panel is responsible to the LSO for setting fittingly bold improvement objectives for each improvement project and executing the plan to achieve them (Mann, 2009).

Sustaining the inherent degree of collaboration required by these value stream improvement projects requires people to strongly commit and prioritise their work with each other, especially

when functions have a poor history of collaboration. This type of *partnering* between functions also helps to break through internal boundaries to enhance coordination and ultimately better serve the customer (Maijala, et al., 2018). At its most basic level, partnering occurs at the front-line process, where lean leaders work with employees to smooth handoffs from one stage to the next.

To establish and support cross-functional collaboration, lean leaders need to understand the organisation's history of collaboration as well as current functional and professional silos that exist (Maijala, et al., 2018; Seidel, et al., 2019). They also need to allocate the necessary time for cross-functional job rotation to ensure that teams have a proper multidisciplinary composition (Maijala, et al., 2018; Aij, et al., 2015).

Therefore, rather than focusing on functional issues, which are typically narrowly defined, lean leaders give attention to the *horizontal flow of value* across entire value streams between different departments, organisations and supply chains (Camuffo & Gerli, 2018). In other words, value stream Kaizen is based on the premise of continuously making value flow through cross-collaboration all while maintaining a horizontal focus across entire value streams. However, leaders need to recognise that people within functional organisations will naturally resist cross-functional initiatives, which critically highlights the leader's ability to handle conflict and maintain relationships (Poksinska, et al., 2013; Maijala, et al., 2018; Mann, 2009).

7.2.3.3.3 Subdimension 3.3 - Process Performance

Lean leaders are expected to increase the likelihood that process improvements will endure the transition from project mode to ongoing processes (Mann, 2009). They should, therefore, *adhere* to not only current but also new, standardised post-project processes in a disciplined manner and support new behaviours and practices consistently (Mann, 2009; Aij, et al., 2015). This level of commitment demonstrated by lean leaders ultimately improves the chances of process improvements being sustained in the long run, as employees are less likely to abandon the new way of working.

Moreover, effective lean leaders, together with their subordinates, must mobilise in the corrective and reactive approach towards *standardisation* and *stabilisation* of tasks, processes and use them as the foundation for continuous improvement (Seidel, et al., 2017; Toledo, et al., 2018; Maijala, et al., 2018; Camuffo & Gerli, 2018). These standardised work procedures should then be enforced to ensure the generation of improvement initiatives by the people who do the job. This approach is grounded in the scientific method of experimentation, where an independent variable is systematically adjusted (i.e. the intentional change to the standardised procedure) and the variation in the dependent variable (process result to be improved) is

observed (Mann, 2009; Netland, et al., 2019). Once the improved outcome has been observed as planned, the casual relationship is verified and change procedure implemented (Mann, 2009).

It is also imperative that leaders focus on managing the process and not the numbers, understanding that it is not necessarily the financial results that are important, but rather the process *yield* (Aij, et al., 2015). This means that the focus on improving process performance should automatically have priority on only improving the result (Aij, et al., 2015). Furthermore, lean leaders are expected to establish and maintain new, process-focused measures of performance alongside traditional measures of results (Mann, 2009).

This then subsequently ties to the principle of *process-management*, where leaders are constantly observing and collecting data on process performance and managing it at the intersections of value streams (Mann, 2009). They manage with a focus on the flow of value between processes instead of isolated operations (Seidel, et al., 2017). Leaders should establish process teams with specific process owners who are made responsible for the management and continuous improvement of these processes (Poksinska, et al., 2013).

Furthermore, lean leaders must enforce new expectations and challenge the current process or traditional approaches daily in order to improve them (Alefari, et al., 2017; Dombrowski & Mielke, 2013). The continuous development of processes is just as important in a lean setting as the continuous development of people (Dombrowski & Mielke, 2013). One way for lean leaders to demonstrate that they've succeeded in stabilising their processes is by making themselves superfluous in their current roles (Dombrowski & Mielke, 2014).

Frequent feedback on process performance is also provided in the workplace through *visual controls* (Aij & Teunissen, 2017; Majjala, et al., 2018; Poksinska, et al., 2013; Mann, 2009). Leaders are expected to implicitly demonstrate that the results displayed by visual controls matter and that the numbers are not merely just abstract measures, but critical in communicating how well an operation is being performed (Aij, et al., 2015). Lean ultimately is a philosophy that strives to continuously improve process performance, and it is the responsibility of leaders to ensure the establishment and maintenance of this metric (Camuffo & Gerli, 2018).

7.2.3.3.4 Subdimension 3.4 – Kaizen suggestion

Successful lean implementation requires people to continuously improve their working environment and take ownership of their processes, which is underpinned by defining

challenging objectives or targets for each work area to stimulate a continuous improvement culture (Tortorella, et al., 2019; Aij, et al., 2015; Camuffo & Gerli, 2018). To promote this culture, leaders can provide their people with opportunities to present their ideas and suggestions for improvement in an environment that is structured and open to experimentation without fear of failure, where each input is valued and acted upon (Aij, et al., 2015; Toledo, et al., 2018; Poksinska, et al., 2013).

A common approach used to structure these ideas is through an employee *suggestion system*, which is usually supported through extrinsic rewards or motivation measures such as incentives (Dombrowski & Mielke, 2014). It is imperative that this suggestion system is acknowledged by leaders as a method of promoting continuous improvement in the organisation (Netland, et al., 2019). They must also give recognition and promptly respond to the submission of improvement ideas as a way of maintaining commitment (Poksinska, et al., 2013; Netland, et al., 2019; Håkansson, et al., 2017).

The people closest to the front line are often the ones that understand the weaknesses and failures of a process best but cannot fix them alone, and therefore need the support of leadership to pick up their ideas, apply them in practice and maintain it at all levels (Dombrowski & Mielke, 2013).

Furthermore, leaders should actively encourage people to participate in this suggestion system, emphasising and celebrating success in the process (Toledo, et al., 2018; Tortorella, et al., 2019; van Dun, et al., 2017; Majjala, et al., 2018). Crucial however to note is that, instead of constantly collecting a long list of improvement ideas that never materialise in any improvements, leaders should identify and focus on those issues that would accomplish the target conditions or metrics for that specific area (Netland, et al., 2019).

Nonetheless, whatever method is selected to drive the suggestion system for continuous improvement, whether through traditional suggestion boxes, or by collecting them in daily meetings, it should be championed by leaders and the necessary time and resources should be allocated to enable continuous improvement activities (Netland, et al., 2019; Aij, et al., 2015; Poksinska, et al., 2013). Also, the leader's ability to articulate the expected outcomes from continuous improvement initiatives to the people is an important supporting principle (Aij & Teunissen, 2017).

7.2.3.4 Subdimensions related to Purpose

For the fourth and final dimension, *Purpose*, two subdimensions apply and, based on the findings in Chapter 6, will be elaborated on in the section to follow.

7.2.3.4.1 Subdimension 4.1 – Strategic Direction (True North)

Leaders who intend to implement and sustain lean successfully should be able to anticipate and prepare for the challenges demanded the transformation (Aij, et al., 2015; Maijala, et al., 2018). Leadership's role here is to develop and implement necessary structures and governance arrangements across internal boundaries that can predict and respond to these challenges posed by the lean implementation (Mann, 2009; Aij, et al., 2015; Aij & Teunissen, 2017; Maijala, et al., 2018). At a more strategic planning level, this calls for leaders to continually reassess their organisation's alignment with other internal units and third parties, realigning from the customer back (Aij & Teunissen, 2017).

Netland, et al. (2019) emphasises that the adoption of a strategic planning approach is crucial for a successful lean transformation, highlighting the importance of having the entire organisation aligned for the lean journey through “hoshin planning”, which is realised through *hoshin kanri*.

Based on this, leaders are expected to define and deploy the organisation's long-term vision and strategic goals through *hoshin kanri* (otherwise known as *Policy Deployment*), ensuring that there exists no trade-off between quality, cost, safety and delivery and ultimately providing a clear direction (true north) for the organisation (Maijala, et al., 2018; Dombrowski & Mielke, 2013; Tortorella, et al., 2019; Netland, et al., 2019; Aij & Teunissen, 2017; van Dun, et al., 2017; Poksinska, et al., 2013; Alefari, et al., 2017; Dombrowski & Mielke, 2014).

This process serves as the foundation for the strategic alignment of priorities and tasks both vertically and horizontally within the organisation and establishes consistency, direction and consensus between otherwise disrupted teams and other organisational functions (Toledo, et al., 2018; Aij & Teunissen, 2017; Alefari, et al., 2017). Also, because improvement activities could be somewhat decentralised, a superior, overarching system is necessary to align the direction of single activities (Dombrowski & Mielke, 2013).

Defining these long-term goals is not done in isolation, but with the participation of all employees and should never be impaired by short-term goals, meaning that lean leaders should exhibit long-term thinking (Toledo, et al., 2018; Dombrowski & Mielke, 2014; Alefari, et al., 2017; van Dun, et al., 2017). Although each team may have their own short-term goals, the PD provides direction for teams to achieve long-term goals (Aij & Teunissen, 2017). This implies lean leadership's exhibition of *long-term consistency* toward the organisation's philosophy and values (Alefari, et al., 2017).

The lean philosophy highlights a bottom-up continuous improvement approach to achieve sustained results, which is described by the previous dimension (Netland, et al., 2019). However, lean efforts should also be enforced top-down, where all activities are connected to the strategic vision and goals of the company (Netland, et al., 2019; Toledo, et al., 2018). In other words, the establishment of goals or performance targets at all levels of the organisation should converge to operationalise the highest-level strategy.

Lean leaders need to ensure that the strategic goals and objectives established during the policy deployment process are broken down into sub-objectives at lower organisational levels and integrated with the daily operations (Alefari, et al., 2017; Netland, et al., 2019). This enables an *organisation-wide alignment* with the same overarching strategy, including the goals of improvement activities (Netland, et al., 2019; Alefari, et al., 2017; Toledo, et al., 2018).

It is important to clarify the connection of these goals with the organisation's true north, ensuring that employees understand their individual objectives and how it all relates to the overall organisational purpose (Aij & Teunissen, 2017; Toledo, et al., 2018; Aij, et al., 2015). Activity plans aligned with strategic goals are also defined and translated to specific targets for each functional area through a set of key performance indicators (KPIs) and key behavioural indicators (KBIs), all based on long-term views (Netland, et al., 2019; Toledo, et al., 2018; Aij & Teunissen, 2017; Seidel, et al., 2017). In other words, quantitative measures are linked with qualitative knowledge and experience in the workplace (Aij, et al., 2015). These strategies need to be developed in ways that support meaningful jobs (Håkansson, et al., 2017).

The emphasis of everyone's work is then shifted to the horizontal process, that is, what adds value to both the internal and external customer and how can it be realised (Aij, et al., 2015; van Dun, et al., 2017; Toledo, et al., 2018). Leaders must therefore establish recognition of and commitment to a shared view of what the customer defines as value, putting it at the heart of the organisation and ensure that it is carried horizontally to everyone across the value stream (Mann, 2009; Aij & Teunissen, 2017; Toledo, et al., 2018). In this way, leaders, as well as their people, understand who the internal and external customers are, what they define as value and how their individual jobs contribute to adding value for the customer (Majjala, et al., 2018; Seidel, et al., 2017; Aij & Teunissen, 2017; van Dun, et al., 2017).

7.2.3.4.2 Subdimension 4.2 – Reinforcement

One of the biggest challenges for any lean transformation is changing both the behaviour and mindsets (culture) of people and to keep them from reverting to their old ways (Dombrowski & Mielke, 2013; Toledo, et al., 2018; Alefari, et al., 2017). Furthermore, because lean ultimately demands an organisation to continuously adapt and evolve, constant change is inevitable and

the establishment of a *culture* that embraces the daily identification and implementation of changes is considered a critical element of not only lean but also its champions, lean leadership (Aij, et al., 2015; Alefari, et al., 2017; Mann, 2009). This then suggests that to be successful in lean, lean leaders are required to change what they reinforce (Mann, 2009).

People's perception of a change has a significant impact on whether it will be successful or not (Aij, et al., 2015). They need to be convinced of the benefits of a transformation and that it will positively affect their work environment, ultimately making their jobs more meaningful (Aij, et al., 2015; Håkansson , et al., 2017). Resistance to the lean transformation, as with any transformation, will always pose a challenge and occurs because of uncertainties surrounding the transformation (Håkansson , et al., 2017; Netland, et al., 2019; Maijala, et al., 2018).

To address these uncertainties, leaders must consistently reinforce and motivate change by conveying the sense of meaning or, *purpose*, that people require to consider a transformation that will drastically change their way of working (Aij, et al., 2015; Aij & Teunissen, 2017; Håkansson , et al., 2017). Crucial then, is for the organisation and its stakeholders to constantly be aware that the change towards lean is delivering the desired results (Seidel, et al., 2019; Netland, et al., 2019). Therefore, *transparency* on the current state of the transformation must be communicated frequently, ensuring that everyone is properly informed about the transformation's progress and what their roles are throughout the change (Netland, et al., 2019; Seidel, et al., 2019).

As a way of obtaining this level of transparency, visual management can be used to offer immediate and easily accessible information on the current state of the transformation (Netland, et al., 2019; Poksinska, et al., 2013). Amongst others, these visual strategies should illustrate Kaizen activities and their success stories, which in turn allows employees to become directly engaged in the improvement process (Seidel, et al., 2019; Poksinska, et al., 2013). It should also help with communicating information on whether PD and area targets are being met (Aij & Teunissen, 2017; Aij, et al., 2015).

To further promote the adoption of constant change, lean leaders need to actively demonstrate engagement in the lean transformation through visible participation, in turn demonstrating their own willingness to embrace change (Netland, et al., 2019; Tortorella, et al., 2019; Aij & Teunissen, 2017; Poksinska, et al., 2013; Maijala, et al., 2018). However, only willingness to embrace change is not enough for sustained influence on people and leaders should be committed to transforming their commitments to change into an actual change. (Maijala, et al., 2018; Aij, et al., 2015; Mann, 2009).

Lean leaders should also use this active participation as an opportunity to reinforce motivation for the transformation by promoting lean and its underlying principles, culture and practices (Netland, et al., 2019; Poksinska, et al., 2013; Seidel, et al., 2019). Through this communication, lean leaders could influence the people's mindset toward lean and encourage wanted behaviour or improve unwanted behaviour (Netland, et al., 2019; Poksinska, et al., 2013; Seidel, et al., 2019).

7.2.4 Maturity scale

The LLMM also consists of **5 maturity levels** for each **capability area** as indicated by the red cells in Figure 29. This maturity scale forms the foundation for the assessment of the **capability areas**.

The following design requirements apply to the maturity scale development:

- **Design Requirement 3:** The LLMM can function as a diagnostic tool of as-is lean leadership.
- **Design Requirement 10:** The LLMM follows a unidirectional and linear path of cumulative stages from lower- to higher maturity. The stage progression is logical.

Dimensions	Subdimensions	Capability areas	Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection	1.1.1.1	1.1.1.2	1.1.1.3	1.1.1.4	1.1.1.5
		1.1.2 Role model	1.1.2.1	1.1.2.2	1.1.2.3	1.1.2.4	1.1.2.5
		1.1.3 Behavioural accountability	1.1.3.1	1.1.3.2	1.1.3.3	1.1.3.4	1.1.3.5
		1.1.4 Aptitude	1.1.4.1	1.1.4.2	1.1.4.3	1.1.4.4	1.1.4.5
		1.1.5 Qualification	1.1.5.1	1.1.5.2	1.1.5.3	1.1.5.4	1.1.5.5
2. People Development	1.2 Hands-on Approach	1.2.1 Teaching-learning Gemba	1.2.1.1	1.2.1.2	1.2.1.3	1.2.1.4	1.2.1.5
		1.2.2 Leader standard work	1.2.2.1	1.2.2.2	1.2.2.3	1.2.2.4	1.2.2.5
		2.1.1 Long-term commitment	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5
	2.2 Coaching Gemba	2.1.2 Development programs	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5
		2.1.3 Nurturing environment	2.1.3.1	2.1.3.2	2.1.3.3	2.1.3.4	2.1.3.5
		2.2.1 Setting	2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4	2.2.1.5
	2.3 Empowerment	2.2.2 Respectful interaction	2.2.2.1	2.2.2.2	2.2.2.3	2.2.2.4	2.2.2.5
		2.2.3 Structured problem-solving	2.2.3.1	2.2.3.2	2.2.3.3	2.2.3.4	2.2.3.5
		2.3.1 Responsible autonomy	2.3.1.1	2.3.1.2	2.3.1.3	2.3.1.4	2.3.1.5
		2.3.2 Choice autonomy	2.3.2.1	2.3.2.2	2.3.2.3	2.3.2.4	2.3.2.5
3. Continuous Improvement	3.1 Daily Kaizen	2.3.3 Engagement	2.3.3.1	2.3.3.2	2.3.3.3	2.3.3.4	2.3.3.5
		3.1.1 Problem-management routine	3.1.1.1	3.1.1.2	3.1.1.3	3.1.1.4	3.1.1.5
		3.1.2 Problem gathering routine	3.1.2.1	3.1.2.2	3.1.2.3	3.1.2.4	3.1.2.5
		3.1.3 Proactive support	3.1.3.1	3.1.3.2	3.1.3.3	3.1.3.4	3.1.3.5
		3.1.4 Go-see-fix	3.1.4.1	3.1.4.2	3.1.4.3	3.1.4.4	3.1.4.5
		3.1.5 Problem to opportunity	3.1.5.1	3.1.5.2	3.1.5.3	3.1.5.4	3.1.5.5
	3.2 Improvement Kaizen	3.1.6 Root cause problem solving	3.1.6.1	3.1.6.2	3.1.6.3	3.1.6.4	3.1.6.5
		3.2.1 Value stream mapping	3.2.1.1	3.2.1.2	3.2.1.3	3.2.1.4	3.2.1.5
		3.2.2 LSO committee	3.2.2.1	3.2.2.2	3.2.2.3	3.2.2.4	3.2.2.5
		3.2.3 PR&A panel	3.2.3.1	3.2.3.2	3.2.3.3	3.2.3.4	3.2.3.5
		3.2.4 Focused improvement	3.2.4.1	3.2.4.2	3.2.4.3	3.2.4.4	3.2.4.5
		3.2.5 Partnering	3.2.5.1	3.2.5.2	3.2.5.3	3.2.5.4	3.2.5.5
	3.3 Process performance	3.2.6 Horizontal flow of value	3.2.6.1	3.2.6.2	3.2.6.3	3.2.6.4	3.2.6.5
		3.3.1 Adherence	3.3.1.1	3.3.1.2	3.3.1.3	3.3.1.4	3.3.1.5
		3.3.2 Standardise, stabilise	3.3.2.1	3.3.2.2	3.3.2.3	3.3.2.4	3.3.2.5
		3.3.3 Yield	3.3.3.1	3.3.3.2	3.3.3.3	3.3.3.4	3.3.3.5
	3.4 Kaizen suggestion	3.3.4 Process management	3.3.4.1	3.3.4.2	3.3.4.3	3.3.4.4	3.3.4.5
		3.3.5 Visual feedback	3.3.5.1	3.3.5.2	3.3.5.3	3.3.5.4	3.3.5.5
4. Purpose	4.1 Strategic direction	3.4.1 Structured system	3.4.1.1	3.4.1.2	3.4.1.3	3.4.1.4	3.4.1.5
		3.4.2 Reward-recognition	3.4.2.1	3.4.2.2	3.4.2.3	3.4.2.4	3.4.2.5
		3.4.3 Kaizen stimulation	3.4.3.1	3.4.3.2	3.4.3.3	3.4.3.4	3.4.3.5
		4.1.1 Policy deployment	4.1.1.1	4.1.1.2	4.1.1.3	4.1.1.4	4.1.1.5
	4.2 Reinforcement	4.1.2 Long-term consistency	4.1.2.1	4.1.2.2	4.1.2.3	4.1.2.4	4.1.2.5
		4.1.3 Operational alignment	4.1.3.1	4.1.3.2	4.1.3.3	4.1.3.4	4.1.3.5
		4.1.4 Customer alignment	4.1.4.1	4.1.4.2	4.1.4.3	4.1.4.4	4.1.4.5
		4.2.1 Change culture	4.2.1.1	4.2.1.2	4.2.1.3	4.2.1.4	4.2.1.5
		4.2.2 Transparency	4.2.2.1	4.2.2.2	4.2.2.3	4.2.2.4	4.2.2.5
		4.2.3 Participation	4.2.3.1	4.2.3.2	4.2.3.3	4.2.3.4	4.2.3.5

Figure 29: Lean leadership maturity grid with dimensions, subdimensions and maturity levels

The SLR conducted in Chapter 5 through its specific review protocol and databases yielded no Lean leadership maturity model and, therefore, also no maturity scale for lean leadership. The first four maturity levels for the LLMM, *Initial*, *Managed*, *Defined* and *Predictable*, were adapted from Curtis, et al's. (2009). According to Curtis, et al. (2009), the P-CMM is based on the fact improved workforce practices (such as lean) cannot be sustained without a change in organisational behaviour that supports them. Furthermore, the P-CMM also provides a roadmap for transforming an organisation through steady improvements in its workforce practices (Curtis, et al., 2009). The reason for adopting the P-CMM's scale for the LLMM is because it applies the principles of the process maturity framework to an organisational domain, which lean leadership encompasses.

However, the name of Curtis, et al's. (2009) fifth maturity level, *Optimising*, is replaced with *Sustained* to emphasise the fact that lean leadership has no endpoint, it is continuous improvement approach. Therefore, *Sustained* implies that the ideal level of lean leadership maturity aims to achieve what this model has set out to accomplish, which is to support organisational leaders to better sustain lean. Each of the five maturity levels represents a

different level of lean leadership capability and provides the foundation for the following level. This means the LLMM follows logical stage progression with a unidirectional and linear path of cumulative stages from lower- to higher maturity. The adapted maturity levels for this model are depicted in Figure 30:

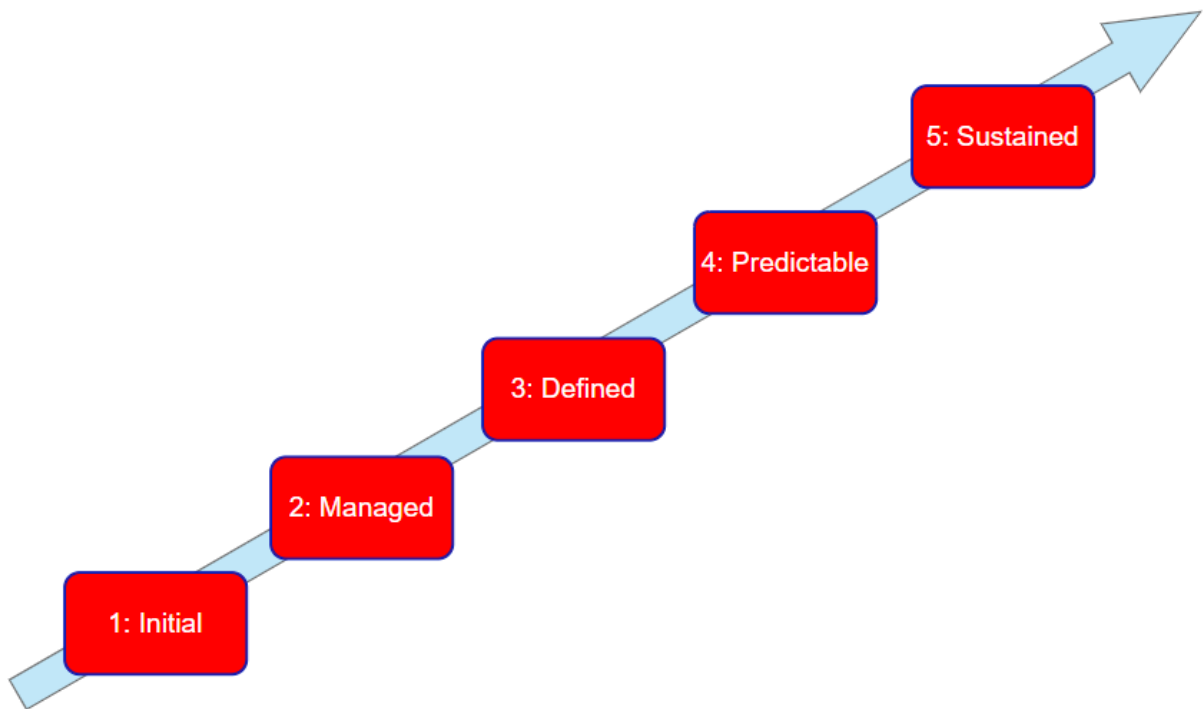


Figure 30: Maturity scale for lean leadership

Furthermore, each maturity level describes their respective **capability areas** through distinctive **capability statements** that are characteristic of those **capability areas**. However, a **capability area** can only be contained in one **maturity level** at a time. Each maturity grid adopts these five **maturity levels**.

7.2.5 Capability areas and ideal statements

Each of the **subdimensions** are described through various **capability areas**, all contained within the lean leadership domain as illustrated in Figure 31. The highest maturity level of each **capability area** is represented by an **ideal statement**.

The following design requirement is also applicable to this section of the model development:

- **Design Requirement 1:** The LLMM describes lean leadership.

Dimensions	Subdimensions	Capability areas	Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection	1.1.1.1	1.1.1.2	1.1.1.3	1.1.1.4	1.1.1.5
		1.1.2 Role model	1.1.2.1	1.1.2.2	1.1.2.3	1.1.2.4	1.1.2.5
		1.1.3 Behavioural accountability	1.1.3.1	1.1.3.2	1.1.3.3	1.1.3.4	1.1.3.5
		1.1.4 Aptitude	1.1.4.1	1.1.4.2	1.1.4.3	1.1.4.4	1.1.4.5
		1.1.5 Qualification	1.1.5.1	1.1.5.2	1.1.5.3	1.1.5.4	1.1.5.5
2. People Development	1.2 Hands-on Approach	1.2.1 Teaching-learning Gemba	1.2.1.1	1.2.1.2	1.2.1.3	1.2.1.4	1.2.1.5
		1.2.2 Leader standard work	1.2.2.1	1.2.2.2	1.2.2.3	1.2.2.4	1.2.2.5
		2.1.1 Long-term commitment	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5
	2.1 Cultivation	2.1.2 Development programs	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5
		2.1.3 Nurturing environment	2.1.3.1	2.1.3.2	2.1.3.3	2.1.3.4	2.1.3.5
		2.2.1 Setting	2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4	2.2.1.5
	2.2 Coaching Gemba	2.2.2 Respectful interaction	2.2.2.1	2.2.2.2	2.2.2.3	2.2.2.4	2.2.2.5
		2.2.3 Structured problem-solving	2.2.3.1	2.2.3.2	2.2.3.3	2.2.3.4	2.2.3.5
		2.3.1 Responsible autonomy	2.3.1.1	2.3.1.2	2.3.1.3	2.3.1.4	2.3.1.5
	2.3 Empowerment	2.3.2 Choice autonomy	2.3.2.1	2.3.2.2	2.3.2.3	2.3.2.4	2.3.2.5
		2.3.3 Engagement	2.3.3.1	2.3.3.2	2.3.3.3	2.3.3.4	2.3.3.5
3. Continuous Improvement	3.1 Daily Kaizen	3.1.1 Problem-management routine	3.1.1.1	3.1.1.2	3.1.1.3	3.1.1.4	3.1.1.5
		3.1.2 Problem gathering routine	3.1.2.1	3.1.2.2	3.1.2.3	3.1.2.4	3.1.2.5
		3.1.3 Proactive support	3.1.3.1	3.1.3.2	3.1.3.3	3.1.3.4	3.1.3.5
		3.1.4 Go-see-fix	3.1.4.1	3.1.4.2	3.1.4.3	3.1.4.4	3.1.4.5
		3.1.5 Problem to opportunity	3.1.5.1	3.1.5.2	3.1.5.3	3.1.5.4	3.1.5.5
		3.1.6 Root cause problem solving	3.1.6.1	3.1.6.2	3.1.6.3	3.1.6.4	3.1.6.5
	3.2 Improvement Kaizen	3.2.1 Value stream mapping	3.2.1.1	3.2.1.2	3.2.1.3	3.2.1.4	3.2.1.5
		3.2.2 LSO committee	3.2.2.1	3.2.2.2	3.2.2.3	3.2.2.4	3.2.2.5
		3.2.3 PR&A panel	3.2.3.1	3.2.3.2	3.2.3.3	3.2.3.4	3.2.3.5
		3.2.4 Focused improvement	3.2.4.1	3.2.4.2	3.2.4.3	3.2.4.4	3.2.4.5
		3.2.5 Partnering	3.2.5.1	3.2.5.2	3.2.5.3	3.2.5.4	3.2.5.5
		3.2.6 Horizontal flow of value	3.2.6.1	3.2.6.2	3.2.6.3	3.2.6.4	3.2.6.5
	3.3 Process performance	3.3.1 Adherence	3.3.1.1	3.3.1.2	3.3.1.3	3.3.1.4	3.3.1.5
		3.3.2 Standardise, stabilise	3.3.2.1	3.3.2.2	3.3.2.3	3.3.2.4	3.3.2.5
		3.3.3 Yield	3.3.3.1	3.3.3.2	3.3.3.3	3.3.3.4	3.3.3.5
		3.3.4 Process management	3.3.4.1	3.3.4.2	3.3.4.3	3.3.4.4	3.3.4.5
		3.3.5 Visual feedback	3.3.5.1	3.3.5.2	3.3.5.3	3.3.5.4	3.3.5.5
	3.4 Kaizen suggestion	3.4.1 Structured system	3.4.1.1	3.4.1.2	3.4.1.3	3.4.1.4	3.4.1.5
		3.4.2 Reward-recognition	3.4.2.1	3.4.2.2	3.4.2.3	3.4.2.4	3.4.2.5
		3.4.3 Kaizen stimulation	3.4.3.1	3.4.3.2	3.4.3.3	3.4.3.4	3.4.3.5
4. Purpose	4.1 Strategic direction	4.1.1 Policy deployment	4.1.1.1	4.1.1.2	4.1.1.3	4.1.1.4	4.1.1.5
		4.1.2 Long-term consistency	4.1.2.1	4.1.2.2	4.1.2.3	4.1.2.4	4.1.2.5
		4.1.3 Operational alignment	4.1.3.1	4.1.3.2	4.1.3.3	4.1.3.4	4.1.3.5
		4.1.4 Customer alignment	4.1.4.1	4.1.4.2	4.1.4.3	4.1.4.4	4.1.4.5
	4.2 Reinforcement	4.2.1 Change culture	4.2.1.1	4.2.1.2	4.2.1.3	4.2.1.4	4.2.1.5
		4.2.2 Transparency	4.2.2.1	4.2.2.2	4.2.2.3	4.2.2.4	4.2.2.5
		4.2.3 Participation	4.2.3.1	4.2.3.2	4.2.3.3	4.2.3.4	4.2.3.5

Figure 31: Lean leadership maturity grid with dimensions, subdimensions, maturity levels, capability areas and ideal statements

The **capability areas** within this framework are also derived from the findings in Chapter 6 and are defined as “groups of related lean leadership activities or behaviours associated with a specific combination of **dimensions** and **subdimensions**, covering all five maturity **levels**” (adapted from van Dyk, 2013). They represent a desired activity or behaviour associated with lean leadership and describe the practice of an activity or behaviour that is considered critical for lean leadership maturity.

Furthermore, each of the **capability areas** comprises of a set of **capability statements**. In this framework, a capability statement can be defined as a “general statement that serves as criteria or descriptor of a capability area as it applies to a specific maturity level” (adapted from van Dyk, 2013).

As briefly explained in the previous section, the highest-level capability statement (level 5), which is referred to as an **ideal statement**, defines the “ideal lean leadership feature of a **capability area** within a specific combination of domain **dimensions** and **subdimensions**”. These **ideal statements** are derived from the findings of the SLR and ATA in Chapter 6 since the data

already indicates the desired feature of lean leadership and, therefore, *what* ideally represents lean leadership maturity.

Moreover, a *purpose statement* for each **subdimension** is defined and serves as “an informative element that describes the purpose of the **subdimension** at a high level”.

In the section to follow, the **capability** areas with their respective **ideal statements** are formulated for each **subdimension** as it relates to a specific **dimension**. Each subdimension is also assigned a specific purpose statement. By combining all these components, a capability matrix is formed that describes the ideal lean leadership maturity.

7.2.5.1 Ideal maturity for Dimension 1 Personal Development

The first **dimension**, *Personal Development*, consists of 2 **subdimensions** and 7 **capability areas** – each with one or more **ideal statements** as illustrated in Figure 32:

Lean leadership maturity grid			Level 5: Sustained
1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection 1.1.2 Role model 1.1.3 Behavioural accountability 1.1.4 Aptitude 1.1.5 Qualification	1.1.1.5 1.1.2.5 1.1.3.5 1.1.4.5 1.1.5.5
	1.2 Hands-on Approach	1.2.1 Teaching-learning Gemba 1.2.2 Leader standard work	1.2.1.5 1.2.2.5

Figure 32: Maturity grid for Dimension 1 – Personal Development

Figure 33 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Self-awareness* forming part of the *Personal development* **dimension**.

1. Personal Development	1.1 Self-awareness	Purpose Statement: To accept accountability towards one’s behaviour and self-reflect on individual learning capabilities required for further development to ensure continuous personal and professional development that is aligned with the organisational values.	
		Capability Areas	Ideal Statements
		1.1.1 Self-reflection	1.1.1.5a Leaders can identify their individual development needs by consciously reflecting on their strengths and weaknesses.
		1.1.2 Role model	1.1.2.5a Leaders recognise the importance of committing themselves daily as role models and always strive to act in ways that are harmonious with the values and culture of the organisation, embodying the vision and true north.
		1.1.3 Behavioural Accountability	1.1.3.5a Leaders accept accountability towards their behaviours, actions and attitude. 1.1.3.5b All leaders understand that their example will influence those around them.
		1.1.4 Aptitude	1.1.4.5a Leaders frequently exhibit demonstrated knowledge and clear understanding of their own work, people, processes and lean principles.

		1.1.5 Qualification	1.1.5.5a Continuous professional and personal evolution that aligns with the organisation's values is a priority for each leader. 1.1.5.5b All leaders are committed to the qualification required by lean.
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Figure 33: Ideal maturity for Self-awareness

Figure 34 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Hands-on approach* forming part of the *Personal development* **dimension**.

1. Personal Development	1.2 Hands-on approach	Purpose Statement: Managing from the Gemba to allow decision-making based on self-gained facts and hands-on experience while following leader standard work to ensure the faithful execution of crucial lean leadership tasks.	
		Capability Areas	Ideal Statements
		1.2.1 Teaching-learning Gemba	1.2.1.5a Leaders are willing to learn through observation of their people's learning at the Gemba.
		1.2.2 Leader standard work	1.2.2.5a Leader standard work is used as a daily working record and is regularly reviewed and revised; 1.2.2.5b Daily standard work activities are defined for all leaders throughout the value stream

Figure 34: Ideal maturity for Hands-on approach

7.2.5.2 Ideal maturity for Dimension 2: People Development

The second **dimension**, *People Development*, consists of 3 **subdimensions** and 9 **capability areas** – each with one or more **ideal statements** as illustrated in Figure 35:

Lean leadership maturity grid			Level 5: Sustained
2. People Development	2.1 Cultivation	2.1.1 Long-term commitment	2.1.1.5
		2.1.2 Development programs	2.1.2.5
		2.1.3 Nurturing environment	2.1.3.5
	2.2 Coaching Gemba	2.2.1 Setting	2.2.1.5
		2.2.2 Respectful interaction	2.2.2.5
		2.2.3 Structured problem-solving	2.2.3.5
	2.3 Empowerment	2.3.1 Responsible autonomy	2.3.1.5
		2.3.2 Choice autonomy	2.3.2.5
		2.3.3 Engagement	2.3.3.5

Figure 35: Maturity grid for Dimension 2 – People Development

Figure 36 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Cultivation* forming part of the *People development dimension*.

2. People development	2.1 Cultivation	Purpose Statement: Committing to the long-term development of people both individually and collectively through development programs that focus on improving their technical knowledge and lean thinking while fostering an environment that cultivates creativity, knowledge and experience.	
		Capability Areas	Ideal Statements
		2.1.1 Long-term commitment	2.1.1.5a Leaders recognise their people as resources to be developed and expanded, and plans, policies, guidelines and opportunities focused on the long-term development of employees are established. 2.1.1.5b Leaders understand that the goal of developing people is for them to become leaders themselves. 2.1.1.5c Leadership is convinced that their role throughout the employee development process is to be coaches and facilitators, not controllers.
		2.1.2 Development Programs	2.1.2.5a Development programs focus on improving people's technical knowledge and abilities to implement organisational changes. 2.1.2.5b Development programs focus on fostering lean thinking through a deep understanding of waste and continuous improvement Employee development is measured through the <i>Shu Ha Ri</i> cycle.
		2.1.3 Nurturing Environment	2.1.3.5a Leaders are constantly aiming to establish an environment that challenges people and nurtures their growth, creativity, knowledge and experience.

Figure 36: Ideal maturity for Cultivation

Figure 37 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Coaching Gemba* forming part of the *People development* **dimension**.

2. People development	2.2 Coaching Gemba	Purpose Statement: Fostering a culture of master problem-solvers by solving actual problems at the Gemba through a structured, standardised and scientific organisational problem-solving process.	
		Capability Areas	Ideal Statements
		2.2.1 Setting	2.2.1.5a Coaching is done primarily at the Gemba by solving actual problems through short learning cycles and a small leader-to-employee ratio (preferably 1:5-1:9).
		2.2.2 Respectful Interaction	2.2.2.5a Gemba walks are done publicly with a focus on the leader-employee relationship 2.2.2.5b Leaders are convinced that they themselves may not always possess the required knowledge to do the job in hand and that the people closest to the problem generally understand it best 2.2.2.5c Leaders demonstrate care, positive recognition, commitment, and respect toward the people's work during the Gemba routine.
		2.2.3 Structured Problem-solving Process	2.2.3.5a The problem-solving process is managed through a structured, standardised and scientific approach that is replicated and adopted throughout the entire organisation. 2.2.3.5b Leaders constantly ask questions that facilitate the problem-solving process rather than providing the solution itself. 2.2.3.5c Leaders ensure that everyone understands and can apply the organisation's problem-solving process to become master problem solvers.

Figure 37: Ideal maturity for Coaching Gemba

Figure 38 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Empowerment* forming part of the *People development* **dimension**.

2. People development	2.3 Empowerment	Purpose Statement: Establishing a workforce of self-managed teams where people are empowered to participate in decision-making processes, have experimental freedom towards their work and actively engaged in the lean transformation.	
		Capability Areas	Ideal Statements
		2.3.1 Responsible Autonomy	2.3.1.5a Leaders ensure that people across all organisational levels actively participate in the decision-making process.
			2.3.1.5b Self-managed teams are established and continuously trained. 2.3.1.5c Authority is delegated as far down the hierarchy as possible.
		2.3.2 Choice Autonomy	2.3.2.5a Leaders are supportive of people's self-discovery and knowledge-sharing.
		2.3.3 Engagement	2.3.3.5a People are given an active voice in all aspects of the lean transformation.
			2.3.3.5b Leaders provide structured opportunities for people to be engaged in lean initiatives according to their individual skills, abilities and maturity. 2.3.3.5c All leaders understand that only work that contributes to development and learning can be considered as value-adding.

Figure 38: Ideal maturity for Empowerment

7.2.5.3 Ideal maturity for Dimension 3: Continuous Improvement

The third **dimension**, *Continuous Improvement*, consists of 4 **subdimensions** and 20 **capability areas** – each with one or more **ideal statements** as illustrated in Figure 39:

Lean leadership maturity grid			Level 5: Sustained
3. Continuous Improvement	3.1 Daily Kaizen	3.1.1 Problem-management routine 3.1.2 Problem gathering routine 3.1.3 Proactive support 3.1.4 Go-see-fix 3.1.5 Problem to opportunity 3.1.6 Root cause problem solving	3.1.1.5 3.1.2.5 3.1.3.5 3.1.4.5 3.1.5.5 3.1.6.5
	3.2 Improvement Kaizen	3.2.1 Value stream mapping 3.2.2 LSO committee 3.2.3 PR&A panel 3.2.4 Focused improvement 3.2.5 Partnering 3.2.6 Horizontal flow of value	3.2.1.5 3.2.2.5 3.2.3.5 3.2.4.5 3.2.5.5 3.2.6.5
	3.3 Process performance	3.3.1 Adherence 3.3.2 Standardise, stabilise 3.3.3 Yield 3.3.4 Process management 3.3.5 Visual feedback	3.3.1.5 3.3.2.5 3.3.3.5 3.3.4.5 3.3.5.5
	3.4 Kaizen suggestion	3.4.1 Structured system 3.4.2 Reward-recognition 3.4.3 Kaizen stimulation	3.4.1.5 3.4.2.5 3.4.3.5

Figure 39: Maturity grid for Dimension 3 – Continuous Improvement

Figure 40 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Daily Kaizen* forming part of the *Continuous improvement* **dimension**.

3. Continuous improvement	3.1 Daily Kaizen	Purpose Statement: To consciously observe the operational environment with a Kaizen mindset and respond to all non-conformances (proactively and reactively) by eliminating the root causes of problems while maintaining the flow of customer value	
		Capability Areas	Ideal Statements
		3.1.1 Problem-management Routine	3.1.1.5a Leadership guarantees daily, standardised stand-up meetings about the previous day's performance and the present day's work. 3.1.1.5b Non-conforming issues affecting performance are escalated through rapid feedback loops with the next level of the hierarchy. 3.1.1.5c Leadership accepts responsibility towards the performance of the areas they're responsible for.
		3.1.2 Problem-gathering Routine	3.1.2.5a Routine Gemba walks focusing on problem-identification are done publicly and consistently. 3.1.2.5b Leaders focus on auditing processes and standardised work procedures daily to ensure that defined processes are followed and working as intended by verifying their execution at the task level.
		3.1.3 Proactive Support	3.1.3.5a Leaders takes a proactive approach to support their team daily by actively removing any obstacles that may prevent them from adding value. 3.1.3.5b Leadership is convinced that they are at the service of value-creating work through identifying and managing problems.
		3.1.4 Go-see-fix	3.1.4.5a Leadership follows a go-see-fix routine whenever a problem arises in the workplace. 3.1.4.5b All decisions related to the problem are made based on self-gained facts gained at the Gemba.
		3.1.5 Problem to Opportunity	3.1.5.5a Leaders create an organisational mindset where problems are recognised as opportunities for continuous improvement and learning
		3.1.6 Root Cause Problem-solving	3.1.6.5a Leaders give high importance to identify the root cause of a problem and prevent a recurrence. 3.1.6.5b Leadership creates a culture where the focus is on the root cause of a problem and not the person. They constantly ask "what", "why" and "how" instead of "who". 3.1.6.5c Standardised and scientific methods are used to identify and resolve the root cause of a problem. 3.1.6.5d Leadership understands that problems will always occur but that their consequences (defects) should be avoided.

Figure 40: Ideal maturity for Daily Kaizen

Figure 41 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Improvement Kaizen* forming part of the *Continuous improvement dimension*.

3. Continuous improvement	3.2 Improvement Kaizen	Purpose Statement: To establish cross-functional teams that centre around identifying, creating and managing continuous improvement projects that focus on the value-producing processes	
		Capability Areas	Ideal Statements
		3.2.1 Value Stream Mapping	3.2.1.5a Value streams are frequently mapped and used as a strategic tool to identify waste and improvement projects
		3.2.2 Lean Steering & Oversight Committee	3.2.2.5a The Lean Steering and Oversight (LSO) committee consists of individuals at top management levels. 3.2.2.5b The LSO committee calls for, sanctions, supports and oversees value stream improvement projects
		3.2.3 Project Resource and Accountability Panel	3.2.3.5a The Project Resource and Accountability (PR&A) panel consists of leaders from functions or departments targeted by value stream improvement projects. 3.2.3.5b The PR&A panel is responsible to the LSO for setting fittingly bold improvement objectives for each improvement project and executing the plan to achieve them.
		3.2.4 Focused Improvement	3.2.4.5a Leadership focuses on the total picture in terms of cost, quality, delivery, safety and the environment when selecting improvement projects. 3.2.4.5b Leaders frequently articulate their expectations toward the outcomes of projects. 3.2.4.5c Improvement objectives are challenging and frequently executed.
		3.2.5 Partnering	3.2.5.5a Leaders have a clear understanding of the organisation's history of collaboration and can identify current cross-functional and professional silos. 3.2.5.5b Leaders allocate the necessary time and resources for cross-functional job rotation of their team members. 3.2.5.5c Leaders recognise that people within functional organisations will naturally resist cross-functional initiatives
		3.2.6 Horizontal Flow	3.2.6.5a Lean leaders give attention to the horizontal flow of value across entire value streams as a way to sustain improvements.

Figure 41: Ideal maturity for Improvement Kaizen

Figure 42 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Improvement Kaizen* forming part of the *Continuous improvement dimension*.

3. Continuous improvement	3.3 Process performance	Purpose Statement: To focus on continuously improving process performance and managing its yield while recognising that a “good process will deliver good results”	
		Capability Areas	Ideal Statements
		3.3.1 Adherence	3.3.1.5a Leaders adhere to all processes in a disciplined manner and support new practices consistently.
		3.3.2 Standardise, stabilise	3.3.2.5a Leaders, together with their subordinates, apply a scientific approach towards standardisation and stabilisation of processes and use them as the foundation for continuous improvement. 3.3.2.5b Leaders enforce new expectations towards improvement and challenge the current process or traditional approaches in order to improve them.
		3.3.3 Yield	3.3.3.5a Improving the process has priority over improving the result. 3.3.3.5b Process-focused measures are established and maintained alongside traditional measures of results. 3.3.3.6c Leadership is convinced that a good process leads to good results.
		3.3.4 Process-management	3.3.4.5a Data on process performance is collected and managed at value stream intersections and used to identify and implement improvement opportunities.
		3.3.5 Visual Feedback	3.3.5.5a Frequent feedback on process performance is provided in the workplace through visual controls. 3.3.3.5b Leaders implicitly demonstrate that the results displayed by visual controls matter and are critical in communicating how well an operation is being performed.

Figure 42: Ideal maturity for Process Performance

Figure 43 applies to the capability areas, ideal statements and purpose statement related to the subdimension of Improvement Kaizen forming part of the Continuous improvement dimension.

3. Continuous improvement	3.4 Kaizen suggestion	Purpose Statement: To stimulate a culture of innovation and creativity, where cultural performance that reflects the established values and attainment of goals is rewarded as part of the strive for continuous improvement	
		Capability Areas	Ideal Statements
		3.4.1 Structured System	3.4.1.5a Leaders provide their people with opportunities to present their suggestions for improvement in an environment that is structured and open to experimentation without fear of failure.
			3.4.1.5b The suggestion system is sustained with a constant input of ideas and output of improvements.
			3.4.1.5c Leadership recognises the suggestion system as a critical method for creating and sustaining continuous improvement in the workplace
		3.4.2 Reward-recognition	3.4.2.5a Leaders promptly respond to the submission of all improvement ideas as a way of maintaining commitment.
			3.4.2.5b Leadership takes time to recognise and reward employees for their inputs to the suggestion system.
			3.4.2.5c Leaders consistently encourage people to participate in the suggestion system, emphasising and celebrating success in the process.
		3.4.3 Kaizen Stimulation	3.4.3.5a Challenging objectives or targets are defined for each work area to stimulate a continuous improvement culture.
			3.4.3.5b Only suggestions that aim at achieving the targets or metrics of specific areas are identified and implemented.

Figure 43: Ideal maturity for Kaizen Suggestion

7.2.5.4 Ideal maturity for Dimension 4: Purpose

The fourth **dimension**, *Purpose*, consists of 2 **subdimensions** and 7 **capability areas** – each with one or more **ideal statements** as illustrated in Figure 44:

Lean leadership maturity grid			Level 5: Sustained
4. Purpose	4.1 Strategic direction	4.1.1 Policy deployment 4.1.2 Long-term consistency 4.1.3 Operational alignment 4.1.4 Customer alignment	4.1.1.5 4.1.2.5 4.1.3.5 4.1.4.5
	4.2 Reinforcement	4.2.1 Change culture 4.2.2 Transparency 4.2.3 Participation	4.2.1.5 4.2.2.5 4.2.3.5

Figure 44: Maturity grid for Dimension 4 – Purpose

Figure 45 applies to the **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Strategic direction* forming part of the *Purpose* **dimension**.

4. Purpose	4.1 Strategic direction	Purpose Statement: To establish unity of purpose to convey the coordination, alignment and prioritisation required for an organisation to achieve hoshin kanri.	
		Capability Areas	Ideal Statements
		4.1.1 Policy Deployment	4.1.1.5a The organisation's long-term vision and strategic goals are defined and deployed through Policy Deployment with no trade-off between quality, cost, safety, delivery and the environment. 4.1.1.5b The PD is used to drive strategic direction for teams to achieve long-term goals and prioritise resources
		4.1.2 Long-term Consistency	4.1.2.5a Long-term thinking is an inherent part of each leader and all leaders exhibit long-term consistency toward the organisational philosophy and values. 4.1.2.5b Long-term goals are never impaired by short-term gains.
		4.1.3 Operational Alignment	4.1.3.5a Activity plans aligned with strategic goals are defined and translated to specific targets for each functional area through a set of key performance indicators (KPIs) and key behavioural indicators (KBIs). 4.1.3.5b Employees understand their individual objectives and how it all relates back to the overall vision and True North.
		4.1.4 Customer Alignment	4.1.4.5a Leaders continually reassess their organisation's alignment with other internal units and third parties, realigning from the customer back. 4.1.4.5b The emphasis of everyone's work shifted to what adds value to both the internal and external customer and how can it be realised. 4.1.4.5c Leaders establish recognition of and commitment to a shared view of what the customer defines as value.

Figure 45: Ideal maturity for Strategic direction

Figure 46 applies to **capability areas**, **ideal statements** and purpose statement related to the **subdimension** of *Reinforcement* forming part of the *Purpose dimension*.

4. Purpose	4.2 Reinforcement	Purpose Statement: To establish an organisational culture that embraces the daily implementation of changes by consistently providing people with a sense of purpose required to sustain the lean transformation.	
		Capability Areas	Ideal Statements
		4.2.1 Change Culture	4.2.1.5a Leaders are committed to establishing a culture that embraces the daily implementation of changes.
			4.2.1.5b Leaders understand that people’s perception of a change influences the success of a change.
			4.2.1.5c People are frequently reminded of the benefits of the lean transformation and how it positively affects their work environment
4.2.2 Transparency	4.2.2.5a The organisation and its stakeholders are frequently informed about the transformation’s progress through visual controls.		
	4.2.2.5b Visual controls are designed to offer immediate and easily understandable information on the current state of the transformation.		
	4.2.2.5c Visual controls clearly illustrate Kaizen activities and their success stories.		
4.2.3 Participation	4.2.3.5a Leaders visibly participate in the lean transformation and change management process, always transforming commitments to change into actual change.		
	4.2.3.5b Leaders use the Gemba to reinforce motivation for the lean transformation by promoting its underlying principles, culture and practices		

Figure 46: Ideal maturity for Reinforcement

Finally, by combining all these lean leadership components, a matrix that describes the ideal lean leadership maturity for each dimension is developed as depicted in Figure 47:

1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection	1.1.1.5a Leaders can identify their individual development needs by consciously reflecting on their strengths and weaknesses.
		1.1.2 Role model	1.1.2.5a Leaders recognise the importance of committing themselves daily as role models and always strive to act in ways that are harmonious with the values and culture of the organisation, embodying the vision and true north.
		1.1.3 Behavioural Accountability	1.1.3.5a Leaders accept accountability towards their behaviours, actions and attitude. 1.1.3.5b All leaders understand that their example will influence those around them.
		1.1.4 Aptitude	1.1.4.5.a Leaders frequently exhibit demonstrated knowledge and clear understanding of their own work, people, processes and lean principles.
		1.1.5 Qualification	1.1.5.5a Continuous professional and personal evolution that aligns with the organisation's values is a priority for each leader. 1.1.5.5b All leaders are committed to the qualification required by lean.
	1.2 Hands-on approach	1.2.1 Teaching-learning Gemba	1.2.1.5a Leaders are willing to learn through observation of their people's learning at the Gemba.
		1.2.2 Leader standard work	1.2.2.5a Leader standard work is used as a daily working record and is regularly reviewed and revised; 1.2.2.5b Daily standard work activities are defined for all leaders throughout the value stream
2. People Development	2.1 Cultivation	2.1.1 Long-term commitment	2.1.1.5a Leaders recognise their people as resources to be developed and expanded, and plans, policies, guidelines and opportunities focused on the long-term development of employees are established. 2.1.1.5b Leaders understand that the goal of developing people is for them to become leaders themselves. 2.1.1.5c Leadership is convinced that their role throughout the employee development process is to be coaches and facilitators, not controllers.
		2.1.2 Development Programs	2.1.2.5a Development programs focus on improving people's technical knowledge and abilities to implement organisational changes. 2.1.2.5b Development programs focus on fostering lean thinking through a deep understanding of waste and continuous improvement Employee development is measured through the <i>Shu Ha Ri</i> cycle.
		2.1.3 Nurturing Environment	2.1.3.5a Leaders are constantly aiming to establish an environment that challenges people and nurtures their growth, creativity, knowledge and experience.
	2.2 Coaching Gemba	2.2.1 Setting	2.2.1.5a Coaching is done primarily at the Gemba by solving actual problems through short learning cycles and a small leader-to-employee ratio (preferably 1:5-1:9).
		2.2.2 Respectful Interaction	2.2.2.5a Gemba walks are done publicly with a focus on the leader-employee relationship 2.2.2.5b Leaders are convinced that they themselves may not always possess the required knowledge to do the job in hand and that the people closest to the problem generally understand it best 2.2.2.5c Leaders demonstrate care, positive recognition, commitment, and respect toward the people's work during the Gemba routine.
		2.2.3 Structured Problem-solving Process	2.2.3.5a The problem-solving process is managed through a structured, standardised and scientific approach that is replicated and adopted throughout the entire organisation. 2.2.3.5b Leaders constantly ask questions that facilitate the problem-solving process rather than providing the solution itself. 2.2.3.5c Leaders ensure that everyone understands and can apply the organisation's problem-solving process to become master problem solvers.
	2.3 Empowerment	2.3.1 Responsible Autonomy	2.3.1.5a Leaders ensure that people across all organisational levels actively participate in the decision-making process. 2.3.1.5b Self-managed teams are established and continuously trained. 2.3.1.5c Authority is delegated as far down the hierarchy as possible.
		2.3.2 Choice Autonomy	2.3.2.5a Leaders are supportive of people's self-discovery and knowledge-sharing.
		2.3.3 Engagement	2.3.3.5a People are given an active voice in all aspects of the lean transformation. 2.3.3.5b Leaders provide structured opportunities for people to be engaged in lean initiatives according to their individual skills, abilities and maturity. 2.3.3.5c All leaders understand that only work that contributes to development and learning can be considered as value-adding.

3. Continuous Improvement	3.1 Daily Kaizen	3.1.1 Problem-management Routine	3.1.1.5a Leadership guarantees daily, standardised stand-up meetings about the previous day's performance and the present day's work. 3.1.1.5b Non-conforming issues affecting performance are escalated through rapid feedback loops with the next level of the hierarchy. 3.1.1.5c Leadership accepts responsibility towards the performance of the areas they're responsible for.
		3.1.2 Problem-gathering Routine	3.1.2.5a Routine Gemba walks focusing on problem-identification are done publicly and consistently. 3.1.2.5b Leaders focus on auditing processes and standardised work procedures daily to ensure that defined processes are followed and working as intended by verifying their execution at the task level.
		3.1.3 Proactive Support	3.1.3.5a Leaders takes a proactive approach to support their team daily by actively removing any obstacles that may prevent them from adding value. 3.1.3.5b Leadership is convinced that they are at the service of value-creating work through identifying and managing problems.
		3.1.4 Go-see-fix	3.1.4.5a Leadership follows a go-see-fix routine whenever a problem arises in the workplace. 3.1.4.5b All decisions related to the problem are made based on self-gained facts gained at the Gemba
		3.1.5 Problem to Opportunity	3.1.5.5a Leaders create an organisational mindset where problems are recognised as opportunities for continuous improvement and learning
		3.1.6 Root Cause Problem-solving	3.1.6.5a Leaders give high importance to identify the root cause of a problem and prevent a recurrence. 3.1.6.5b Leadership creates a culture where the focus is on the root cause of a problem and not the person. They constantly ask "what", "why" and "how" instead of "who". 3.1.6.5c Standardised and scientific methods are used to identify and resolve the root cause of a problem. 3.1.6.5d Leadership understands that problems will always occur but that their consequences (defects) should be avoided.
	3.2 Improvement Kaizen	3.2.1 Value Stream Mapping	3.2.1.5a Value streams are frequently mapped and used as a strategic tool to identify waste and improvement projects
		3.2.2 Lean Steering & Oversight Committee	3.2.2.5a The Lean Steering and Oversight (LSO) committee consists of individuals at top management levels. 3.2.2.5b The LSO committee calls for, sanctions, supports and oversees value stream improvement projects
		3.2.3 Project Resource and Accountability Panel	3.2.3.5a The Project Resource and Accountability (PR&A) panel consists of leaders from functions or departments targeted by value stream improvement projects. 3.2.3.5b The PR&A panel is responsible to the LSO for setting fittingly bold improvement objectives for each improvement project and executing the plan to achieve them.
		3.2.4 Focused Improvement	3.2.4.5a Leadership focuses on the total picture in terms of cost, quality, delivery, safety and the environment when selecting improvement projects. 3.2.4.5b Leaders frequently articulate their expectations toward the outcomes of projects. 3.2.4.5c Improvement objectives are challenging and frequently executed.
		3.2.5 Partnering	3.2.5.5a Leaders have a clear understanding of the organisation's history of collaboration and can identify current cross-functional and professional silos. 3.2.5.5b Leaders allocate the necessary time and resources for cross-functional job rotation of their team members. 3.2.5.5c Leaders recognise that people within functional organisations will naturally resist cross-functional initiatives
		3.2.6 Horizontal Flow	3.2.6.5a Lean leaders give attention to the horizontal flow of value across entire value streams as a way to sustain improvements.

4. Purpose	3.3 Process performance	3.3.1 Adherence	3.3.1.5a Leaders adhere to all processes in a disciplined manner and support new practices consistently.
		3.3.2 Standardise, stabilise	3.3.2.5a Leaders, together with their subordinates, apply a scientific approach towards standardisation and stabilisation of processes and use them as the foundation for continuous improvement.
			3.3.2.5b Leaders enforce new expectations towards improvement and challenge the current process or traditional approaches in order to improve them.
		3.3.3 Yield	3.3.3.5a Improving the process has priority over improving the result.
			3.3.3.5b Process-focused measures are established and maintained alongside traditional measures of results.
		3.3.4 Process-management	3.3.3.6c Leadership is convinced that a good process leads to good results. 3.3.4.5a Data on process performance is collected and managed at value stream intersections and used to identify and implement improvement opportunities.
	3.4 Kaizen Suggestion	3.3.5 Visual Feedback	3.3.5.5a Frequent feedback on process performance is provided in the workplace through visual controls.
			3.3.3.5b Leaders implicitly demonstrate that the results displayed by visual controls matter and are critical in communicating how well an operation is being performed.
		3.4.1 Structured System	3.4.1.5a Leaders provide their people with opportunities to present their suggestions for improvement in an environment that is structured and open to experimentation without fear of failure.
			3.4.1.5b The suggestion system is sustained with a constant input of ideas and output of improvements. 3.4.1.5c Leadership recognises the suggestion system as a critical method for creating and sustaining continuous improvement in the workplace
		3.4.2 Reward-recognition	3.4.2.5a Leaders promptly respond to the submission of all improvement ideas as a way of maintaining commitment.
			3.4.2.5b Leadership takes time to recognise and reward employees for their inputs to the suggestion system. 3.4.2.5c Leaders consistently encourage people to participate in the suggestion system, emphasising and celebrating success in the process.
	4.1 Strategic Direction	3.4.3 Kaizen Stimulation	3.4.3.5a Challenging objectives or targets are defined for each work area to stimulate a continuous improvement culture.
			3.4.3.5b Only suggestions that aim at achieving the targets or metrics of specific areas are identified and implemented.
		4.1.1 Policy Deployment	4.1.1.5a The organisation's long-term vision and strategic goals are defined and deployed through Policy Deployment with no trade-off between quality, cost, safety, delivery and the environment.
			4.1.1.5b The PD is used to drive strategic direction for teams to achieve long-term goals and prioritise resources
	4.1 Strategic Direction	4.1.2 Long-term Consistency	4.1.2.5a Long-term thinking is an inherent part of each leader and all leaders exhibit long-term consistency toward the organisational philosophy and values.
			4.1.2.5b Long-term goals are never impaired by short-term gains
		4.1.3 Operational Alignment	4.1.3.5a Activity plans aligned with strategic goals are defined and translated to specific targets for each functional area through a set of key performance indicators (KPIs) and key behavioural indicators (KBIs).
			4.1.3.5b Employees understand their individual objectives and how it all relates back to the overall vision and True North.
	4.1 Strategic Direction	4.1.4 Customer Alignment	4.1.4.5a Leaders continually reassess their organisation's alignment with other internal units and third parties, realigning from the customer back.
			4.1.4.5b The emphasis of everyone's work shifted to what adds value to both the internal and external customer and how can it be realised. 4.1.4.5c Leaders establish recognition of and commitment to a shared view of what the customer defines as value.

4.2 Reinforcement	4.2.1 Change Culture	4.2.1.5a Leaders are committed to establishing a culture that embraces the daily implementation of changes. 4.2.1.5b Leaders understand that people's perception of a change influences the success of a change. 4.2.1.5c People are frequently reminded of the benefits of the lean transformation and how it positively affects their work environment
	4.2.2 Transparency	4.2.2.5a The organisation and its stakeholders are frequently informed about the transformation's progress through visual controls. 4.2.2.5b Visual controls are designed to offer immediate and easily understandable information on the current state of the transformation. 4.2.2.5c Visual controls clearly illustrate Kaizen activities and their success stories.
	4.2.3 Participation	4.2.3.5a Leaders visibly participate in the lean transformation and change management process, always transforming commitments to change into actual change. 4.2.3.5b Leaders use the Gemba to reinforce motivation for the lean transformation by promoting its underlying principles, culture and practices

Figure 47: Matrix that describes the ideal lean leadership maturity

7.3 Assessment criteria

In the previous section, the structural components of the LLMM were conceptualised to create a matrix that describes the ideal lean leadership capabilities for all **capability areas**, **subdimensions** and **dimensions**. In this section, the assessment criteria for the LLMM will be developed by formulating the **capability statements** for each **capability area** within the frame of the LLMM. This will conclude the model development process as illustrated by Figure 48.

As with the **capability areas** and **ideal statements**, the significance and practicality of these **capability statements** are supported with evidence from the literature.

The following design requirements apply to this section of the model development:

- **Design Requirement 5:** The model enables a self- or group-oriented assessment from individuals across multiple functional areas and levels
- **Design Requirement 12:** The capability statements are mutually exclusive.
- **Design Requirement 13:** The capability statements are collectively exhaustive

Dimensions	Subdimensions	Capability areas	Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection	1.1.1.1	1.1.1.2	1.1.1.3	1.1.1.4	1.1.1.5
		1.1.2 Role model	1.1.2.1	1.1.2.2	1.1.2.3	1.1.2.4	1.1.2.5
		1.1.3 Behavioural accountability	1.1.3.1	1.1.3.2	1.1.3.3	1.1.3.4	1.1.3.5
		1.1.4 Aptitude	1.1.4.1	1.1.4.2	1.1.4.3	1.1.4.4	1.1.4.5
		1.1.5 Qualification	1.1.5.1	1.1.5.2	1.1.5.3	1.1.5.4	1.1.5.5
	1.2 Hands-on Approach	1.2.1 Teaching-learning Gemba 1.2.2 Leader standard work	1.2.1.1 1.2.2.1	1.2.1.2 1.2.2.2	1.2.1.3 1.2.2.3	1.2.1.4 1.2.2.4	1.2.1.5 1.2.2.5
2. People Development	2.1 Cultivation	2.1.1 Long-term commitment	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5
		2.1.2 Development programs	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5
		2.1.3 Nurturing environment	2.1.3.1	2.1.3.2	2.1.3.3	2.1.3.4	2.1.3.5
	2.2 Coaching Gemba	2.2.1 Setting	2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4	2.2.1.5
		2.2.2 Respectful interaction	2.2.2.1	2.2.2.2	2.2.2.3	2.2.2.4	2.2.2.5
		2.2.3 Structured problem-solving	2.2.3.1	2.2.3.2	2.2.3.3	2.2.3.4	2.2.3.5
	2.3 Empowerment	2.3.1 Responsible autonomy	2.3.1.1	2.3.1.2	2.3.1.3	2.3.1.4	2.3.1.5
		2.3.2 Choice autonomy	2.3.2.1	2.3.2.2	2.3.2.3	2.3.2.4	2.3.2.5
		2.3.3 Engagement	2.3.3.1	2.3.3.2	2.3.3.3	2.3.3.4	2.3.3.5
3. Continuous Improvement	3.1 Daily Kaizen	3.1.1 Problem-management routine	3.1.1.1	3.1.1.2	3.1.1.3	3.1.1.4	3.1.1.5
		3.1.2 Problem gathering routine	3.1.2.1	3.1.2.2	3.1.2.3	3.1.2.4	3.1.2.5
		3.1.3 Proactive support	3.1.3.1	3.1.3.2	3.1.3.3	3.1.3.4	3.1.3.5
		3.1.4 Go-see-fix	3.1.4.1	3.1.4.2	3.1.4.3	3.1.4.4	3.1.4.5
		3.1.5 Problem to opportunity	3.1.5.1	3.1.5.2	3.1.5.3	3.1.5.4	3.1.5.5
		3.1.6 Root cause problem solving	3.1.6.1	3.1.6.2	3.1.6.3	3.1.6.4	3.1.6.5
	3.2 Improvement Kaizen	3.2.1 Value stream mapping	3.2.1.1	3.2.1.2	3.2.1.3	3.2.1.4	3.2.1.5
		3.2.2 LSO committee	3.2.2.1	3.2.2.2	3.2.2.3	3.2.2.4	3.2.2.5
		3.2.3 PR&A panel	3.2.3.1	3.2.3.2	3.2.3.3	3.2.3.4	3.2.3.5
		3.2.4 Focused improvement	3.2.4.1	3.2.4.2	3.2.4.3	3.2.4.4	3.2.4.5
		3.2.5 Partnering	3.2.5.1	3.2.5.2	3.2.5.3	3.2.5.4	3.2.5.5
		3.2.6 Horizontal flow of value	3.2.6.1	3.2.6.2	3.2.6.3	3.2.6.4	3.2.6.5
	3.3 Process performance	3.3.1 Adherence	3.3.1.1	3.3.1.2	3.3.1.3	3.3.1.4	3.3.1.5
		3.3.2 Standardise, stabilise	3.3.2.1	3.3.2.2	3.3.2.3	3.3.2.4	3.3.2.5
		3.3.3 Yield	3.3.3.1	3.3.3.2	3.3.3.3	3.3.3.4	3.3.3.5
		3.3.4 Process management	3.3.4.1	3.3.4.2	3.3.4.3	3.3.4.4	3.3.4.5
		3.3.5 Visual feedback	3.3.5.1	3.3.5.2	3.3.5.3	3.3.5.4	3.3.5.5
	3.4 Kaizen suggestion	3.4.1 Structured system	3.4.1.1	3.4.1.2	3.4.1.3	3.4.1.4	3.4.1.5
		3.4.2 Reward-recognition	3.4.2.1	3.4.2.2	3.4.2.3	3.4.2.4	3.4.2.5
		3.4.3 Kaizen stimulation	3.4.3.1	3.4.3.2	3.4.3.3	3.4.3.4	3.4.3.5
4. Purpose	4.1 Strategic direction	4.1.1 Policy deployment	4.1.1.1	4.1.1.2	4.1.1.3	4.1.1.4	4.1.1.5
		4.1.2 Long-term consistency	4.1.2.1	4.1.2.2	4.1.2.3	4.1.2.4	4.1.2.5
		4.1.3 Operational alignment	4.1.3.1	4.1.3.2	4.1.3.3	4.1.3.4	4.1.3.5
		4.1.4 Customer alignment	4.1.4.1	4.1.4.2	4.1.4.3	4.1.4.4	4.1.4.5
	4.2 Reinforcement	4.2.1 Change culture	4.2.1.1	4.2.1.2	4.2.1.3	4.2.1.4	4.2.1.5
		4.2.2 Transparency	4.2.2.1	4.2.2.2	4.2.2.3	4.2.2.4	4.2.2.5
		4.2.3 Participation	4.2.3.1	4.2.3.2	4.2.3.3	4.2.3.4	4.2.3.5

Figure 48: Lean leadership maturity model with dimensions, subdimensions, maturity levels, capability areas, ideal statements and capability statements

7.3.1 Capability statements

A **capability statement** is a general statement that serves as a criteria or descriptor of articulating behaviours of a **capability area** as it applies to a specific **maturity level**. These capability statements provide a scale where a quantitative value can be assigned to an intangible concept, such as maturity. Just as temperature is measured by a scale in degrees Celsius (empirical system), the measurement unit for maturity is **maturity levels**.

The assessment or, “measurement”, criteria of the LLMM focuses on the evaluation of an ideal lean leadership feature, which is represented by the **ideal statements** developed in the previous section. In other words, the LLMM measures the degree to which leadership within an organisation is aligned with the ideal maturity for lean leadership. The **ideal statement**, therefore, represents the standard for lean leadership maturity and the maturity assessment criteria aims to evaluate the fulfilment of the **ideal statements** in practice.

Leadership at the applicable entity will be assessed according to the degree to which their behaviours are aligned with the LLMM components where the focus is on behaviours and other

indicators that will result in the ideal lean leadership maturity. The approach to developing the **capability statements** is adopted from the Shingo *SCOPE* Model (The Shingo Prize, 2013).

The **capability statements** were defined by asking standard questions related to the **ideal statement** or, ideal lean leadership feature of a **capability area**, for each **maturity level**. This way, it can be ensured that the corresponding descriptors of **capability statements** are precise and clearly differentiate between **maturity levels**. The questions applicable to each category are defined as (adapted from The Shingo Prize, 2013):

- **Involvement:** What percentage of leaders are witnessed participating?
- **Frequency:** How often is the behaviour witnessed?
- **Duration:** Has this behaviour or practice been sustained for a period or is this the first time?
- **Intensity:** Is there an apparent sense of passion or importance for the behaviour? In other words, to deviate from the behaviour would signal problems?
- **Scope:** Is the behaviour only witnessed in a few localised areas or is it systemically adopted throughout the organisation?

7.3.2 Descriptors of evolution

The stage progression of the **capability statements** and **maturity levels** are logically defined by *descriptors of evolution* as presented in Table 30 (adapted from The Shingo Prize, 2013):

Table 30: Descriptors of evolution for capability statements (adapted from The Shingo Prize, 2013)

Category	Level 1 – Initial	Level 2 – Managed	Level 3 – Defined	Level 4 – Predictable	Level 5 - Sustained
Involvement	• Few	• Some	• Many	• Most	• All
Frequency	• Rare • Infrequent • Seldom	• Sporadic • Irregular • Sometimes • Occasionally	• Frequent • Common • Regularly	• Consistent • Predominant	• Constant • Always • Continuously
Duration	• Undeveloped • New • Initial	• Experimental • Trial • Managed	• Repeatable • Defined	• Established • Predictable	• Culturally Ingrained • Stable • Sustained
Intensity	• Apathetic • Indifferent	• Apparent • Awareness • Individual Commitment	• Moderate • Understand • Local Commitment	• Persistent • Accept • Wide Commitment	• Tenacious • Convinced • Full Commitment
Scope	• Isolated	• Silos • Internal Value Streams	• Operations • Functional Value Streams	• Multiple Business Processes • Integrated Value Streams	• Enterprise • External Value Streams

To reduce any form of ambiguity, each of the descriptors of evolution and how they are used in this study are described in the following section.

The quantifiers in the *involvement* category represent percentages of populations involved with an ideal lean leadership feature of a **capability area**, as presented in Table 31:

Table 31: Definitions of evolutionary descriptors in the *involvement* category

Maturity Level	Evolutionary descriptor (s)	Definition
Level 1 – Initial	Few	Between 0-24% of a population.
Level 2 – Managed	Some	Between 25-49% of a population.
Level 3 – Defined	Many	Between 50-74% of a population.
Level 4 – Predictable	Most	Between 75-99% of a population.
Level 5 - Sustained	All	100% of a population.

The descriptors in the *frequency* category describe how often an ideal lean leadership feature of a **capability area** is repeatably witnessed in practice, as presented in Table 32:

Table 32: Definitions of evolutionary descriptors in the *frequency* category

Maturity Level	Evolutionary descriptor (s)	Definition
Level 1 – Initial	• Rare • Infrequent • Seldom	An ideal lean leadership feature of a capability area is only witnessed in a few instances.
Level 2 – Managed	• Sporadic • Irregular • Sometimes • Occasionally	An ideal lean leadership feature of a capability area occurs in random instances.
Level 3 – Defined	• Frequent • Common • Regularly	An ideal lean leadership feature of a capability area occurs habitually.
Level 4 – Predictable	• Consistent • Predominant	An ideal lean leadership feature of a capability area is marked by steady continuity free from variation.
Level 5 - Sustained	• Constant • Always • Continuously	An ideal lean leadership feature of a capability area is witnessed without cessation.

Those descriptors in the *duration* category express the time during which an ideal lean leadership feature of a **capability area** exists or lasts in practice, as presented in Table 33:

Table 33: Definitions of evolutionary descriptors in the *duration* category

Maturity Level	Evolutionary descriptor (s)	Definition
Level 1 – Initial	• Undeveloped • New • Initial	An ideal lean leadership feature of a capability area is in the beginning phases of development
Level 2 – Managed	• Experimental • Trial • Managed	An ideal lean leadership feature of a capability area is based on untested and unestablished ideas or techniques
Level 3 – Defined	• Repeatable • Defined	An ideal lean leadership feature of a capability area is tested and can be repeated without variation
Level 4 – Predictable	• Established • Predictable	An ideal lean leadership feature of a capability area has been successful for a long period and is widely known
Level 5 - Sustained	• Culturally Ingrained • Stable • Sustained	An ideal lean leadership feature of a capability area is maintained at length without interruption or weakening and is deeply embedded in the culture.

The descriptors in the *intensity* category describe the leadership enthusiasm towards an ideal lean leadership feature of a **capability area**, as presented in Table 34:

Table 34: Definitions of evolutionary descriptors in the *intensity* category

Maturity Level	Evolutionary descriptor (s)	Definition
Level 1 – Initial	• Apathetic • Indifferent	Leaders have no interest, enthusiasm or concern towards the required ideal lean leadership feature of a capability area.
Level 2 – Managed	• Apparent • Awareness • Individual Commitment	Leaders have a concern and interest in the ideal lean leadership feature of a capability area.
Level 3 – Defined	• Moderate • Understand • Local Commitment	Leaders have a good grasp of the required ideal lean leadership feature of a capability area.
Level 4 – Predictable	• Persistent • Accept • Wide Commitment	Leaders have come to recognise that the ideal lean leadership feature of a capability area is correct, enduring in this belief without protest.
Level 5 - Sustained	• Tenacious • Convinced • Full Commitment	Leaders are firm in their belief about an ideal lean leadership feature of a capability area.

Finally, the descriptors in the *scope* category represent the extent of the area or subject matter that an ideal lean leadership feature of a capability area deals with, as presented in Table 35:

Table 35: Definitions of evolutionary descriptors in the *scope* category

Maturity Level	Evolutionary descriptor (s)	Definition
Level 1 – Initial	Isolated	An ideal lean leadership feature of a capability area exists alone within the organisation and is set apart from others.
Level 2 – Managed	- Silos - Internal Value Streams	An ideal lean leadership feature of a capability area exists within the limits of individual divisions or departments of an organisation.
Level 3 – Defined	- Operations - Functional Value Streams	An ideal lean leadership feature of a capability area exists within the limits of cross-functional divisions or departments of an organisation.
Level 4 – Predictable	- Multiple Business Processes - Integrated Value Streams	An ideal lean leadership feature of a capability area exists within the limits of various divisions or departments of an organisation.
Level 5 - Sustained	- Enterprise - External Value Streams	An ideal lean leadership feature of a capability area exists throughout the entire organisation and its extended functions.

The application of these descriptors of evolution will be illustrated in the next section, where the *capability statements* for each *capability area* is populated within the frame of the LLMM.

7.3.3 Capability statements populated within the Lean leadership maturity model

In the following section, *capability statements* are formulated for each *capability area* of lean leadership maturity. No more than three *capability statements* are defined. Based on this principle, together with the structural design of the LLMM developed earlier, the *capability statements* are organised according to specific *maturity levels* for each *dimension*.

As a starting point, the *ideal statement* for each *capability area* defined in the previous section was populated along each with *maturity level*. Each time, the standard questions defined earlier were asked and, using the behavioural scale and descriptors of evolution, the *capability statements* for each *capability area* were developed.

For example, the *ideal statement* for the *capability area* *Teaching-learning Gemba* that forms part of the *Hands-on Approach* *subdimension* (under the Personal Development *dimension*), was defined earlier as:

Leaders are willing to learn through observation of their people's learning at the Gemba.

Standard questions regarding the articulating behaviours were asked per maturity level.

For maturity level 1, first, the involvement was determined. Being the lowest level of maturity, involvement should naturally be rare. Hence, “few” (between 0-24% of) leaders participate. The remaining elements of the behavioural scale were not applicable for this maturity level to ensure mutual exclusivity. This led to the capability statement for the first maturity level of the capability area; Teaching-learning Gemba:

Few leaders are willing to learn through observation of their people’s learning at the Gemba.

For maturity level two, “some” was selected from the involvement category. This ideal feature also occurs in random instances for the applicable maturity level, and therefore, “occasionally” was selected from the frequency category. This led to the capability statement for the second maturity level of the capability area; Teaching-learning Gemba:

Some leaders are occasionally willing to learn through observation of their people’s learning at the Gemba.

This pattern was repeated for the remaining maturity levels of this capability area and those of all the subdimensions applicable to the LLMM to ultimately form a set of maturity grids that will be illustrated in the following sections.

Figure 49 demonstrates the **capability statements** defined for the **Self-awareness subdimension** forming part of the **Personal Development dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
1. Personal Development	1.1 Self-awareness	1.1.1 Self-reflection	1.1.1.1a Few leaders can identify their development needs and are mostly apathetic toward reflecting on their strengths and weaknesses.	1.1.1.2a Some leaders can sporadically identify their development needs and are individually committed toward reflecting on their strengths and weaknesses when required.	1.1.1.3a Many leaders can repeatably identify their development needs and are locally committed to reflecting on their strengths and weaknesses throughout operations.	1.1.1.4a Most leaders can consistently identify their development needs and are widely committed to reflecting on their strengths and weaknesses throughout multiple business functions.	1.1.1.5a All leaders can constantly identify their individual development needs and are fully committed to consciously reflect on their strengths and weaknesses.
		1.1.2 Role Model	1.1.2.1a Few leaders recognise the importance of committing themselves as a role model.	1.1.2.2a Some leaders are aware of the importance of committing themselves as role models and are individually committed to acting in ways that are harmonious with the values and culture of the organisation.	1.1.2.3a Many leaders understand the importance of committing themselves as role models and are locally committed to acting in ways that are harmonious with the values and culture of the organisation.	1.1.2.4a Most leaders accept the importance of committing themselves as role models and are widely committed to acting in ways that are harmonious with the values and culture of the organisation.	1.1.2.5a All leaders are convinced of the importance of committing themselves daily as role models and always strive to act in ways that are harmonious with the values and culture of the organisation, embodying the vision and true north.
		1.1.3 Behavioural accountability	1.1.3.1a Few leaders accept accountability towards their behaviour, mostly unwilling to understand that their example will influence those around them	1.1.3.2a Some leaders occasionally accept accountability towards their behaviour and is aware that their example will influence those around them	1.1.3.3a Many leaders commonly accept accountability towards their behaviour and understand that their example will influence those around them	1.1.3.4a Most leaders consistently accept accountability towards their behaviour and accept that their example will influence those around them	1.1.3.5a All leaders continuously accept accountability towards their behaviours, actions and attitude daily and are convinced that their example will influence those around them.
		1.1.4 Aptitude	1.1.4.1a Few leaders exhibit knowledge and an understanding of their own work, people, processes and lean principles.	1.1.4.2a Some leaders inconsistently exhibit knowledge and an understanding of their own work, people, processes and lean principles.	1.1.4.3a Many leaders commonly exhibit knowledge and an understanding of their own work, people, processes and lean principles.	1.1.4.4a Most leaders repeatably exhibit knowledge and an understanding of their own work, people, processes and lean principles.	1.1.4.5a All leaders exhibit stable knowledge and a clear understanding of their own work, people, processes and lean principles.
		1.1.5 Qualification	1.1.5.1a Few leaders ever recognise the importance of continuous professional and personal evolution.	1.1.5.2a Some leaders can occasionally recognise the importance of continuous professional and personal evolution and are individually committed to the development required by lean.	1.1.5.3a Many leaders can frequently recognise the importance of continuous professional and personal evolution and are moderately committed to the development required by lean.	1.1.5.4a Most leaders can consistently recognise the importance of continuous professional and personal evolution and are widely committed to the development required by lean.	1.1.5.5a Continuous professional and personal evolution that aligns with the organisation's values is a priority for all leaders. 1.1.5.5b All leaders are fully committed to the development required by lean.

Figure 49: Capability statements for the Self-awareness subdimension

Figure 50 demonstrates the *capability statements* defined for the *Hands-on Approach* *subdimension* forming part of the *Personal Development* *dimension*.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
1. Personal Development	1.2 Hands-on Approach	1.2.1 Teaching-learning Gemba	1.2.1.1a Few leaders are willing to learn through observation of their people's learning at the Gemba.	1.2.1.2a Some leaders are occasionally willing to learn through observation of their people's learning at the Gemba.	1.2.1.3a Many leaders are frequently willing to learn through observation of their people's learning at the Gemba.	1.2.1.4a Most leaders are consistently willing to learn through observation of their people's learning at the Gemba.	1.2.1.5a All leaders are continuously learning through observation of their people's learning at the Gemba.
		1.2.2 Leader Standard Work	1.2.2.1a Leader standard work is undeveloped rarely applied in practice.	1.2.2.2a Leader standard work is applied event-based with individual commitment from leaders.	1.2.2.3a Leader standard work is applied frequently with moderate local commitment from leaders.	1.2.2.4a Leader standard work is applied consistently with persistent commitment from leaders.	1.2.2.5a Leader standard work is used as a daily working record for all leaders and is constantly reviewed and revised. 1.2.2.5b Daily standard work activities are defined for all leaders throughout the extended value stream .

Figure 50: Capability statements for the *Hands-on Approach* subdimension

Figure 51 demonstrates the **capability statements** defined for the **Cultivation subdimension** forming part of the **People Development dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
2. People Development	2.1 Cultivation	2.1.1 Long-term commitment	2.1.1.1a People are rarely viewed as resources to be developed. 2.1.1.1b Few leaders are interested in their role in employee development	2.1.1.2a People are occasionally viewed as resources to be developed and expanded, and plans focused on the long-term development of employees are experimental . 2.1.1.2b Some leaders are aware that the goal of developing people is for them to become leaders themselves. 2.1.1.2c Some leaders are aware that their role throughout the employee development process is to be coaches and facilitators, not controllers.	2.1.1.3a People are frequently viewed as resources to be developed and expanded, and plans focused on the long-term development of employees are created repeatable . 2.1.1.3b Many leaders understand that the goal of developing people is for them to become leaders themselves. 2.1.1.3c Many leaders understand that their role throughout the employee development process is to be coaches and facilitators, not controllers.	2.1.1.4a People are consistently viewed as resources to be developed and expanded, and plans focused on the long-term development of employees are created established . 2.1.1.4b Most leaders accept that the goal of developing people is for them to become leaders themselves 2.1.1.4c Most leaders accept that their role throughout the employee development process is to be coaches and facilitators, not controllers.	2.1.1.5a People are always viewed as resources to be developed and expanded, and plans, policies, guidelines and opportunities focused on the long-term development of employees are sustained . 2.1.1.5b All leaders are fully committed to developing more leaders. 2.1.1.5c All leaders throughout the enterprise are fully committed as coaches and facilitators.
		2.1.2 Development programs	2.1.2.1a Development programs are undeveloped and rarely executed. 2.1.2.1b Measuring employee development is rarely done through the Shi Ha Ri cycle.	2.1.2.2a Experimental development programs exist but are executed irregularly and within departmental silos. 2.1.2.2b Measuring employee development occasionally done through the Shi Ha Ri cycle.	2.1.2.3a Repeatable development programs that focus on technical knowledge and lean thinking exist and are executed frequently within functional value streams . 2.1.2.3b Measuring employee development commonly done through the Shi Ha Ri cycle.	2.1.2.4a Established development programs that focus on technical knowledge and lean thinking exist and are executed consistently within integrated value streams . 2.1.2.4b Measuring employee development predominantly done through the Shi Ha Ri cycle.	2.1.2.5a Integrated development programs that focus on technical knowledge and lean thinking exist and are executed constantly within extended value streams . 2.1.2.5b Measuring employee development is continuously done through the Shi Ha Ri cycle.
		2.1.3 Nurturing environment	2.1.3.1a Few leaders are committed to establishing a nurturing environment	2.1.3.2a Some leaders are irregularly committed to establishing an environment that challenges people and nurtures their growth, creativity, knowledge and experience.	2.1.3.3a Many leaders are frequently committed to establishing an environment that challenges people and nurtures their growth, creativity, knowledge and experience.	2.1.3.4a Most leaders are consistently committed to establishing an environment that challenges people and nurtures their growth, creativity, knowledge and experience.	2.1.3.5a All leaders are fully committed to establishing an environment that challenges people and nurtures their growth, creativity, knowledge and experience.

Figure 51: Capability statements for the **Cultivation** subdimension

Figure 52 demonstrates the **capability statements** defined for the **Coaching Gemba subdimension** forming part of the **People Development dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
2. People Development	2.2 Coaching Gemba	2.2.1 Setting	2.2.1.1a Coaching at the Gemba is rarely witnessed and mostly in isolation . 2.2.1.1b Actual problems are seldom solved through short learning cycles and a small leader-to-employee ratio.	2.2.1.2a Coaching at the Gemba is witnessed intermittently and executed in silos . 2.2.1.2b Actual problems are sometimes solved through short learning cycles and a small leader-to-employee ratio.	2.2.1.3a Coaching at the Gemba is frequently witnessed and executed within the functional value stream . 2.2.1.3b Actual problems are frequently solved through short learning cycles and a small leader-to-employee ratio.	2.2.1.4a Coaching at the Gemba is consistently witnessed and executed within the integrated value stream . 2.2.1.4b Actual problems are consistently solved through short learning cycles and a small leader-to-employee ratio.	2.2.1.5a Coaching at the Gemba is culturally ingrained and constantly executed within the extended value stream . 2.2.1.5b Actual problems are always solved through short learning cycles and a small leader-to-employee ratio.
		2.2.2 Respectful interaction	2.2.2.1a Gemba walks are seldom conducted and rarely a focus on the leader-employee relationship. 2.2.2.1b Few leaders are willing to understand that the people closest to the problem generally understand it best. 2.2.2.1c Few leaders are interested to demonstrate care, positive recognition, commitment, and respect toward the people's work during the Gemba routine	2.2.2.2a Gemba walks are done experimentally and sporadically focus on the leader-employee relationship. 2.2.2.2b Some leaders are aware that the people closest to the problem generally understand it best. 2.2.2.2c Some leaders are aware of the need to demonstrate care, positive recognition, commitment, and respect toward the people's work during the Gemba routine	2.2.2.3a Gemba walks are done repeatably and commonly focus on the leader-employee relationship. 2.2.2.3b Many leaders understand that the people closest to the problem generally understand it best. 2.2.2.3c Many leaders understand the need to demonstrate care, positive recognition, commitment, and respect toward the people's work during the Gemba routine	2.2.2.4a Gemba walks are consistently done and predominantly focus on the leader-employee relationship. 2.2.2.4b Most leaders widely accept that the people closest to the problem generally understand it best. 2.2.2.4c Most leaders accept the need to demonstrate care, positive recognition and respect toward the people's work during the Gemba routine	2.2.2.5a Gemba walks are ingrained in the culture of all leaders and are done with a persistent focus on the leader-employee relationship. 2.2.2.5b All leaders are convinced that they themselves may not always possess the required knowledge to do the job in hand and that the people closest to the problem generally understand it best. 2.2.2.5c All leaders are convinced of the need to demonstrate care, positive recognition and respect toward the people's work during the Gemba routine
		2.2.3 Structured problem-solving	2.2.3.2a The problem-solving process is rarely managed through a structured, standardised and scientific approach – mostly in isolation . 2.2.3.2b Few leaders ask questions that facilitate the problem-solving process. 2.2.3.2c Few leaders recognise the need for everyone to understand and apply the organisation's problem-solving process.	2.2.3.2a The problem-solving process is irregularly managed through a structured, standardised and scientific approach and is experimentally replicated within functional silos . 2.2.3.2b Some leaders intermittently ask questions that facilitate the problem-solving process. 2.2.3.2c Some leaders are individually committed to ensuring that everyone understands and can apply the organisation's problem-solving process to become master problem-solvers	2.2.3.3a The problem-solving process is commonly managed through a structured, standardised and scientific approach and is repeatably throughout operations. 2.2.3.3b Many leaders commonly ask questions that facilitate the problem-solving process. 2.2.3.3c Many leaders are locally committed to ensuring that everyone understands and can apply the organisation's problem-solving process to become master problem-solvers	2.2.3.4a The problem-solving process is predominantly managed through a structured, standardised and scientific approach and is established throughout multiple business operations . 2.2.3.4b Most leaders consistently ask questions that facilitate the problem-solving process. 2.2.3.4c Most leaders are widely committed to ensuring that everyone understands and can apply the organisation's problem-solving process to become master problem-solvers	2.2.3.5a The problem-solving process is always managed through a structured, standardised and scientific approach and is adopted enterprise-wide . 2.2.3.5b All leaders constantly ask questions that facilitate the problem-solving process rather than providing the solution itself. 2.2.3.5c All leaders are fully committed to ensuring that everyone understands and can apply the organisation's problem-solving process to become master problem-solvers

Figure 52: Capability statements for the Coaching Gemba subdimension

Figure 53 demonstrates the **capability statements** defined for the *Empowerment* **subdimension** forming part of the *People Development* **dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
2. People Development	2.3 Empowerment	2.3.1 Responsible autonomy	2.3.1.1a Few leaders ensure that people participate in the decision-making process. 2.3.1.1b Self-managed teams are undeveloped . 2.3.1.1c Authority is rarely delegated to lower levels	2.3.1.2a Some leaders ensure that people participate in the decision-making process, but only within functional silos . 2.3.1.2b Self-managed teams are formative and experimentally developed. 2.3.1.2c Authority is sporadically delegated to lower levels of mainly departmental silos	2.3.1.3a Many leaders frequently ensure that people participate in the decision-making process, commonly within operations . 2.3.1.3b Self-managed teams are defined and repeatably developed. 2.3.1.3c Authority is frequently delegated to lower levels of mainly the functional value stream	2.3.1.4a Most leaders consistently ensure that people participate in the decision-making process throughout multiple business processes . 2.3.1.4b Self-managed teams are established and consistently developed. 2.3.1.4c Authority is consistently delegated to lower levels of mainly the integrated value stream	2.3.1.5a All leaders continuously ensure that people across the enterprise actively participate in the decision-making process. 2.3.1.5b Self-managed teams are stable and continuously developed. 2.3.1.5c Authority is constantly delegated to lower levels of the extended value stream
		2.3.2 Choice autonomy	2.3.2.1a Few leaders are supportive of people's self-discovery and knowledge-sharing.	2.3.2.2a Some leaders are irregularly supportive of people's self-discovery and knowledge-sharing.	2.3.2.3a Many leaders are frequently supportive of people's self-discovery and knowledge-sharing.	2.3.2.4a Most leaders are consistently supportive of people's self-discovery and knowledge-sharing.	2.3.2.5a All leaders are constantly supportive of people's self-discovery and knowledge-sharing.
		2.3.3 Engagement	2.3.3.1a People are rarely given a voice in the lean transformation. 2.3.3.1b Few leaders provide opportunities for people to be engaged in lean initiatives. 2.3.3.1c Few leaders recognise that only work that contributes to development and learning can be considered as value-adding.	2.3.3.2a Some people are irregularly given a voice in the lean transformation. 2.3.3.2b Some leaders sporadically provide event-based opportunities for people to be engaged in lean initiatives according to their individual skills, abilities and maturity. 2.3.3.2c Some leaders are aware that only work that contributes to development and learning can be considered as value-adding	2.3.3.3a Many people are commonly given a voice in the lean transformation. 2.3.3.3b Many leaders commonly provide repeatably opportunities for people to be engaged in lean initiatives according to their individual skills, abilities and maturity. 2.3.3.3c Many leaders understand that only work that contributes to development and learning can be considered as value-adding.	2.3.3.4a Most people are consistently given a voice in the lean transformation. 2.3.3.4b Most leaders consistently provide established opportunities for people to be engaged in lean initiatives according to their individual skills, abilities and maturity. 2.3.3.4c Most leaders accept that only work that contributes to development and learning can be considered as value-adding.	2.3.3.5a All people are constantly given an active voice in all aspects of the lean transformation. 2.3.3.5b All leaders constantly provide stable opportunities for people to be engaged in lean initiatives according to their individual skills, abilities and maturity. 2.3.3.5c All leaders are convinced that only work that contributes to development and learning can be considered as value-adding

Figure 53: Capability statements for the Empowerment subdimension

Figure 54 demonstrates the first set of **capability statements** defined for the *Daily Kaizen* **subdimension** forming part of the *Continuous Improvement* **dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
3. Continuous Improvement	3.1 Daily Kaizen	3.1.1 Problem-management routine	3.1.1.1a Stand-up meetings about the previous day's performance and the present day's work are rarely witnessed and executed in isolation. 3.1.1.1b Non-conforming issues affecting performance are infrequently escalated with the next level of the hierarchy. 3.1.1.1c Few leaders recognise their responsibility towards the performance of the areas they're responsible for.	3.1.1.2a Stand-up up meetings about the previous day's performance and the present day's work are sporadically witnessed and executed in silos. 3.1.1.2b Non-conforming issues affecting performance are sometimes escalated with the next level of the hierarchy. 3.1.1.2c Some leaders are aware of their responsibility towards the performance of the areas they're responsible for.	3.1.1.3a Stand-up meetings about the previous day's performance and the present day's work are commonly witnessed and executed throughout operations. 3.1.1.3b Non-conforming issues affecting performance are frequently escalated with the next level of the hierarchy. 3.1.1.3c Many leaders understand their responsibility towards the performance of the areas they're responsible for.	3.1.1.4a Stand-up up meetings about the previous day's performance and the present day's work is consistently witnessed and established throughout multiple business processes. 3.1.1.4b Non-conforming issues affecting performance are consistently escalated with the next level of the hierarchy. 3.1.1.4c Most leaders accept responsibility towards the performance of the areas they're responsible for.	3.1.1.5a Daily standardised stand-up meetings about the previous day's performance and the present day's work are guaranteed throughout the entire enterprise. 3.1.1.5b Non-conforming issues affecting performance are always escalated through rapid feedback loops with the next level of the hierarchy. 3.1.1.5c All leaders are fully committed towards the performance of the areas they're responsible for.
		3.1.2 Problem gathering routine	3.1.2.1a Routine Gemba walks focusing on problem-identification are rarely witnessed and executed in isolation. 3.1.2.1b Few leaders focus on auditing processes and standardised work procedures	3.1.2.2a Routine Gemba walks focusing on problem-identification are sometimes witnessed and executed in silos. 3.1.2.2b Some leaders irregularly focus on auditing processes and standardised work procedures to ensure that defined processes are followed.	3.1.2.3a Routine Gemba walks focusing on problem-identification are commonly executed in functional value streams. 3.1.2.3b Many leaders frequently focus on auditing processes and standardised work procedures, ensuring that defined processes are followed and working as intended by verifying their execution at operational task levels	3.1.2.4a Routine Gemba walks focusing on problem-identification are consistently executed in integrated value streams. 3.1.2.4b Most leaders consistently focus on auditing processes and standardised work procedures, ensuring that defined processes are followed and working as intended by verifying their execution at integrated value stream task levels	3.1.2.5a Routine Gemba walks focusing on problem-identification are continuously executed in extended value streams. 3.1.2.5b All leaders continuously focus on auditing processes and standardised work procedures daily to ensure that defined processes are followed and working as intended by verifying their execution at extended value stream task levels
		3.1.3 Proactive support	3.1.3.1a Few leaders take a proactive approach to support their team and remove obstacles that may prevent them from adding value. 3.1.3.1b Few leaders are interested that they are at the service of value-creating work.	3.1.3.2a Some leaders irregularly take a proactive approach to support their team and erratically remove obstacles that may prevent them from adding value. 3.1.3.2b Some leaders are aware that they are at the service of value-creating work through identifying and managing problems	3.1.3.3a Many leaders frequently take a proactive approach to support their team and are moderately committed to remove obstacles that may prevent them from adding value. 3.1.3.3b Many leaders understand that they are at the service of value-creating work through identifying and managing problems	3.1.3.4a Most leaders consistently take a proactive approach to support their team and are widely committed to removing obstacles that may prevent them from adding value. 3.1.3.4b Most leaders can consistently explain how they are at the service of value-creating work through identifying and managing problems	3.1.3.5a All leaders constantly take a proactive approach to support their team and are fully committed to removing obstacles that may prevent them from adding value. 3.1.3.5b All leaders are convinced that they are at the service of value-creating work through identifying and managing problems

Figure 54: Capability statements for the *Daily Kaizen* subdimension (1)

Figure 55 demonstrates the second set of **capability statements** defined for the *Daily Kaizen* **subdimension** forming part of the *Continuous Improvement dimension*.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
3. Continuous Improvement	3.1 Daily Kaizen	3.1.4 Go-see-fix	3.1.4.1a Go-see-fix routines are rarely followed whenever a problem arises in the workplace. 3.1.4.1b Decisions related to the problem are seldomly made based on self-gained facts gained at the Gemba.	3.1.4.2a Go-see-fix routines are sometimes followed whenever a problem arises in the workplace – mostly in silos . 3.1.4.2b Decisions related to the problem are irregularly made based on self-gained facts gained at the Gemba.	3.1.4.3a Go-see-fix routines are frequently followed whenever a problem arises in the workplace – mostly within functional value streams . 3.1.4.3b Decisions related to the problem are commonly made based on self-gained facts gained at the Gemba.	3.1.4.4a Go-see-fix routines are consistently followed whenever a problem arises in the workplace – mostly within the integrated value streams . 3.1.4.4b Decisions related to the problem are consistently made based on self-gained facts gained at the Gemba.	3.1.4.5a Go-see-fix routines are continuously followed whenever a problem arises in the workplace – always within the extended value streams 3.1.4.5b Decisions related to the problem are constantly made based on self-gained facts gained at the Gemba.
		3.1.5 Problem to opportunity	3.1.5.1a Few leaders are committed to creating an organisational mindset where problems are recognised as opportunities for continuous improvement and learning	3.1.5.2a Some leaders are occasionally committed to creating an organisational mindset where problems are recognised as opportunities for continuous improvement and learning	3.1.5.3a Many leaders are frequently committed to creating an organisational mindset where problems are recognised as opportunities for continuous improvement and learning	3.1.5.4a Most leaders are consistently committed to creating an organisational mindset where problems are recognised as opportunities for continuous improvement and learning	3.1.5.5a All leaders are constantly committed to creating an organisational mindset where problems are recognised as opportunities for continuous improvement and learning
		3.1.6 Root cause problem solving	3.1.6.1a Few leaders give any importance to identify the root cause of a problem and prevent a recurrence. 3.1.6.1b Few leaders create a culture where the focus is on the root cause of a problem and not the person. They rarely ask “what”, “why” and “how” instead of “who”. 3.1.6.1c Standardised and scientific methods are rarely used to identify and resolve the root cause of a problem	3.1.6.2a Some leaders occasionally give importance to identify the root cause of a problem and prevent a recurrence. 3.1.6.2b Some leaders commit to creating a culture where the focus is on the root cause of a problem and not the person. They sporadically ask “what”, “why” and “how” instead of “who”. 3.1.6.2c Standardised and scientific methods are sometimes used to identify and resolve the root cause of a problem	3.1.6.3a Many leaders are frequently committed to giving importance to identify the root cause of a problem and prevent a recurrence. 3.1.6.3b Many leaders commit to creating a culture where the focus is on the root cause of a problem and not the person. They commonly ask “what”, “why” and “how” instead of “who”. 3.1.6.3c Standardised and scientific methods are commonly used to identify and resolve the root cause of a problem	3.1.6.4a Most leaders are consistently committed to giving importance to identify the root cause of a problem and prevent a recurrence. 3.1.6.4b Most leaders commit to creating a culture where the focus is on the root cause of a problem and not the person. They persistently ask “what”, “why” and “how” instead of “who”. 3.1.6.4c Standardised and scientific methods are consistently used to identify and resolve the root cause of a problem	3.1.6.5a All leaders are continuously committed to giving high importance to identify the root cause of a problem and prevent a recurrence. 3.1.6.5b All leaders commit daily to creating a culture where the focus is on the root cause of a problem and not the person. Asking “what”, “why” and “how” instead of “who” is culturally ingrained . 3.1.6.5c Standardised and scientific methods are always used to identify and resolve the root cause of a problem

Figure 55: Capability statements for the *Daily Kaizen* subdimension (2)

Figure 56 demonstrates the first set of **capability statements** defined for the *Improvement Kaizen* **subdimension** forming part of the *Continuous Improvement* **dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
3. Continuous Improvement	3.2 Improvement Kaizen	3.2.1 Value stream mapping	3.2.1.1a Value streams are rarely mapped and used as a tool to identify waste and improvement projects	3.2.1.2a Value streams are sometimes mapped and used as an event-based tool to identify waste and improvement projects	3.2.1.3a Value streams are frequently mapped and used as a repeatable tool to identify waste and improvement projects	3.2.1.4a Value streams are consistently mapped and used as an established tool to identify waste and improvement projects	3.2.1.5a Value streams are constantly mapped and used as a strategic tool to identify waste and improvement projects
		3.2.2 LSO committee	3.2.2.1a The Lean Steering and Oversight (LSO) committee exists in isolation and does not consist of individuals at top management levels. 3.2.2.1b The LSO committee seldom calls for, sanctions, supports and oversees value stream improvement projects	3.2.2.2a The LSO committee exists experimentally and irregularly consists of individuals at top management levels. 3.2.2.2b The LSO committee only occasionally calls for, sanctions, supports and oversees value stream improvement projects	3.2.2.3a The LSO committee is defined and commonly consists of individuals at top management levels. 3.2.2.3b The LSO committee commonly calls for, sanctions, supports and oversees value stream improvement projects	3.2.2.4a The LSO committee is established and predominantly consists of individuals at top management levels. 3.2.2.5b The LSO committee predominantly calls for, sanctions, supports and oversees value stream improvement projects	3.2.2.5a The LSO committee is stable and always consists of individuals at top management levels. 3.2.2.5b The LSO committee always calls for, sanctions, supports and oversees value stream improvement projects
		3.2.3 PR&A panel	3.2.3.1a The Project Resource and Accountability (PR&A) panel exists in isolation and does not consist of leaders from functions or departments targeted by value stream improvement projects. 3.2.3.1b The PR&A panel is rarely responsible to the LSO for setting fittingly bold improvement objectives for each improvement project and seldom executes the plan to achieve them.	3.2.3.2a The PR&A panel exists experimentally and irregularly consists of leaders from functions or departments targeted by value stream improvement projects. 3.2.3.2b The PR&A panel is irregularly responsible to the LSO for setting fittingly bold improvement objectives for each improvement project and occasionally executes the plan to achieve them	3.2.3.3a The PR&A panel is defined and commonly consists of leaders from functions or departments targeted by value stream improvement projects. 3.2.3.3b The PR&A panel is commonly responsible to the LSO for setting fittingly bold improvement objectives for each improvement project and frequently executes the plan to achieve them.	3.2.3.4a The PR&A panel is established and predominantly consists of leaders from functions or departments targeted by value stream improvement projects. 3.2.3.4b The PR&A panel is predominantly responsible to the LSO for setting fittingly bold improvement objectives for each improvement project and consistently executes the plan to achieve them.	3.2.3.5a The PR&A panel is stable and always consists of leaders from functions or departments targeted by value stream improvement projects. 3.2.3.5b The PR&A panel is continuously responsible to the LSO for setting fittingly bold improvement objectives for each improvement project and always executes the plan to achieve them.

Figure 56: Capability statements for the *Improvement Kaizen* subdimension (1)

Figure 57 demonstrates the second set of **capability statements** defined for the *Improvement Kaizen* **subdimension** forming part of the *Continuous Improvement* **dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
3. Continuous Improvement	3.2 Improvement Kaizen	3.2.4 Focused improvement	3.2.4.1a Few leaders focus on the total picture in terms of cost, quality, delivery, safety and the environment when selecting improvement projects. 3.2.4.1b Few leaders articulate their expectations toward the outcomes of projects. 3.2.4.1c Improvement objectives are rarely challenging and seldomly executed.	3.2.4.2a Some leaders irregularly focus on the total picture in terms of cost, quality, delivery, safety and the environment when selecting improvement projects. 3.2.4.2b Some leaders can occasionally articulate their expectations toward the outcomes of projects. 3.2.4.2c Improvement objectives are sometimes challenging and intermittently executed.	3.2.4.3a Many leaders commonly focus on the total picture in terms of cost, quality, delivery, safety and the environment when selecting improvement projects. 3.2.4.3b Many leaders can frequently articulate their expectations toward the outcomes of projects. 3.2.4.3c Improvement objectives are moderately challenging and regularly executed.	3.2.4.4a Most leaders consistently focus on the total picture in terms of cost, quality, delivery, safety and the environment when selecting improvement projects. 3.2.4.4b Most leaders can consistently articulate their expectations toward the outcomes of projects. 3.2.4.4c Improvement objectives are predominantly challenging and regularly executed.	3.2.4.5a Focusing on the total picture in terms of cost, quality, delivery, safety and the environment when selecting improvement projects is culturally ingrained for all leaders. 3.2.4.5b All leaders can constantly articulate their expectations toward the outcomes of projects. 3.2.4.5c Improvement objectives are always challenging and continuously executed.
		3.2.5 Partnering	3.2.5.1a Few leaders are interested in the organisation's history of collaboration and can rarely identify current cross-functional and professional silos. 3.2.5.1b Few leaders allocate the necessary time and resources for cross-functional job rotation of their team members	3.2.5.2a Some leaders have a basic awareness of the organisation's history of collaboration and can sometimes identify current cross-functional and professional silos. 3.2.5.2b Some leaders sporadically allocate time and resources for cross-functional job rotation of their team members, but only within silos .	3.2.5.3a Many leaders understand the organisation's history of collaboration and can repeatedly identify current cross-functional and professional silos. 3.2.5.3b Many leaders frequently allocate the necessary time and resources for cross-functional job rotation of their team members, commonly within operations .	3.2.5.4a Most leaders accept the organisation's history of collaboration and can consistently identify current cross-functional and professional silos. 3.2.5.4b Most leaders consistently allocate the necessary time and resources for cross-functional job rotation of their team members, mainly within multiple business functions .	3.2.5.5a All leaders are fully committed to understanding the organisation's history of collaboration and can constantly identify current cross-functional and professional silos. 3.2.5.5b All leaders constantly allocate the necessary time and resources for cross-functional job rotation of their team members within the entire enterprise .
		3.2.6 Horizontal flow of value	3.2.6.1a Few leaders give attention to the horizontal flow of value across value streams, mainly in isolated value streams.	3.2.6.2a Some leaders irregularly give attention to the horizontal flow of value, mainly across internal value streams .	3.2.6.3a Many leaders commonly give attention to the horizontal flow of value, mainly across functional value streams .	3.2.6.4a Most leaders consistently give attention to the horizontal flow of value, mainly across integrated value streams .	3.2.6.5a All leaders continuously give attention to the horizontal flow of value across extended value streams and recognise it as a way to sustain improvements.

Figure 57: Capability statements for the *Improvement Kaizen* subdimension (2)

Figure 58 demonstrates the **capability statements** defined for the *Process Performance* **subdimension** forming part of the *Continuous Improvement* **dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
3. Continuous Improvement	3.3 Process Performance	3.3.1 Adherence	3.3.3.1a Few leaders interested in adhering to processes	3.3.1.2a Some leaders sporadically adhere to processes and support new practices only experimentally .	3.3.1.3a Many leaders frequently adhere to processes and support new practices repeatably	3.3.1.4a Most leaders consistently adhere to processes and support new practices persistently	3.3.1.5a All leaders constantly adhere to all processes and always support new practices.
		3.3.2 Standardise, stabilise	3.3.2.1a Few leaders apply a scientific approach towards standardisation and stabilisation of processes. 3.3.2.1b Few leaders enforce new expectations towards improvement and challenge the current process or traditional approaches	3.3.2.2a Some leaders apply a scientific approach towards standardisation and stabilisation of processes and seldom use them as the foundation for continuous improvement. 3.3.2.2b Some leaders occasionally enforce new expectations towards improvement and irregularly challenge the current process or traditional approaches	3.3.2.3a Many leaders commonly apply a scientific approach towards standardisation and stabilisation of several processes and frequently use them as the foundation for continuous improvement. 3.3.2.3a Many leaders frequently enforce new expectations towards improvement and regularly challenge the current process or traditional approaches	3.3.2.4a Most leaders consistently apply a scientific approach towards standardisation and stabilisation of most processes and predominantly use them as the foundation for continuous improvement. 3.3.2.4b Most leaders consistently enforce new expectations towards improvement and persistently challenge the current process or traditional approaches	3.3.2.5a All leaders continuously apply a scientific approach towards standardisation and stabilisation of all processes and constantly use them as the foundation for continuous improvement. 3.3.2.5b All leaders continuously enforce new expectations towards improvement and constantly challenge the current process or traditional approaches
		3.3.3 Yield	3.3.3.1a Improving the process rarely has priority over improving the result. 3.3.3.1b Process-focused measures are undeveloped and rarely maintained alongside traditional measures of results. 3.3.3.1c Few leaders understand that a good process leads to good results	3.3.3.2a Improving the process has occasional priority over improving the result. 3.3.3.2b Process-focused measures are experimental and seldomly maintained alongside traditional measures of results. 3.3.3.2c Some leaders are aware that a good process leads to good results	3.3.3.3a Improving the process has frequent priority over improving the result. 3.3.3.3b Process-focused measures are repeatable and frequently maintained alongside traditional measures of results. 3.3.3.3c Many leaders understand that a good process leads to good results	3.3.3.4a Improving the process has consistent priority over improving the result. 3.3.3.4b Process-focused measures are established and consistently maintained alongside traditional measures of results. 3.3.3.4c Most leaders understand that a good process leads to good results	3.3.3.5a Improving the process has continuous priority over improving the result. 3.3.3.5b Process-focused measures are stable and continuously maintained alongside traditional measures of results. 3.3.3.5c All leaders are convinced that a good process leads to good results
		3.3.4 Process management	3.3.4.1a Data on process performance is rarely collected	3.3.4.2a Data on process performance is sporadically collected and erratically managed at internal value stream intersections or used to identify and implement improvement opportunities	3.3.4.3a Data on process performance is frequently collected and repeatably managed at functional value stream intersections or used to identify and implement improvement opportunities	3.3.4.4a Data on process performance is consistently collected and persistently managed at integrated value stream intersections or used to identify and implement improvement opportunities	3.3.4.5a Data on process performance is continuously collected and constantly managed at extended value stream intersections or used to identify and implement improvement opportunities
		3.3.5 Visual feedback	3.3.5.1a Feedback on process performance is rarely provided in the workplace through visual controls. 3.3.5.1b Few leaders are interested in the results displayed by visual controls	3.3.5.2a Feedback on process performance is inconsistently provided in the workplace through visual controls. 3.3.5.2b Some leaders are aware that the results displayed by visual controls matter and are critical in communicating how well an operation is being performed	3.3.5.3a Feedback on process performance is frequently provided in the workplace through visual controls. 3.3.5.3b Many leaders understand that the results displayed by visual controls matter and are critical in communicating how well an operation is being performed	3.3.5.4a Feedback on process performance is consistently provided in the workplace through visual controls. 3.3.5.4b Most leaders accept that the results displayed by visual controls matter and are critical in communicating how well an operation is being performed	3.3.5.5a Feedback on process performance is constantly provided in the workplace through visual controls. 3.3.5.5b All leaders are convinced that the results displayed by visual controls matter and are critical in communicating how well an operation is being performed

Figure 58: Capability statements for the *Process Performance* subdimension

Figure 59 demonstrates the of **capability statements** defined for the *Kaizen Suggestion* **subdimension** forming part of the *Continuous Improvement* **dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
3. Continuous Improvement	3.4 Kaizen suggestion	3.4.1 Structured system	3.4.1.1a Few leaders provide their people with opportunities to present their suggestions for improvement. 3.4.1.1b The suggestion system is infrequently sustained with the input of ideas and output of improvements. 3.4.1.1c The suggestion system is rarely recognised as a critical method for creating and sustaining continuous improvement in the workplace	3.4.1.2a Some leaders occasionally provide their people with opportunities to present their suggestions for improvement in an environment that is structured and open to experimentation without fear of failure. 3.4.1.2b The suggestion system is intermittently sustained with the input of ideas and output of improvements. 3.4.1.2c The suggestion system is sometimes recognised as a critical method for creating and sustaining continuous improvement in the workplace	3.4.1.3a Many leaders frequently provide their people with opportunities to present their suggestions for improvement in an environment that is structured and open to experimentation without fear of failure. 3.4.1.3b The suggestion system is frequently sustained with the input of ideas and output of improvements. 3.4.1.3c The suggestion system is frequently recognised as a critical method for creating and sustaining continuous improvement in the workplace	3.4.1.4a Most leaders consistently provide their people with opportunities to present their suggestions for improvement in an environment that is structured and open to experimentation without fear of failure. 3.4.1.4b The suggestion system is consistently sustained with the input of ideas and output of improvements. 3.4.1.4c The suggestion system is consistently recognised as a critical method for creating and sustaining continuous improvement in the workplace	3.4.1.5a All leaders continuously provide their people with opportunities to present their suggestions for improvement in an environment that is structured and open to experimentation without fear of failure. 3.4.1.5b The suggestion system is continuously sustained with the input of ideas and output of improvements. 3.4.1.5c The suggestion system is always recognised as a critical method for creating and sustaining continuous improvement in the workplace
		3.4.2 Reward-recognition	3.4.2.1a Few leaders respond to the submission of all improvement ideas. 3.4.2.1b Employees are rarely recognised and rewarded for their inputs to the suggestion system. 3.4.2.1c Few leaders encourage people to participate in the suggestion system, infrequently emphasising and celebrating success	3.4.2.2a Some leaders occasionally respond to the submission of all improvement ideas. 3.4.2.2b Employees are occasionally recognised and rewarded for their inputs to the suggestion system. 3.4.2.2c Some leaders irregularly encourage people to participate in the suggestion system, sporadically emphasising and celebrating success	3.4.2.3a Many leaders frequently respond to the submission of all improvement ideas. 3.4.2.3b Employees are commonly recognised and rewarded for their inputs to the suggestion system. 3.4.2.3c Many leaders frequently encourage people to participate in the suggestion system, regularly emphasising and celebrating success	3.4.2.4a Most leaders consistently respond to the submission of all improvement ideas. 3.4.2.4b Employees are rarely recognised and rewarded consistently for their inputs to the suggestion system. 3.4.2.4c Most leaders consistently encourage people to participate in the suggestion system, predominantly emphasising and celebrating success	3.4.2.5a All leaders promptly and continuously respond to the submission of all improvement ideas as a way of maintaining commitment. 3.4.2.5b Employees are always recognised and rewarded for their inputs to the suggestion system. 3.4.2.5c All leaders continuously encourage people to participate in the suggestion system, always emphasising and celebrating success
		3.4.3 Kaizen stimulation	3.4.3.1a Challenging objectives or targets are rarely defined, usually for isolated work areas. 3.4.3.1b Suggestions that aim at achieving the targets or metrics of specific areas are infrequently identified and implemented.	3.4.3.2a Challenging objectives or targets are sometimes defined, usually within internal value streams . 3.4.3.2b Suggestions that aim at achieving the targets or metrics of specific areas are sometimes identified and implemented.	3.4.3.3a Challenging objectives or targets are frequently defined, usually within functional value streams . 3.4.3.3b Suggestions that aim at achieving the targets or metrics of specific areas are commonly identified and implemented.	3.4.3.4a Challenging objectives or targets are consistently defined, usually within integrated value streams . 3.4.3.4b Suggestions that aim at achieving the targets or metrics of specific areas are consistently identified and implemented.	3.4.3.5a Challenging objectives or targets are continuously defined, usually within extended value streams to stimulate a continuous improvement culture. 3.4.3.5b Suggestions that aim at achieving the targets or metrics of specific areas are continuously identified and implemented.

Figure 59: Capability statements for the *Kaizen Suggestion* subdimension

Figure 60 demonstrates the of **capability statements** defined for the *Strategic Direction* **subdimension** forming part of the *Purpose* **dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
4. Purpose	4.1 Strategic Direction	4.1.1 Policy deployment	4.1.1.1a The organisation's long-term vision and strategic goals are undeveloped and inconsistently deployed through Policy Deployment. 4.1.1.1b The PD is rarely used to drive strategic direction for teams to achieve long-term goals and prioritise resources.	4.1.1.2a The organisation's long-term vision and strategic goals are experimental and deployed sporadically through Policy Deployment. 4.1.1.2b The PD is sometimes used to drive strategic direction for teams to achieve long-term goals and prioritise resources.	4.1.1.3a The organisation's long-term vision and strategic goals are defined and deployed repeatably through Policy Deployment. 4.1.1.3b The PD is commonly used to drive strategic direction for teams to achieve long-term goals and prioritise resources.	4.1.1.4a The organisation's long-term vision and strategic goals are established and predominantly deployed through Policy Deployment. 4.1.1.4b The PD is consistently used to drive strategic direction for teams to achieve long-term goals and prioritise resources.	4.1.1.5a The organisation's long-term vision and strategic goals are stable and culturally ingrained through Policy Deployment with no trade-off between quality, cost, safety, delivery and the environment. 4.1.1.5b The PD is always used to drive strategic direction for teams to achieve long-term goals and prioritise resources.
		4.1.2 Long-term consistency	4.1.2.1a Few leaders exhibit long-term consistency toward the organisational philosophy and values. 4.1.2.1b Short-term gains are only rarely overruled by long-term goals.	4.1.2.2a Some leaders exhibit long-term consistency toward the organisational philosophy and values. 4.1.2.2b Short-term gains are sometimes overruled by long-term goals.	4.1.2.3a Many leaders exhibit long-term consistency toward the organisational philosophy and values. 4.1.2.3b Short-term gains are frequently overruled by long-term goals.	4.1.2.4a Most leaders exhibit long-term consistency toward the organisational philosophy and values. 4.1.2.4b Short-term gains are consistently overruled by long-term goals.	4.1.2.5a Long-term thinking is ingrained in each leader and all leaders exhibit long-term consistency toward the organisational philosophy and values. 4.1.2.5b Short-term gains are always overruled by long-term goals.
		4.1.3 Operational alignment	4.1.3.1a Activity plans aligned with strategic goals are undeveloped and rarely translated to specific targets for each functional area. 4.1.3.1b Few employees understand their individual objectives and how it all relates back to the overall vision or True North	4.1.3.2a Activity plans aligned with strategic goals are experimental and occasionally translated to specific targets for internal value streams . 4.1.3.2b Some employees understand their individual objectives and how it all relates back to the overall vision or True North	4.1.3.3a Activity plans aligned with strategic goals are repeatably and frequently translated to specific targets for functional value streams . 4.1.3.3b Many employees understand their individual objectives and how it all relates back to the overall vision or True North	4.1.3.4a Activity plans aligned with strategic goals are established and consistently translated to specific targets for integrated value streams . 4.1.3.4b Most employees understand their individual objectives and how it all relates back to the overall vision or True North	4.1.3.5a Activity plans aligned with strategic goals are stable and always translated to specific targets for the entire enterprise through a set of key performance indicators (KPIs) and key behavioural indicators (KBIs). 4.1.3.5b All employees understand their individual objectives and how it all relates back to the overall vision or True North
		4.1.4 Customer alignment	4.1.4.1a Few leaders assess the organisation's alignment with other internal units and third parties. 4.1.4.1b The emphasis of a few people's work is shifted to what adds value to mostly isolated value streams. 4.1.4.1c Few leaders establish recognition of and commitment to a shared view of what the customer defines as value.	4.1.4.2a Some leaders occasionally assess the organisation's alignment with other internal units and third parties, mostly realigning the internal value stream with the customer. 4.1.4.2b The emphasis of some people's work is shifted to what adds value to mostly internal value streams . 4.1.4.2c Some leaders occasionally establish recognition of and commitment to a shared view of what the customer defines as value.	4.1.4.3a Many leaders frequently assess the organisation's alignment with other internal units and third parties, mostly realigning the functional value streams with the customer. 4.1.4.3b The emphasis of many people's work is shifted to what adds value to mostly functional value streams . 4.1.4.3c Many leaders commonly establish recognition of and commitment to a shared view of what the customer defines as value	4.1.4.4a Most leaders consistently assess the organisation's alignment with other internal units and third parties, mostly realigning the integrated value stream with the customer. 4.1.4.4b The emphasis of most people's work is shifted to what adds value to mostly integrated value streams . 4.1.4.4c Most leaders repeatably establish recognition of and commitment to a shared view of what the customer defines as value	4.1.4.5a All leaders continuously assess the organisation's alignment with other internal units and third parties, realigning the entire enterprise with the customer. 4.1.4.5b The emphasis of all people's work is shifted to what adds value to both the external value streams and external customers. 4.1.4.5c All leaders constantly establish recognition of and commitment to a shared view of what the customer defines as value

Figure 60: Capability statements for the *Strategic Direction* subdimension

Figure 61 demonstrates the of **capability statements** defined for the *Reinforcement* **subdimension** forming part of the *Purpose* **dimension**.

			Level 1: Initial	Level 2: Managed	Level 3: Defined	Level 4: Predictable	Level 5: Sustained
4. Purpose	4.2 Reinforcement	4.2.1 Change culture	4.2.1.1a Few leaders are committed to establishing a culture that embraces the daily implementation of changes, mostly in isolation . 4.2.1.1b Few leaders are willing to understand that people's perception of a change influences the success of a change. 4.2.1.1c People are seldom reminded of the benefits of the lean transformation and how it positively affects their work environment	4.2.1.2a Some leaders are individually committed to establishing a culture that embraces the daily implementation of changes, mostly within silos . 4.2.1.2b Some leaders are aware that people's perception of a change influences the success of a change. 4.2.1.2c People are occasionally reminded of the benefits of the lean transformation and how it positively affects their work environment	4.2.1.3a Many leaders are locally committed to establishing a culture that embraces the daily implementation of changes, mostly visible in operations . 4.2.1.3b Many leaders understand that people's perception of a change influences the success of a change. 4.2.1.3c People are frequently reminded of the benefits of the lean transformation and how it positively affects their work environment	4.2.1.4a Most leaders are widely committed to establishing a culture that embraces the daily implementation of changes, mostly visible in multiple business operations . 4.2.1.4b Most leaders accept that people's perception of a change influences the success of a change. 4.2.1.4c People are consistently reminded of the benefits of the lean transformation and how it positively affects their work environment	4.2.1.5a All leaders are fully committed to establishing a culture that embraces the daily implementation of changes, visible throughout the entire enterprise . 4.2.1.5b All leaders are convinced that people's perception of a change influences the success of a change. 4.2.1.5c People are continuously reminded of the benefits of the lean transformation and how it positively affects their work environment
		4.2.2 Transparency	4.2.2.1a People are infrequently informed about the transformation's progress through visual controls, mostly within isolation . 4.2.2.1b Visual controls are undeveloped . 4.2.2.1c Visual controls rarely illustrate Kaizen activities and their success stories	4.2.2.2a Some people are occasionally informed about the transformation's progress through visual controls, mostly within departmental silos . 4.2.2.2b Visual controls are experimental and occasionally offer immediate and easily understandable information on the current state of the transformation. 4.2.2.2c Visual controls sometimes illustrate Kaizen activities and their success stories	4.2.2.3a Many people are frequently informed about the transformation's progress through visual controls, mostly within the operational environment. 4.2.2.3b Visual controls are defined and can repeatedly offer immediate and easily understandable information on the current state of the transformation. 4.2.2.3c Visual controls frequently illustrate Kaizen activities and their success stories	4.2.2.4a Most people are consistently informed about the transformation's progress through visual controls, mostly throughout multiple business operations . 4.2.2.4b Visual controls are established and can predictably offer immediate and easily understandable information on the current state of the transformation. 4.2.2.4c Visual controls consistently illustrate Kaizen activities and their success stories	4.2.2.5a The entire enterprise and its stakeholders are continuously informed about the transformation's progress through visual controls. 4.2.2.5b Visual controls are stable and can always offer immediate and easily understandable information on the current state of the transformation. 4.2.2.5c Visual always clearly illustrate Kaizen activities and their success stories
		4.2.3 Participation	4.2.3.1a Few leaders visibly participate in the lean transformation and change management process, rarely transforming commitments to change into actual change. 4.2.3.1b The Gemba is rarely used to reinforce motivation for the lean transformation	4.2.3.2a Some leaders visibly participate in the lean transformation and change management process, irregularly transforming commitments to change into actual change. 4.2.3.2b The Gemba is sometimes used to reinforce motivation for the lean transformation and promote its underlying principles, culture and practices	4.2.3.3a Many leaders visibly participate in the lean transformation and change management process, frequently transforming commitments to change into actual change. 4.2.3.3b The Gemba is regularly used to reinforce motivation for the lean transformation and promote its underlying principles, culture and practices	4.2.3.4a Most leaders visibly participate in the lean transformation and change management process, consistently transforming commitments to change into actual change. 4.2.3.4b The Gemba is predominantly used to reinforce motivation for the lean transformation and promote its underlying principles, culture and practices	4.2.3.5a All leaders visibly participate in the lean transformation and change management process, continuously transforming commitments to change into actual change. 4.2.3.5b The Gemba is always used to reinforce motivation for the lean transformation and promote its underlying principles, culture and practices

Figure 61: Capability statements for the *Reinforcement* subdimension

7.4 Conclusion: Lean Leadership Maturity Model

The purpose of this chapter was to finalise the development of the new LLMM by presenting the central constructs related to the application domain and formulating the assessment criteria through capability statements. Consequently, the following research objective is addressed:

- **Research Objective 6:** “If no existing models are identified, develop a new LLMM.”

Also, the following research question is answered:

- **Research Question 6.3:** “What model design will address all the design requirements?”

Furthermore, design requirements 1, 3, 5, 8, 9, 10, 11, 12 & 13 were all considered during the model developed in this chapter. The chapters to follow describe the Delphi method as well as other verification and validation processes.

CHAPTER 8: EVALUATION OF THE LEAN LEADERSHIP MATURITY MODEL

8.1 Introduction

In the previous chapter, the Lean leadership maturity model was developed. The following chapter discusses how the Delphi technique was applied to verify and validate the LLMM. The section of the research design related to the first part of Phase 4 is indicated in the bottom-left of Figure 62. The transparent blue blocks indicate the sections of the research design that are still to be explored.

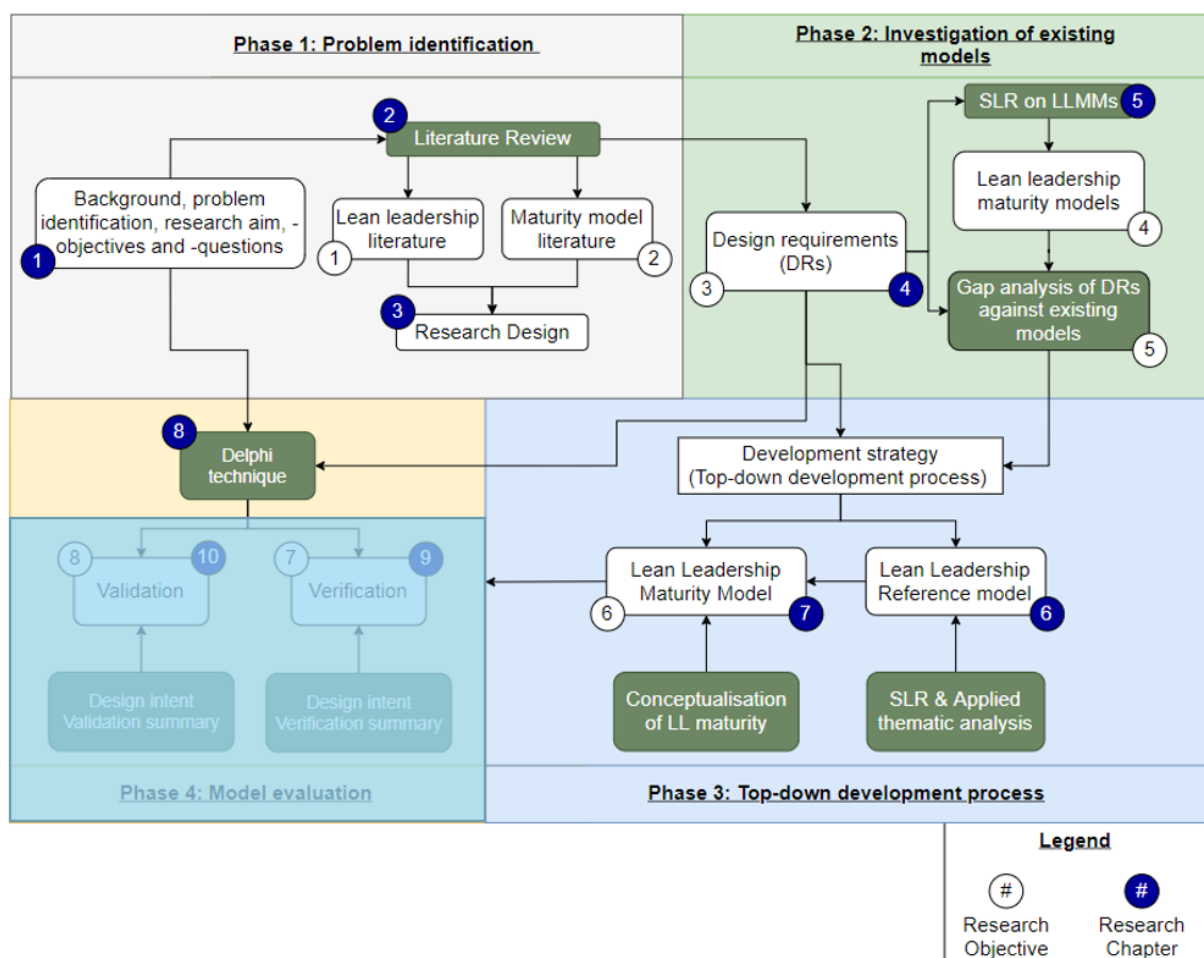


Figure 62: Section of the research design relevant to the first part of Phase 4

8.2 Delphi technique

The purpose of the Delphi technique was to determine whether there is consensus on the various aspects of the LLMM. In other words, judgement was made on whether a tool (in this case the LLMM) is fit for purpose (can be used to guide the leadership within an organisation

through the different phases of maturing as lean leaders and for organisations to assess their current lean leadership maturity in order to determine the status quo and starting point of development). Input was obtained from a panel of experts on lean leadership in both the professional and academic realms.

8.3 Selection of participants

In order to establish a decent sample, selecting a panel of participants was done by purposively sampling experts based on their ability to answer the research questions, or not (Nordin, et al., 2012; Skulmoski, et al., 2007).

Based on this, an inclusion criteria to participate in the study was established (Skulmoski, et al., 2007):

1. Experience or expertise in the field of lean;
2. Sufficient time to participate;
3. Capacity and willingness to participate;
4. Effective communication skills;

Moreover, a heterogeneous population was formed by selecting

- a) Practising lean experts from the industry and;
- b) Lean experts from the academic domain.

A total of 18 experts were purposefully sampled based on the inclusion criteria. Snowball sampling was also used by requesting participants to forward the questionnaire to other potential participants that met the inclusion criteria. In total, 13 participants responded, providing a 72% response rate.

The frequency distribution of the level of experience of the participants is outlined in Table 36 and Figure 63 respectively.

Table 36: Frequency distribution of Delphi panel's expert level

Years of experience	Frequency	%
0-5 years	3	23.1%
6-10 years	2	15.4%
11-15 years	3	23.1%
16-20 years	2	15.4%
20+ years	3	23.1%

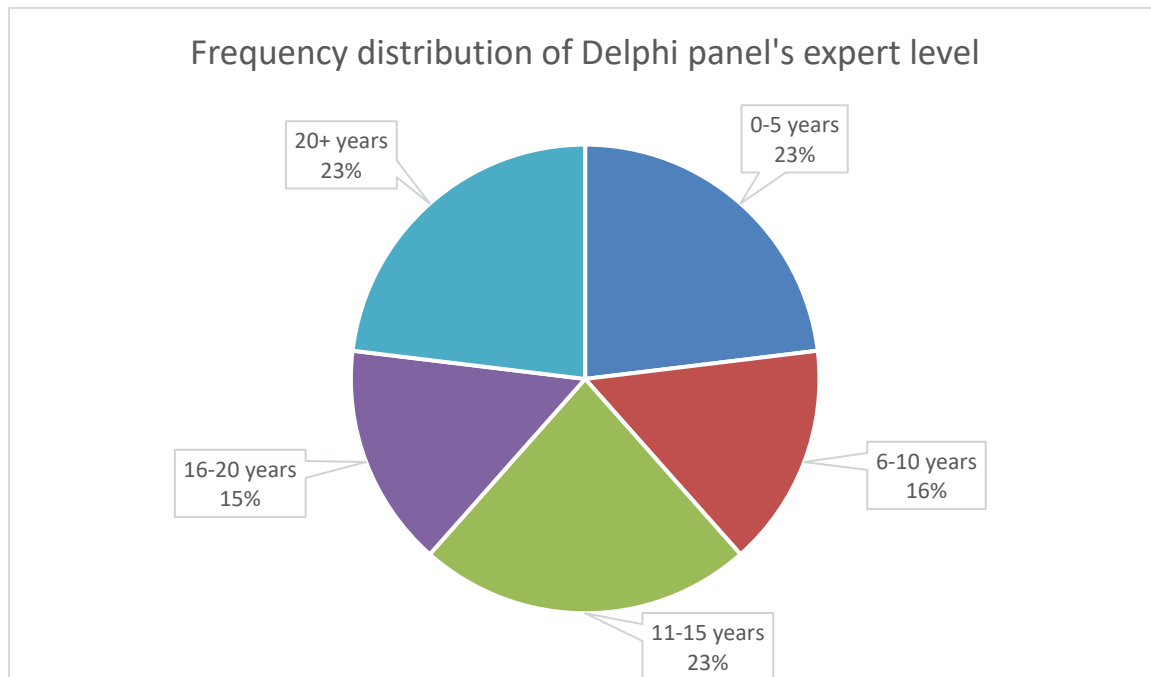


Figure 63: Frequency distribution of Delphi panel's expert level

In addition, the frequency distribution of the field in which the participants are involved in is presented in Table 37:

Table 37: Frequency distribution of Delphi panel's field of practice

Field	Frequency	%
Academic	8	61.5%
Industry	5	38.5%

8.4 Defining consensus

The agreement between the panel of experts on rating a specific item on the questionnaire was used to define consensus. A minimum percentage of 70% was set for the agreement on a specific item (Sumsion, 1998; Kleyne, et al., 2014; Vogel, et al., 2019; Veugelers, et al., 2020). This implies that on a 5-point Likert scale, a consensus was reached when the average rating of ≥ 3.5 was achieved for each item on the questionnaire.

8.5 Pilot study of questionnaire

The survey questions were designed to obtain agreement between the participants through a five-point Likert scale (Nordin, et al., 2012). Initially, the applicable points were (1) strongly disagree, (2) disagree, (3) I don't know, (4) agree and (5) strongly agree. However, an initial pilot study of the questionnaire was conducted with two participants in the industry, whose

feedback indicated that point 3, *I don't know*, is too ambiguous. This was then changed to *neutral* and used for the questionnaire. The rest of the questionnaire was acceptable to the participants and no additional changes were implemented.

After the concern of *ambiguity* was raised in the pilot study, the questions were also carefully formulated to remove any ambiguity. No other problems were encountered throughout the Delphi process.

8.6 Design of the first-round questionnaire

The first-round questionnaire was developed focusing on two main inputs:

1. **Verification** – Questions necessary to verify that the model adheres to the design requirements developed in Chapter 4 and;
2. **Validation** – Questions necessary to prove that a valid research problem was identified and pursued as well as proving that the LLMM addressed the research problem as intended.

The formulation of these questions is explained in the next section and the complete questionnaire can be found in Appendix A.

At the end of each section in the questionnaire, an opportunity was given to the participant to provide qualitative, open-ended feedback.

8.6.1 Validation questions – Research problem

The research problem's validity was investigated through specific questions in the Delphi questionnaires as outlined in Table 38:

Table 38: Research problem validation Delphi questions

Validation requirement	Questionnaire (Strongly disagree, disagree, don't know, agree, strongly agree)
1. Research problem validity	1. This section relates to the research problem's validity
a) The research problem should be valid	a) Lack of lean leadership is a barrier to the success of lean implementation. b) To date, no artefact or model exists that is solely dedicated to describing or assess lean leadership maturity within an organisation.

8.6.2 Verification questions – Design requirements

Each of the design requirements for an LLMM defined in Chapter 4 was converted into questions and consolidated and incorporated in the Delphi questionnaire as shown in Table 39:

Table 39: LLMM design requirements verification Delphi questions

Design requirements	Questionnaire (Strongly disagree, disagree, don't know, agree, strongly agree)
2. Application domain and conditions for application	2. This section relates to the prospective application domain and conditions for the application of the LLMM
a) The LLMM describes lean leadership	a) The LLMM describes lean leadership
b) The LLMM can be applied any point in time regardless of the lean implementation phase	b) The model can be applied to an organisation regardless of their lean implementation phase
3. Purpose of use	3. This section relates to the purpose of use of the LLMM
a) The LLMM can function as a diagnostic tool of as-is lean leadership	a) The LLMM enables the assessment of lean leadership within an organisation
b) The LLMM can be used as a foundation for educating stakeholders	b) The LLMM can be used to educate stakeholders about lean leadership
4. Target group	4. This section relates to the target group of the LLMM
a) The model enables a self- or group-oriented assessment from individuals across multiple functional areas and levels.	a) Role players from different functional areas and levels can use the LLMM to assess lean leadership maturity, either as a team or individually
5. Class of entities considered	5. This section relates to the class of entities considered for the LLMM
a) The model can be used to assess lean leadership maturity of multiple organisational entities and is not restricted by the size or location of the organisation under consideration.	a) Lean leadership of multiple organisational units can be measured by the LLMM. It is not restricted by the size or location of the applicable organisation.
6. LLMM design	6. This section relates to the LLMM's design
a) The LLMM design can be understood by the audience.	a) The LLMM design is easily understood and can be followed naturally
7. Central constructs related to maturity and maturation	7. This section relates to the central constructs related to maturity and maturation of the LLMM
a) The LLMM operationalises maturity in a multi-dimensional manner	a) The maturity model consists of multiple lean leadership dimensions
b) The LLMM follows a unidirectional and linear path of cumulative stages from lower- to higher maturity. The stage progression is logical.	b) The capability statements and maturity levels accumulate progressively from lower- to higher levels
8. Central constructs related to the application domain	8. This section relates to the central constructs of the LLMM's application domain
a) The LLMM includes definitions of central constructs related to the application domain	a) All structural components of the LLMM are clearly defined
9. Intersubjectively verifiable criteria for each maturity level and level of granularity	9. This section relates to intersubjectively verifiable criteria for each maturity level and level of granularity of the LLMM
a) The capability statements are mutually exclusive.	a) No combination of the capability statements contradicts each other
b) The capability statements are collectively exhaustive	b) The LLMM considers all matters that could have an impact on the success of lean leadership

8.6.3 Validation questions – Research output

The validity of the research output was investigated through specific questions in the Delphi questionnaires as outlined in Table 40:

Table 40: Research output validation Delphi questions

Validation requirement	Questionnaire (Strongly disagree, disagree, don't know, agree, strongly agree)
10. Research output validity	10. This section relates to the validity of the research output
a) The artefact must address the research problem	a) The Lean leadership maturity model can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders. b) The LLMM can assess an organisation's current lean leadership maturity in order to determine the status quo and starting point of development. c) The LLMM could contribute towards more sustainable lean implementation.
11. Differentiation from existing models	11. This section relates to the exclusivity of the LLMM
a) The design and usability facets of the LLMM clearly differs from existing models.	a) The LLMM is unique and not based on any existing models

8.7 Distribution and analysis of first-round questionnaire

All participants were contacted via email. This email included a link to a video that explained the LLMM (<https://www.dropbox.com/s/r45tgp0fmggvqwg/A%20Conceptual%20LLMM%20Video%20-%20Final%202020-08-17.ppsx?dl=0>) and also a link to the questionnaire (https://docs.google.com/forms/d/e/1FAIpQLSc7tmks3pS8YrIOycNSYhNk0QLsvxxdsDKQLEXN-DghWUi5IA/viewform?usp=sf_link) through Google Forms. This email also requested the participants to watch the short video where after the questionnaire could be completed.

In events where feedback was not yet received after 7 business days, a follow-up email was sent. After another 7 business days, the results were analysed and summarised by combining the qualitative and quantitative data collected.

8.8 Results from Delphi process

As explained earlier, consensus is achieved once 70% of the participants agree on a specific question. Based on this principle, if an average of 3.5 (which is 70% of a 5 point Likert scale) was achieved for a question, it can be implied that consensus is achieved for the applicable question. The average obtained per question is indicated in Table 41. An average of at least

3.5 was achieved for all questions and, therefore, consensus was achieved after only one round of the Delphi Technique.

Table 41: Delphi questionnaire results

Survey Questions	Results
1. This section relates to the RESEARCH PROBLEM's VALIDITY	
a) Lack of lean leadership is a barrier to the success of lean implementation.	4.6
b) To date, no artefact or model exists that is solely dedicated to describing or assess lean leadership maturity within an organisation.	3.5
2. This section relates to the PROSPECTIVE APPLICATION DOMAIN and CONDITIONS FOR APPLICATION of the LLMM	
a) The LLMM describes lean leadership	4.2
b) The model can be applied to an organisation regardless of their lean implementation phase	4.2
3. This section relates to the PURPOSE of use of the LLMM	
a) The LLMM enables the assessment of lean leadership within an organisation	4.5
b) The LLMM can be used to educate stakeholders about lean leadership	4.3
4. This section relates to the TARGET GROUP of the LLMM	
a) Role players from different functional areas and levels can use the LLMM to assess lean leadership maturity, either as a team or individually	4.2
5. This section relates to the CLASS OF ENTITIES considered for the LLMM	
a) Lean leadership of multiple organisational units can be measured by the LLMM. It is not restricted by the size or location of the applicable organisation.	4.1
6. This section relates to the LLMM's DESIGN	
a) The LLMM design is easily understood and can be followed naturally	3.8
7. This section relates to the CENTRAL CONSTRUCTS related to MATURITY and MATURATION of the LLMM	
a) The maturity model consists of multiple lean leadership dimensions	4.2
b) The capability statements and maturity levels accumulate progressively from lower- to higher levels	4.3
8. This section relates to the CENTRAL CONSTRUCTS of the LLMM's APPLICATION DOMAIN	
a) All structural components of the LLMM are clearly defined	4.1
9. This section relates to INTERSUBJECTIVELY VERIFIABLE CRITERIA for each MATURITY LEVEL and LEVEL of GRANULARITY of the LLMM	
a) No combination of the capability statements contradicts each other	4.1
b) The LLMM considers all matters that could have an impact on the success of lean leadership	3.8
10. This section relates to the VALIDITY of the RESEARCH OUTPUT	
a) The Lean leadership maturity model can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders	4.3
b) The LLMM can assess an organisation's current lean leadership maturity in order to determine the status quo and starting point of development	4.3
c) The LLMM could contribute towards more sustainable lean implementation	4.2
11. This section relates to the EXCLUSIVITY of the LLMM	
a) To the best of your knowledge, the LLMM is unique and not based on any existing models	4.0

The following section discusses the results obtained from the Delphi questionnaire according to *quantitative* and *qualitative* feedback. The detailed quantitative and qualitative feedback as extracted from the data can be found in Appendix B and C respectively.

8.8.1 Research problem validity

According to the **quantitative** results applicable to this section, there was a consensus that the research problem is in fact a valid problem. Almost all the participants agreed that a) lack of lean leadership is a barrier to the success of lean implementation and, b) to date, no artefact or model exists that is solely dedicated to describing or assessing lean leadership within an organisation.

According to the **qualitative** feedback, it was clear that some participants have seen or heard of artefacts that partly describe lean leadership, but none have come across one to this effect.

- *“Without having done a comprehensive survey of Lean leadership I cannot answer the second question comprehensively, but I have not come across a model to this effect so I am inclined to agree that one might not exist.”* (Participant B)
- *“I am aware of the 3 A approach.”* (Participant G)

The “A3” approach, not “3A” as was accidentally indicated by the participant, is a lean management and leadership thought process based on the famous “Plan-Do-Check-Act” or, “PDCA” cycle (Schwagerman & Ulmer, 2013). Although this approach touches on various lean leadership aspects (such as “go and see” and “having respect for the people”), many based on the values of the Toyota Culture, it fails to present basic components required to qualify as a Lean leadership maturity model. Furthermore, it (1) does not explicitly focus on describing lean leadership, (2) cannot function as a diagnostic tool of as-is lean leadership, (3) does not enable an assessment of any sorts, (4) operationalise maturity in any way and (5) follows a unidirectional and linear path of cumulative stages from lower- to higher maturity.

- *“Some models are available, though they are not specific.”* (Participant H)

The participant is a well-experienced employee of the Toyota Motor Company and has been exposed to multiple leadership models throughout his career. However, none of them was specific to lean leadership and never utilised a maturity scale.

- *“There is no prove that researcher investigated second statement.”* (Participant I)

It is imperative to note that the participants did not have a copy of the thesis during the survey because of the major time constraints they’ve faced and considering that the thesis was still in

development. This is, however, a valid point made by the participant and the second statement, *“(b) to date, no artefact or model exists that is solely dedicated to describing or assess lean leadership within an organisation”*, was extensively investigated in Chapter 5 (Phase 2) and yielded no results.

- *“See Mary and Tom Poppendieck’s model and LeanIT.”* (Participant J)

This is a well-known model in the field of Software Development. However, this model focuses on the application of *lean principles* (not lean leadership) in software development (Poppendieck & Poppendieck, 2003) and, although it translates widely accepted lean principles into suitable practices for software development leaders (Poppendieck & Poppendieck, 2003), it (1) does not describe lean leadership, (2) cannot function as a diagnostic tool for lean leadership, (3) cannot assess lean leadership maturity of organisations, (4) does not operationalise maturity and (5) presents no cumulative stages from lower- to higher maturity.

Based on these, the model from Poppendieck & Poppendieck, (2003) cannot be considered as a lean leadership maturity model. It should be noted that some of the principles, such as “Empower the team”, does resemble aspects of lean leadership, yet, lean leadership is still not the primary focus of the model.

- *“I believe leadership is important to ensure the success of lean implementation, but even more crucial when trying to sustain lean in an organisation.”* (Participant K)

8.8.2 Application domain and conditions for application

According to the **quantitative** results applicable for this section, there is consensus that a) the LLMM describes lean leadership and, b) the model can be applied to an organisation regardless of their lean implementation phase.

Some participants utilised the **qualitative** feedback section to provide input to the model:

- *“The model is well structured with detailed descriptions. This may allow any organisation to utilise the model regardless of their lean implementation phase.”* (Participant F)
- *“If you do not understand lean concept - answers could be biased.”* (Participant I)

8.8.3 Purpose of use

According to the **quantitative** results applicable for this section, there is consensus that a) the LLMM enables the assessment of lean leadership within an organisation and, b) the LLMM can be used to educate stakeholders about lean leadership.

The **qualitative** feedback further supported the LLMM's purpose of use:

- *“The structured manner of the model allows for easy understanding.”* (Participant F)

8.8.4 Target group

According to the **quantitative** results applicable for this section, there is consensus that role players from different functional areas can use the LLMM to assess lean leadership maturity, either as a team or individually. One participant was uncertain about the applicability of concepts such as *Gemba* and whether it is applicable to organisations outside of manufacturing.

The **qualitative** feedback further contributed to the target group:

- *“I'm unsure if in this question, the concept of different functional areas implies different functions within an organisation, other than manufacturing. If so, concepts related the *Gemba* for instance, may not be applicable to these other areas, hence not all of the LLMM ratings would apply. If the model is purely talking about direct manufacturing operations however, then I would strongly agree to this question.”* (Participant B)

This is a valid point, however, *Gemba* is defined as the actual place where work is being done, it is not exclusively applicable to only the manufacturing sector, even though being a common term in this environment. *Gemba* can also be applicable to sectors such as services or construction. The data used to develop the LLMM was obtained without any restrictions placed on the applicable field as outlined in Chapter 6. The dataset of primary studies identified in Chapter 6 also provide an even distribution of fields applicable where most that were not applicable to manufacturing refers to the *Gemba*.

8.8.5 Class of entities considered

According to the **quantitative** results applicable for this section, there is consensus that lean leadership of multiple organisational units can be measured by the LLMM. It is not restricted by the size or location of the applicable organisation.

The **qualitative** feedback further contributed to the class of entities considered:

- *“In terms of smaller organisational units, there may be insufficient resources available to prioritise having structures such as LSO's and PRA panels, and as such, it may be off-putting to smaller units.”* (Participant B)

This is a good observation by the participant and well noted for future work related to the LLMM. In the interim, it might be suggested that smaller organisational units scale their resources to accommodate structures required by LSO and PRA panels.

- *“Does the LLMM consider the culture of the country or area? Is it neutral or does this influence the results?”* (Participant G)

Based on the data gathered through the SLR in chapter 6, the LLMM is not country- or area-specific and rather focuses on a broad scope of geographic locations. It should, however, be interesting to deploy the model in different geographical locations to test the relevance of each component to the specific area. As stated earlier, lean leadership practices should remain constant throughout different demographical and geographical populations. Instead, perhaps the *style* of lean leadership rather than the *practice* should be adjusted per area. This point is well noted and will be taken into consideration should the model be developed further to align with either a *prescriptive* or *comparative* model.

- *“I believe the use of quantity descriptors such as some, many and most to establish the level of maturity can become complex. Perhaps a percentage of stakeholders, teams or employees within a division/company can assist.”* (Participant K)

This point was taken into consideration for the LLMM as outlined in Section 7.3.2, where a quantitative value was assigned for each evolutionary descriptor (from *few* to *all*). However, as previously mentioned, the participants did not have access to the thesis at the time of the survey, which might have addressed the participant's concern.

8.8.6 Lean leadership maturity model design

According to the **quantitative** results applicable for this section, there is consensus that the LLMM design is easily understood and can be followed naturally.

However, although showing consensus, the **qualitative** feedback indicated that 2 out of 13 participants found the LLMM's design to be complex:

- *“Any model that complex cannot be easily understood.”* (Participant I)
- *“Appears complicated.”* (Participant J)

8.8.7 Central constructs related to maturity and maturation

According to the **quantitative** results applicable for this section, there is consensus that a) the maturity model consists of multiple lean leadership dimensions and, b) the capability statements and maturity levels accumulate progressively from lower- to higher levels.

The **qualitative** feedback further contributed to the central constructs related to maturity and maturation:

- *“Potential to improve the wording of each point to remove ambiguity [that] exists.”*
(Participant B)

8.8.8 Central constructs related to the application domain

According to the **quantitative** results applicable for this section, there is consensus that all structural components of the LLMM are clearly defined.

Participants did not provide any **qualitative** feedback to this section.

8.8.9 Intersubjectively verifiably criteria for each maturity level and level of granularity

According to the **quantitative** results applicable for this section, there is consensus that a) no combination of the capability statements contradicts each other and, b) the LLMM considers all matters that could have an impact on the success of lean leadership

One participant provided **qualitative** feedback for this section:

- *“I feel like the teaching and learning of lean concepts as part of creating and the culture could also be assessed, as it is fundamental in creating and sustaining the lean culture.”*
(Participant B)

This is a valid point made by the participant and could potentially be included under the *People Development* dimension going forward. For the LLMM, a similar practice is provided under the *Setting* capability area that forms part of the *Coaching Gemba* subdimension and *People Development* dimension. This “Coaching” done by leaders at the Gemba that should be culturally ingrained, could include the teaching and learning of lean concepts which, as the participant rightfully mentioned, is fundamental in creating and sustaining the lean culture. This point made will be considered in future applications of the LLMM.

8.8.10 Research output validity

According to the **quantitative** results applicable for this section, there is consensus that a) the Lean leadership maturity model can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders, b) the LLMM can assess an organisation's current lean leadership maturity in order to determine the status quo and starting point of development and, c) the LLMM could contribute towards more sustainable lean implementation.

Participants did not provide any **qualitative** feedback to this section.

8.8.11 Differentiation from existing models

According to the **quantitative** results applicable for this section, there is consensus that the LLMM is unique and not based on any existing models

Participants did not provide any **qualitative** feedback to this section.

8.9 Conclusion: Delphi process

This chapter explained the Delphi technique used for verification and validation of the research. It also provided the quantitative and qualitative data collected from the Delphi questionnaire. Since consensus of all 11 areas of the survey questions was obtained after only one round of questions, no further rounds were required.

The overall feedback provided by the participants indicated that a lack of lean leadership is a barrier to the success of lean implementation and that LLMM can guide the leadership within an organisation through the different phases of maturing as lean leaders while being able to assess an organisation's current lean leadership maturity in order to determine the status quo and starting point of development – contributing towards more sustainable lean implementation.

The next two chapters are dedicated to the verification and validation of this study and summarise all the results obtained to conclude the research.

CHAPTER 9: VERIFICATION

9.1 Introduction

The aim of this study was to develop a Lean leadership maturity model that can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders. The purpose of the LLMM is for organisations to assess their current lean leadership maturity in order to determine the status quo and starting point of development. The design requirements for such a model were formulated in Phase 2 while the LLMM was designed in Phase 3. Finally, the Delphi technique (amongst other techniques) was used for verification and validation. The purpose of this chapter is to give a summary of the verification results obtained through the different methodologies utilised to verify that the LLMM satisfies all the design requirements. The section of the research roadmap relevant to the second part of Phase 4 is indicated in the bottom-left of Figure 64. The transparent blue blocks indicate the sections of the research design that are still to be explored.

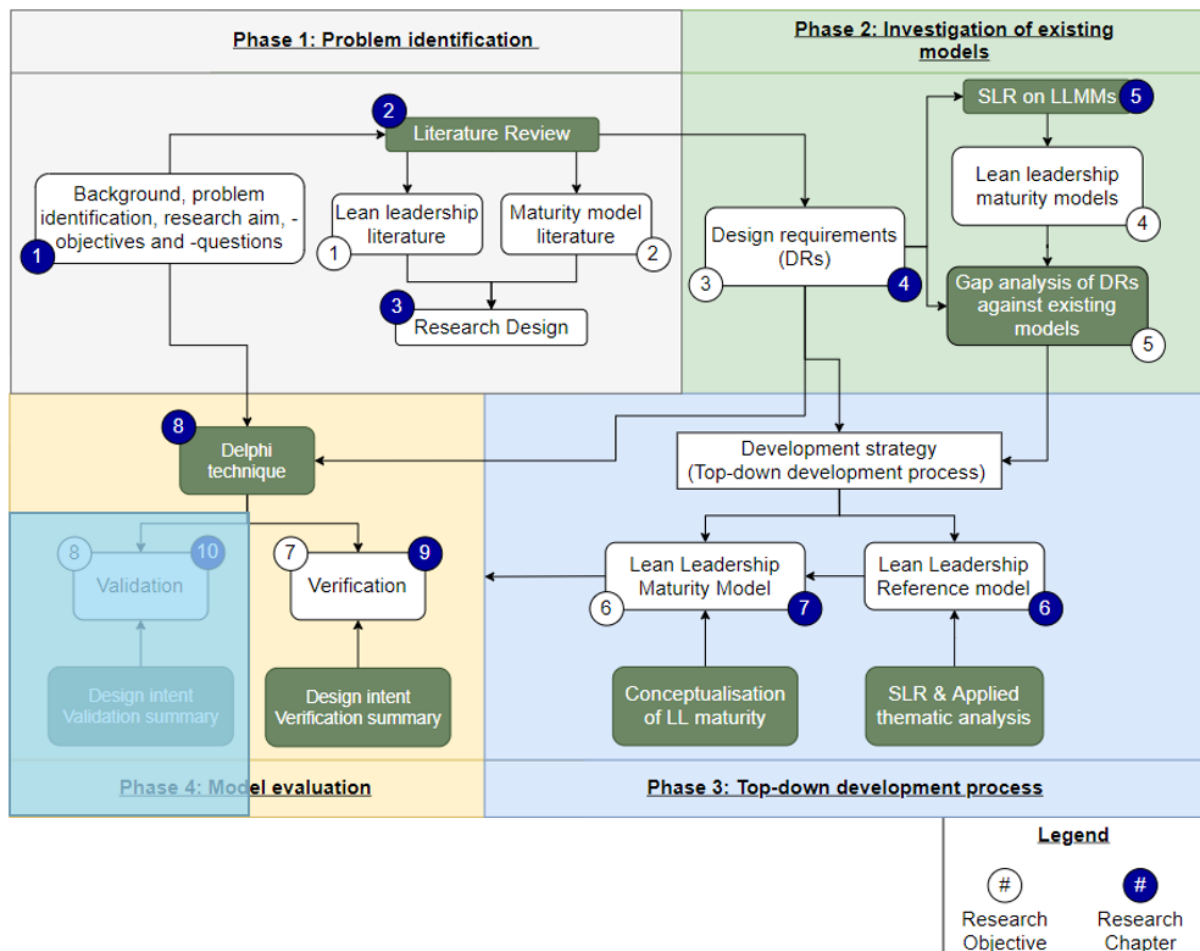


Figure 64: Section of the research design relevant to the second part of Phase 4

Furthermore, an overview of the research methods, -objectives and -questions applicable to the second part of Phase 4 is presented in Table 42:

Table 42: Overview of research methods, -objectives, and -questions applicable to the second part of Phase 4

Phase 4: Model evaluation	
Research Method	• Design intent • Delphi technique • Verification summary
Research Objectives	7. Verify whether the LLMM addresses all the design requirements.
Research Questions	7.1 Does the LLMM address all the design requirements?

9.2 Verification methodology

The verification methodology seeks to prove that the Lean leadership maturity model satisfies all the initial design requirements developed in Phase 2. Based on this, the verification process had three inputs:

- **Design intent:** In Section 9.2.1, a retrospective review on the model design process is presented. This indicates the initial intent of the design requirements while the LLMM was developed. Verification of the LLMM against the self-developed design requirements was done.
- **Delphi technique:** Section 9.2.2 provides a summary of the verification results obtained for each design requirement through the Delphi technique (as explained in Chapter 8).
- **Verification summary:** Section 9.2.3 provides a summary that confirms the adherence of all requirements relevant to this study.

9.2.1 Design intent

Throughout the design and development of the LLMM, all the DRs developed in Chapter 4 were referenced. In this section, each DR will be considered and evaluated individually and retrospectively to verify that it did form part of the design process.

Design Requirement 1 - The LLMM describes lean leadership.

The *Personal Development*, *People Development*, *Continuous Improvement* and *Purpose* dimensions encompass lean leadership through their own distinctive subdimensions, and capability areas as defined in Chapter 7. The dimensions describe the high-level capability of lean leadership. Each dimension consists of one or more subdimensions that consist of various

capability areas. These capability areas form groups of related lean leadership activities or behaviours associated with a specific combination of dimensions and subdimensions. The ideal lean leadership feature of a capability area is represented by an ideal statement. By combining all these components, a grid is formed according to which lean leadership can be described as presented in Section 7.2.5. By populating the capability statements within the frame of the model, the phases that leadership within an organisation progress through while maturing as lean leaders are presented.

Design Requirement 2 - The model can be applied any point in time regardless of lean implementation phase.

The control mechanisms in the research protocol of the SLR in Chapter 6, such as the inclusion/exclusion criteria and study quality assessment (Section 6.2.2) did not place any restrictions on the implementation phase of lean. Also, since the LLMM contains 5 maturity levels, from lowest to highest maturity, organisations in various phases of lean implementation can apply the model.

Design Requirement 3 - The LLMM can function as a diagnostic tool of as-is lean leadership.

The LLMM maturity scale presented in Section 7.2.4 presents the foundation for the assessment of lean leadership. The LLMM facilitates the assessment of as-is lean leadership maturity through capability statements developed in Section 7.3.1. These capability statements, along with their respective descriptors of evolution, were aligned with each maturity level of the maturity scale to form the LLMM's assessment criteria. The current (as-is) capabilities of the entity under consideration can be compared with this assessment criteria to determine lean leadership maturity. This ultimately enables the assessment of lean leadership within an organisation.

Design Requirement 4 - The LLMM can be used as a foundation for educating stakeholders.

The LLMM contains a solid theoretical foundation (established in Chapter 6) based on a rigorous systematic literature review and applied thematic analysis of lean leadership, ultimately synthesised into the 4 dimensions, 11 subdimensions and 43 capability areas. This comprehensive coverage of lean leadership can be used to educate stakeholders within the academic or professional domains.

Design Requirement 5 - The model enables a self- or group-oriented assessment from individuals across multiple functional areas and levels.

In Section 7.3, the capability statements and descriptors of evolution were formulated in such a way that they provide intersubjective assessment criteria for the assessment of lean leadership maturity and reduce the level of ambiguity presented by theoretical research. In other words, the LLMM assessment criteria was deliberately developed to ensure objective measurements to accommodate individual or group assessments from various functional areas and levels.

Design Requirement 6 - The model can be used to assess lean leadership maturity of multiple organisational entities and is not restricted by the size or location of the organisation under consideration.

Again, control mechanisms in the research protocol of the SLR in Chapter 6, such as the inclusion/exclusion criteria and study quality assessment (Section 6.2.2), did not place any restrictions on the location, size or sector of the studies identified. The data set that forms the foundation of the LLMM is based on a set of studies applicable to a diverse range of organisations of different sizes, locations and industries.

Design Requirement 7 - The design and usability facets of the LLMM clearly differs from existing models.

As concluded from the SLR of selected databases in Chapter 5, no model was identified that is dedicated to assessing the lean leadership maturity of an organisation. From this evidence, the design and usability facets of the LLMM are unique and is not based on any existing models of the same or similar domain.

Design Requirement 8 - The LLMM design can be understood by the audience.

The LLMM's structure is generically based on the structure for maturity models as proposed by Lasrado, et al., (2015). This type of structure is well established and has been widely accepted by the academic and professional communities. Known maturity model terminology was used for each of the structural components. Each component and how they are used in the LLMM were also clearly defined in Section 7.2 to allow the audience to easily understand the model. Additionally, the descriptors of evolution are designed for each capability statement to allow the user to naturally follow or almost predict the progression of maturity for each capability area.

Design Requirement 9 - The LLMM operationalises maturity in a multi-dimensional manner.

The LLMM consists of 4 dimensions and operationalises them in a multi-dimensional manner through a maturity grid – all of which were developed in Chapter 7.

Design Requirement 10 - The LLMM follows a unidirectional and linear path of cumulative stages from lower- to higher maturity. The stage progression is logical.

The maturity scale presented in Section 7.2.4 is based on that of the popular P-CMM developed by Curtis, et al. (2009) and accumulates progressively from lower to higher levels. The capability statements were formulated accordingly, and higher levels build on the characteristics of lower levels. The descriptors of evolution for capability statements were also formulated with progression from a lower to higher, more mature state and the behavioural scale used to formulate each capability statement ensures enough control is maintained for corresponding descriptors of evolution. There exists a clear differentiation between maturity levels for each capability area.

Design Requirement 11 - The LLMM includes definitions of central constructs related to the application domain.

As presented in Section 7.2, all the central constructs related to the application domain are defined and described in detail. How each of these constructs relates to the structural framework of the LLMM is also described in the same section.

Design Requirement 12 - The capability statements are mutually exclusive.

The capability statements (Section 7.3.1) and their corresponding capability areas were deliberately formulated with mutual exclusivity in mind. No combination of statements in the LLMM are contradicting or repeating each other and can all be viewed from different perspectives. For example, capability statements can either be viewed per dimension or per maturity level. The ability to frame the capability statements in multiple views support their mutual exclusivity.

Design Requirement 13 - The capability statements are collectively exhaustive

The comprehensive SLR used for data collection in Chapter 6 and ample literature sources identified on the domain ensures that the LLMM capability statements are collectively exhaustive. A total of 4 dimensions, 11 subdimensions and 43 capability areas of lean leadership were defined, each containing assessment criteria. A total of 215 cells, each

describing a different level of lean leadership maturity for a specific capability area are defined for the LLMM.

9.2.2 Delphi technique

As explained in Chapter 8, verification of the LLMM design requirements was achieved through the Delphi technique. The design requirements formulated in Chapter 4 were converted into specific questions and added to a questionnaire that was distributed to a panel of experts. A summary of the results obtained from this survey is illustrated in Table 43. For each question, an average of 3.50 (70% of 5) or above was required for consensus to be reached. In table 42, it can be seen that all the results are above 3.5 and therefore, it can be concluded that consensus was obtained and that all the LLMM design requirements were met.

Table 43: Delphi questionnaire results related to the LLMM design requirements

LLMM design requirements	Result	Consensus obtained?
Application domain and conditions for application		
1. The LLMM describes lean leadership.	4.2	Yes
2. The model can be applied any point in time regardless of the lean implementation phase.	4.2	Yes
Purpose of use		
3. The LLMM can function as a diagnostic tool of as-is lean leadership.	4.5	Yes
4. The LLMM can be used as a foundation for educating stakeholders.	4.3	Yes
Target group		
5. The model enables a self- or group-oriented assessment from individuals across multiple functional areas and levels	4.2	Yes
Class of entities considered		
6. The model can be used to assess lean leadership maturity of multiple organisational entities and is not restricted by the size or location of the organisation under consideration.	4.1	Yes
Differentiation from existing models		
7. The design and usability facets of the LLMM clearly differs from existing models.	4.0	Yes
LLMM design		
8. The LLMM design can be understood by the audience.	3.8	Yes
Central constructs related to maturity and maturation		
9. The LLMM operationalises maturity in a multi-dimensional manner.	4.2	Yes
10. The LLMM follows a unidirectional and linear path of cumulative stages from lower- to higher maturity. The stage progression is logical.	4.3	Yes
Central constructs related to the application domain		
11. The LLMM includes definitions of central constructs related to the application domain.	4.1	Yes

Intersubjectively verifiably criteria for each maturity level and level of granularity		
12. The capability statements are mutually exclusive.	4.1	Yes
13. The capability statements are collectively exhaustive	3.8	Yes

9.2.3 Verification Summary

A summary of the inputs used to verify adherence to the LLMM design requirements can be found in Table 44. The design requirements are stated in the first column while column two refers to the section of the study where the design requirements were intentionally considered in the LLMM's design. Column 3 confirms the adherence of the design requirements from the Delphi technique and column 4 the presents a conclusion on whether each design requirement was verified or not.

Table 44: Verification summary of the LLMM design requirements

LLMM design requirements	Design intent	Delphi technique	Conclusion
Application domain and conditions for application			
1. The LLMM describes lean leadership.	Chapter 7 – Central constructs and maturity grid	Confirmed by survey question 2.a	Verified
2. The model can be applied any point in time regardless of the lean implementation phase.	Chapter 6 – SLR control mechanisms	Confirmed by survey question 2.b	Verified
Purpose of use			
3. The LLMM can function as a diagnostic tool of as-is lean leadership.	Chapter 7 – Maturity scale	Confirmed by survey question 3.a	Verified
4. The LLMM can be used as a foundation for educating stakeholders.	Chapter 6 – SLR theoretical foundation	Confirmed by survey question 3.b	Verified
Target group			
5. The model enables a self- or group-oriented assessment from individuals across multiple functional areas and levels	Chapter 7 – Assessment criteria	Confirmed by survey question 4.a	Verified
Class of entities considered			
6. The model can be used to assess lean leadership maturity of multiple organisational entities and is not restricted by the size or location of the organisation under consideration.	Chapter 6 – SLR control mechanisms	Confirmed by survey question 5.a	Verified
Differentiation from existing models			

7. The design and usability facets of the LLMM clearly differs from existing models.	Chapter 5 – SLR and conclusion of no existing models	Confirmed by survey question 11.a	Verified
LLMM design			
8. The LLMM design can be understood by the audience.	Chapter 7 – Follows state-of-the-art constructs and known terminology	Confirmed by survey question 6.a	Verified
Central constructs related to maturity and maturation			
9. The LLMM operationalises maturity in a multi-dimensional manner.	Chapter 7 – Multiple lean leadership dimensions are utilised.	Confirmed by survey question 7.a	Verified
10. The LLMM follows a unidirectional and linear path of cumulative stages from lower- to higher maturity. The stage progression is logical.	Chapter 7 – Maturity scale	Confirmed by survey question 7.b	Verified
Central constructs related to the application domain			
11. The LLMM includes definitions of central constructs related to the application domain.	Chapter 7 – Definitions central constructs	Confirmed by survey question 8.a	Verified
Intersubjectively verifiably criteria for each maturity level and level of granularity			
12. The capability statements are mutually exclusive.	Chapter 7 – No contradiction in capability statements	Confirmed by survey question 9.a	Verified
13. The capability statements are collectively exhaustive	Chapter 6 & 7 – Capability statements theoretically exhaustive	Confirmed by survey question 9.a	Verified

9.3 Conclusion: Verification

This chapter confirmed that the LLMM adheres to all the predetermined design requirements. This was done through a retrospective review on the design intent and the Delphi technique. All conclusions obtained are summarised in Table 44. Based on this, it is concluded that all the design requirements were positively verified by either one or more of the methods followed and, therefore, the following research objective is addressed:

- **Research Objective 7:** “Verify whether the LLMM addresses all the design requirements.”

Through confirming this adherence, the following research question is answered:

- **Research Question 7.1:** “Does the LLMM address all the design requirements?”

The validity of the research problem, output and method remains unproven and will be addressed in the next chapter.

CHAPTER 10: VALIDATION

10.1 Introduction

Validation is a process used to judge whether a tool is fit for purpose (Nordin, et al., 2012) and if the research output can be used to make generalisations about the world outside the research context (Leedy & Ormrod, 2012). Based on these statements, this chapter confirms the validity of the research problem, research design and whether the research output addresses the research problem.

The section of the research design relevant to the final part of Phase 4 is indicated in the bottom-left of Figure 65:

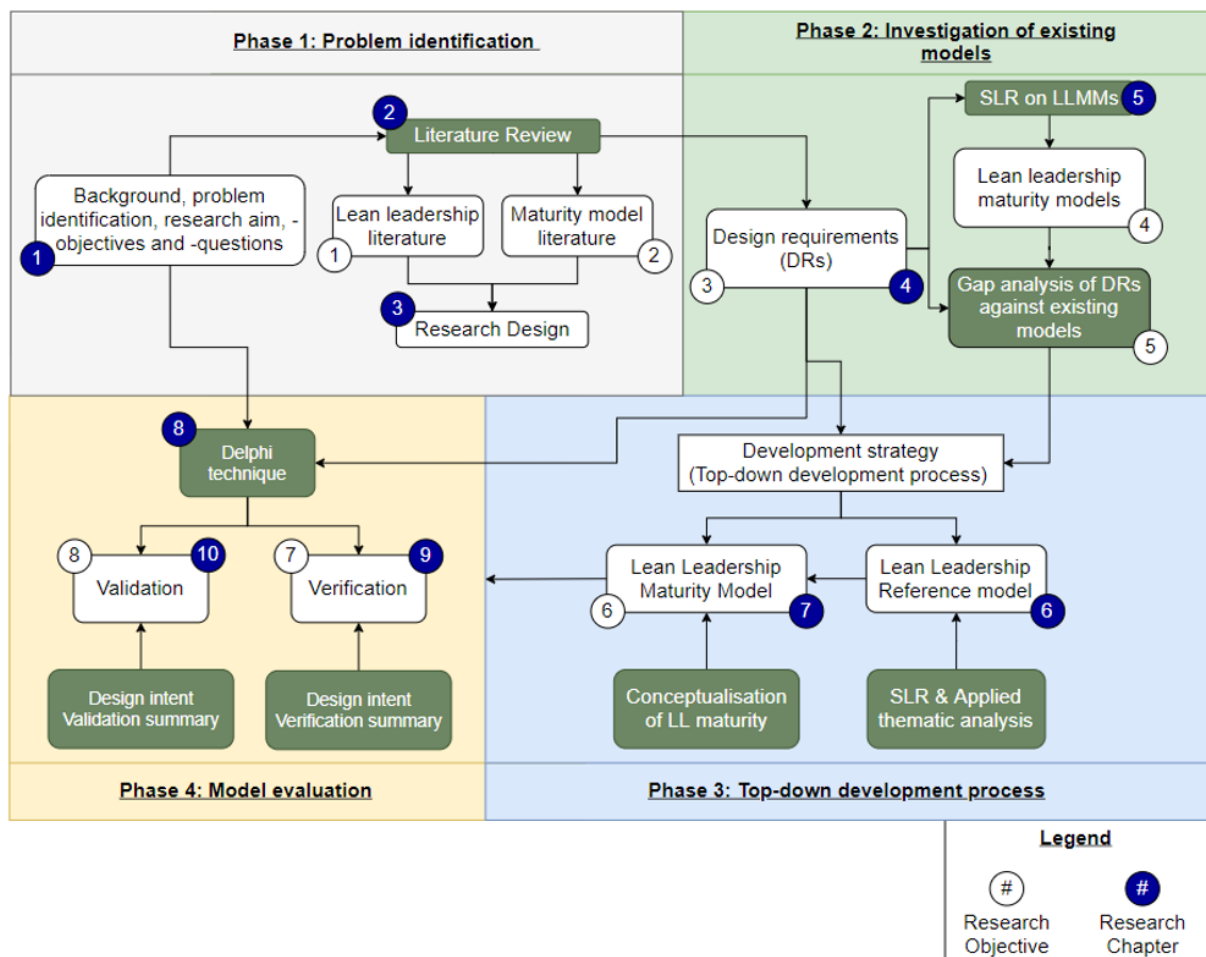


Figure 65: Section of the research design relevant to the final part of Phase 4

Furthermore, an overview of the research methods, -objectives and -questions applicable to the final part of Phase 4 is presented in Table 45:

Table 45: Overview of research methods, -objectives, and -questions applicable to the final part of Phase 4

Phase 4: Model evaluation	
Research Method	• Design intent • Delphi technique • Validation summary
Research Objectives	8. Validate the research problem, research design and output.
Research Questions	8.1 Is the research problem valid? 8.2 Is the research design that was followed valid? 8.3 Is the research problem addressed by the research output?

10.2 Validation Methodology

This chapter focuses on the rigour of the research process followed and the significance of the study contribution by means of the following methods:

- **Research problem:**
 - In Section 10.3.1, it is explained how the Delphi technique was used to validate the first aspect of the research problem:
“The success rate of a lean implementation is highly dependable on the leadership and, therefore, the lack of mature lean leadership creates a barrier to successful lean implementation”.
 - In Section 10.3.2, it is explained how both the SLR in Chapter 5 and the Delphi technique was used to validate the second aspect of the research problem;
“No artefact currently exists that is solely dedicated to describing or assessing lean leadership within an organisation”.
- **Research design** – Section 10.4 provides a retrospective view of the research process to determine the validity of the research design, which was evaluated against the DSR guidelines.
- **Research output** –Section 10.5 proves the validity of the research output based on the Delphi technique.
- **Validation summary** – Section 10.6 provides a summary of the validation requirements applicable to this study.

The results of each of these methods are summarised in a table as presented in Section 10.6.

10.3 Research problem validation

The research problem was stated in Chapter 1 as follows:

The success rate of lean implementation is highly dependable on the lean leadership capabilities of an organisation and, therefore, the lack of mature lean leadership creates a barrier to successful lean implementation.

An SLR of selected databases and their review protocol in Chapter 5 of this study did not produce any models that are dedicated to assessing the lean leadership maturity within an organisation. The purpose of this section is to provide proof that (a) a valid research problem has been selected for investigation, (b) the research design that was followed throughout this study is valid and (c) the research problem is addressed by the research output.

10.3.1 Delphi technique

The validity of the first part of the research problem was confirmed by means of specific questions in the Delphi questionnaire as discussed in Chapter 8. The results from the question related to the first part of the research problem are shown in Table 46. This question scored an average of 4.6, indicating that consensus was achieved on the validity of the research problem.

Table 46: Validation results of the first part of the research problem from the Delphi technique

Delphi questions	Results
1. This section relates to the research problem's validity	
a) Lack of lean leadership is a barrier to the success of lean implementation.	4.6

10.3.2 Systematic Literature Review (in conjunction with the Delphi technique)

Following an SLR of the selected databases presented in Chapter 5, no artefacts or models were identified that are dedicated to assessing the lean leadership maturity within an organisation, creating the need for a new artefact to be developed altogether. The validity of the second part of the research problem was also confirmed by the Delphi questionnaire, indicating consensus based on an average score of 3.5 from the survey, as shown in Table 47:

Table 47: Validation results of the second part of the research problem from the Delphi technique

Delphi questions	Results
1. This section relates to the research problem's validity	
b) To date, no artefact or model exists that is solely dedicated to describing or assessing lean leadership maturity within an organisation.	3.5

10.4 Research design validation

Next, the validity of the research design is proved. In other words, did the research process followed, contain enough controls to ensure that the research outputs are warranted by the research inputs (Van Dyk, 2013)? This was achieved by evaluating the maturity model

development approach used in this study against the guidelines for DSR as provided by Hevner, et al., (2004), all of which is outlined in Table 48:

Table 48: LLMM design process evaluated against the DSR Guidelines (Hevner, et al., 2004)

Design Science Research Guideline	Guideline Description (Hevner, et al., 2004)	Description in this Study	Chapter reference
Design as an Artefact	DSR must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.	A lean leadership maturity model was developed as a feasible artefact that can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders. The LLMM enables organisations to assess their current lean leadership maturity in order to determine the status quo and starting point of development.	Chapter 7 – The Lean Leadership Maturity Model
Problem Relevance	The objective of DSR is to develop solutions to important and relevant business problems.	The LLMM addresses a relevant business problem based on, a) the low success rate of lean implementation and, b) lack of models or artefacts that are dedicated to assessing lean leadership.	- Chapter 5 – Investigation of existing models - Chapter 7 - The Lean Leadership Maturity Model
Design Evaluation	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.	The developed artefact is empirically evaluated for rigour and relevance. The Delphi technique is utilised to verify and validate the applicability, effectiveness and usability of the LLMM	- Chapter 8 –Delphi process - Chapter 9 – Verification - Chapter 10 - Validation
Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.	The novel LLMM contributes to the world of science, technology and business through practical- and knowledge-based applications. Both the Delphi technique (Chapter 8) and the investigation of existing models (Chapter 5) proved that the model is a unique design and not based on any existing models or previous work. This also validated the design's novelty and artefact's contribution.	- Chapter 8 – Delphi process - Chapter 5 – Investigation of existing models

Research Rigour	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.	The construction, evaluation and design of the artefact are based on rigorously tested and proven methods popular in the field of maturity model development. First, a systematic literature review was followed to identify existing models. Second, another SLR in conjunction with an applied thematic analysis was utilised to develop a lean leadership reference model based on themes and subthemes pertaining to lean leadership. The model development is based on a popular top-down development approach – grounded in DSR. Finally, the Delphi technique was used during the model evaluation step.	• Chapter 5 – Investigation of existing models • Chapter 6 – Lean Leadership Reference Model • Chapter 7 – The Lean Leadership Maturity Model • Chapter 8 – Delphi process
Design as a Search Process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.	During the Investigation of existing model phase, an SLR was conducted to search for any existing artefacts dedicated to lean leadership. None could be identified. This created the need for a new, novel LLMM to be developed to address the research problem – as proven by the Delphi technique and validation chapter.	• Chapter 5 – Investigation of existing models • Chapter 7 – The Lean Leadership Maturity Model • Chapter 8 – Delphi process • Chapter 10 - Validation
Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented stakeholders.	The LLMM was communicated to a panel of experts through a video. Moreover, the research is communicated through this thesis.	• Chapter 7 – The Lean Leadership Maturity Model • Chapter 8 – Delphi process • Thesis document

10.5 Research output validation

Validation simply means to prove that something is correct. In other words, a process is followed where judgement is made on whether something does what it is intended to do (Nordin, et al., 2012).

The validity of the LLMM was established by means of specific questions in the Delphi questionnaire. These questions are also in line with the study aim presented in Chapter 1. The results from these questions are shown in Table 49. All three questions scored an average of ≥ 3.5 , indicating that consensus was achieved regarding the LLMM's novelty as well as addressing the research problem.

Table 49: Validation results of the research output from the Delphi technique

Delphi questions	Results
10. This section relates to the validity of the research output	
a) The LLMM can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders.	4.3
b) The LLMM can assess an organisation's current lean leadership maturity in order to determine the status quo and starting point of development.	4.3
c) The LLMM could contribute towards more sustainable lean implementation.	4.2
11. This section relates to the novelty of the LLMM	
a) The LLMM is unique and not based on any existing models	4.0

10.6 Validation summary

A summary of the research validity is presented in Table 50. The validity requirement is stated in the first column while columns 2 to 4 confirm the validity for each requirement through the respective method(s) utilised. Finally, column 5 indicates the conclusion that was obtained for each of the validation requirements.

Table 50: Summary of study validity

Validation Requirements	DSR Guidelines (Hevner et al (2004))	Delphi Technique	SLR (Chapter 5)	Conclusion
Research problem validity				
a) The research problem should be valid	N/A	Confirmed by question 1.a and 1.b	N/A	Validated
Research design validity				
a) The research design should be valid	Confirmed	N/A	N/A	Validated
Research output validity				
a) The research output (artefact) should address a valid research problem	N/A	Confirmed by question 10.a, 10.b & 10.c	N/A	Validated
b) The research output (artefact) should be unique	N/A	Confirmed by question 11.a	Confirmed	Validated

10.7 Conclusion: Validation

This chapter addressed the following research objective:

- **Research Objective 8:** “Validate the research problem, research design and output.”

This confirmation was attained by conducting a retrospective review of the research process to evaluate the research design against the guidelines for DSR and utilisation of the Delphi technique.

The research validity is confirmed based on the results summarised in Table 50 and, consequently, the following research questions were answered:

- **Research question 8.1:** “Is the research problem valid?”
- **Research question 8.2:** “Is the research design that was followed valid?”
- **Research question 8.3:** “Is the research problem addressed by the research output?”

The study conclusion will be discussed in the next chapter.

CHAPTER 11: CONCLUSION

11.1 Introduction

This chapter concludes the study by providing an overview of the research conducted and contributions that resulted therefrom. Limitations applicable to this study and recommendations for future research are also be presented.

11.2 Overview of research conducted

Lean is a well-established and reputable continuous improvement methodology. When implemented correctly, lean has been proven to enhance all aspects of business performance and could position a company to achieve significant growth. Many of lean's concepts, principles and techniques are also relatively easy to understand and usually not capital-intensive.

However, despite the appeal of this methodology, most organisations fail to sustain the implementation of lean due to (amongst other reasons) a lack of lean leadership. Furthermore, to date, from the SLR of selected databases and review protocol followed in Chapter 5, no artefact or model was identified that is solely dedicated to assessing the lean leadership maturity of an organisation.

In order to address this gap, this study set out to develop a lean leadership maturity model as a feasible artefact that can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders. Also, the purpose of the LLMM is for organisations to assess their current lean leadership maturity in order to determine the status quo and the starting point of development.

As part of Phase 1 of the study, the state of the art was presented through a literature review of lean leadership, maturity models and the research methods & paradigms relevant to the study. The design requirements for an LLMM were developed in the first part of Phase 2 (Chapter 4) as a central control mechanism to guide the rest of the study. The second part of Phase 2 (Chapter 5) utilised a systematic literature review to investigate whether a maturity model dedicated to the domain or similar domains of lean leadership currently exist and, if so, whether any of these models could satisfy all the design requirements. No maturity models could be identified through the SLR, its review protocol and selected databases, consequently confirming the need for a new lean leadership maturity model to be developed.

In the first part of Phase 3 (Chapter 6), a rigorous systematic literature review was conducted to develop the lean leadership reference model (LLRM) and establish a sound theoretical basis

for the final model development. Data extraction was done through an applied thematic analysis to determine the themes and subthemes pertaining to lean leadership as evidenced in the literature. All of this is predicated on the fact that maturity models have been criticised for their lack of solid theoretical foundations, where the structure (such as the dimensions, maturity levels etc.) is not grounded in the literature (Lasrado, et al., 2015).

The design requirements, along with the LLRM and theoretical foundation were used as an input to the Lean leadership maturity model development and presented in the second part of Phase 3 (Chapter 7).

The purpose of the 4th and final phase was to verify that all design requirements were met and that the research problem, method and output was valid. A questionnaire was prepared and an explanation of the model presented in the form of a video was sent to a panel of experts via email. Using the Delphi technique, consensus was achieved on all questions, verifying and validating the LLMM.

It is worth noting that the LLMM was developed over a three-year period from 2017 to 2020. In the latter part of 2019, Phase 2 was conducted to identify any feasible artefacts that might be able to address the design requirements for a LLMM. During this period, no feasible artefacts were identified through the SLR and review protocol. Out of curiosity, at the end of 2020, while concluding the research study, the same search strings used in 2019 were again entered into the respective Electronic Database Sources and, surprisingly, a higher number of initial search results were yielded as compared to the end of 2019. The abstracts of these additional studies added in 2020 were systematically analysed as per the research protocol for Phase 2. Yet, in light of these new findings, still, no feasible artefact could be identified from the literature.

11.3 Research contribution

With reference to Figure 66, this study's contribution primarily falls within the top-left, *improvement* quadrant, where a new solution is provided for a known problem in the field of Industrial Engineering. In DSR, this quadrant provides improved solutions through more effective and efficient processes, products, technologies, services or ideas. The problem environment was investigated to provide an innovative artefact as a solution to a crucial problem.

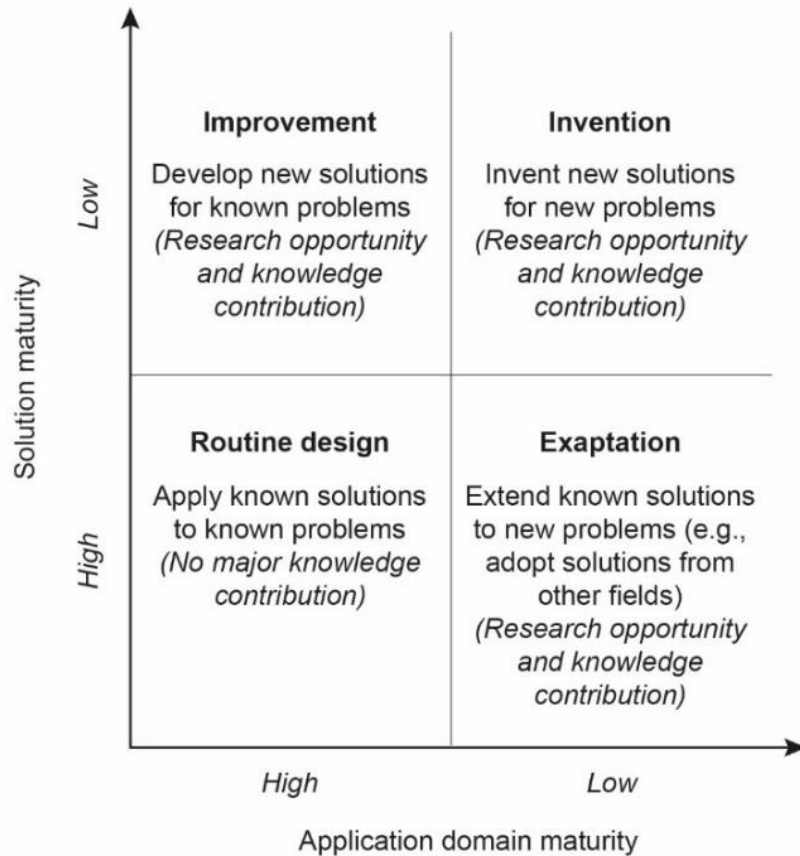


Figure 66: DSR knowledge contribution framework (Gregor & Hevner, 2013)

11.3.1 Contribution to the academic community

This study contributes to the literature and academic community by offering the following solutions:

- Design requirements for a lean leadership maturity model;
- A lean leadership reference model based on themes and subthemes pertaining to lean leadership;
- An innovative, novel, lean leadership maturity model.

11.3.2 Contribution to the industry

For organisations who have embarked, or are considering embarking on the lean journey, the LLMM provides the phases that leadership within an organisation should progress through while maturing as lean leaders. It could also help organisations to assess their current lean leadership maturity to determine the status quo and the starting point of development. The LLMM's targeted audience is those individuals within an organisation who would be applying the model, such as organisational leaders who are directly responsible for the implementation of lean or organisational-wide activities or processes, and those to whom assessment results

are reported to, such as auditors or consultants. The LLMM also functions as a diagnostic tool, enabling organisations to assess their current, “as-is” lean leadership maturity regardless of their size, location or industry. This assessment can be done either individually or as a team, the latter of which could enable a cross-functional and objective perspective of the assessment while also promoting team building and consensus among staff.

With the capability statements being collectively exhaustive, the LLMM provides a firm basis to educate key stakeholders within organisations on the topic of lean leadership. It was also intentionally developed to be followed naturally and intuitively so that it can be easily understood by most audiences.

11.4 Limitations and future research

This research produced an LLMM that consists of 4 lean leadership dimensions, 11 subdimensions, 43 capability areas and a total of 215 capability statements explaining the phases that lean leadership within an organisation should progress through while maturing as lean leaders. All these components are theoretically derived and were empirically verified and validated by a panel of experts on the domain. However, certain limitations apply to the LLMM developed in this study and should be prioritised for future research:

- To demonstrate its proof of concept, utility, quality and efficacy, the LLMM should ideally be applied to a sufficiently large sample group for an extended period, noting the applicability of the lean leadership capabilities about the entity under consideration, especially aspects such as the LSO (Lean Steering and Oversight) and PRA (Project Resource and Accountability) panels and if they can be applied to smaller organisational units. Other aspects such as the model’s applicability to the demographic area (such as country or culture) also need to be studied.
- The theoretical constructs related to maturity, maturation and the application domain were all restricted based on the availability and accessibility of literature and should be empirically evaluated and revised iteratively to maintain the model’s reliability, generalisability and growth.
- No specific emphasis was placed on the roles of different levels of leadership within an organisation, such as strategic, programmatic and tactical levels. This can be considered in future applications of the LLMM to improve its relevance and focus while progressing it from a 2D to a 3D model. Perhaps lean also requires a specific style of leadership, such as transactional and transformational, and could be added to future model development.
- Following a *descriptive* approach, the model was only developed as a diagnostic tool to assess the “as-is” lean leadership maturity of organisations. De Bruin, et al. (2005) states

that, following several applications and testing of a maturity model, it can be developed for *prescriptive* use. Once it has been applied repeatedly in various industries or regions and enough data has been obtained from sample groups, the LLMM can be developed into a *comparative* model. This will ultimately provide a benchmark of maturity across different industries or regions and enable the comparison of maturity of similar business units and organisations within multi-national companies.

- The LLMM does not include an assessment instrument or methodology. This could be developed to support future applications of the model and ensure a more accurate measurement of maturity.
- The SLR's review protocol only allows for the inclusion of peer-reviewed, scholarly publications. To expand the theoretical foundation of the LLMM, the inclusion/exclusion criteria applied in Section 5.2.2 and 6.2.2 could include grey literature as part of the search process. A more robust quality assessment protocol should be applied when grey literature is included since there is a high probability that these studies may not be of good quality.

11.5 Concluding remarks

Lean's roots in the automotive and manufacturing industry have grown over the years to offer increased business performance in almost every sector imaginable, ranging from financial services to healthcare to information technology. However, most attempts to implement lean end up in failure or a deterioration of its benefits over time. This could be attributed to the fact that most organisations, often under financial pressure, pursue the lean philosophy to achieve "quick wins", typically adopting the somewhat "easily grasped" and "capital-friendly" tools of lean but failing to recognise the management and cultural aspects that sustain them. As stated by Mann (2009), these tools of lean only represent about 20% of the implementation effort while the remaining 80% is required to change leadership's mindsets, practices and behaviours.

Although these tools are important mechanisms to enable improvement, even the right tool in the wrong hands might do more harm than good. Furthermore, at its core, lean is a culture and consists of a set of complex organisational attitudes, rather than the use of tools and demands continuous changes to both technical and socio-cultural dimensions within an organisation. (Mann, 2009; Wangwacharakul, et al., 2014; Walentynowicz, 2014; Urban, 2015). All of these factors produce expectations regarding leadership's capabilities to catalyse and sustain the changes demanded by the transformation (Aij & Teunissen, 2017; Tortorella, et al., 2017).

If organisational leaders can grasp this and realise that lean is not a once-off project or quick fix, perhaps lean will be adopted more often with better results. It is, however, also

understandable that the lean concept may have been construed over the years due to its many definitions and meanings, leaving organisations and their leaders confused and without a clear guideline on what principles and practices to adopt to sustain lean. This is the essence of the LLMM – to provide organisations not only with a means of assessing their current lean leadership maturity to determine the status quo and starting point of development but also with a practical guideline of the lean leadership capabilities required for lean implementation. The combination of these could contribute to a more successful and sustainable lean implementation.

To conclude: *“the biggest gap in capabilities in the lean movement, and the root cause of failure on many lean programs, is in leadership”* - Liker with Convis (2012, p.13).

REFERENCES

- 12 Abbas, W. & Asghar, I., 2010. *The role of leadership in organizational change*. s.l.:University of Gavle.
- Adams, R. J., Smart, P. & Huff, A. S., 2017. Shades of Grey: Guidelines for Working with the Grey Literature in Systematic Reviews for Management and Organizational Studies. *International Journal of Management Reviews*, Volume 19, pp. 432-454.
- Ahern, D., Clouse, A. & Turner, R., 2004. *CMMI distilled: a practical introduction to integrated process improvement*. Boston; London: Addison-Wesley.
- Aij, K. H. & Teunissen, M., 2017. Lean leadership attributes: a systematic review of the literature. *Journal of Health Organization and Management*, 31(7/8), pp. 713-729.
- Aij, K. H., Visse, M. & Widdershoven, G. A., 2015. Lean leadership : an ethnographic study. *Leadership in Health Services*, 28(2), pp. 119-134.
- Alefari, M., Salonitis, K. & Xu, Y., 2017. The Role of Leadership in Implementing Lean Manufacturing. *Procedia CIRP*, Volume 63, pp. 756-761.
- AL-Najem, M., Dhakal, H. N. & Bennett, N., 2012. The role of culture and leadership in lean transformation: a review and assessment model. *International Journal of Lean Thinking*, 3(1), pp. 119-138.
- Andersen, E. S. & Jessen, S. A., 2003. Project maturity in organisations. *International Journal of Project Management*, 21(6), pp. 457-461.
- Ashtiani, N. N., 2016. *Building a sustainable lean culture: a holistic lean leadership model*. Canada: Concordia University.
- Ashtiani, N. N., Bhulyan, N. & Zanjani, M. K., 2017. Lean Leadership Practices - A Literature Review. *Industrial Engineering and Management*, 6(3), pp. 1-10.
- Ashtiani, N. N., Bhulyan, N. & Zanjani, M. K., 2017. Lean Leadership Practices - A Literature Review. *Industrial Engineering and Management*, 6(3), pp. 1-10.
- Axelos, 2013. *ITIL® Maturity Model*. s.l.:AXELOS Limited.
- Azuan, S. & Ahmad, S., 2017. Culture and Lean Manufacturing: Towards a Holistic Framework. *Journal of Business and Management*, 7(1), pp. 334-338.

Băeșu, C. & Bejinaru, R., 2013. Leadership approaches regarding the organizational change. *The USV Annals of Economics and Public Administration*, 13(2), pp. 146-152.

Baisley, G., 2015. *The Bushido of Lean Leadership: The Correlation between the Principles of Lean Leadership and the Principles of Lean Management*, Cape Town, South Africa: University of Cape Town.

Becker, J., Knackstedt, R. & Pöppelbuß, J., 2009. Developing Maturity Models for IT Management - A Procedure Model and its Application. *Business & Information Systems Engineering No.*, Volume 3, pp. 213-222.

Bellefontaine, S. & Lee, C., 2013. Between black and white: examining grey literature in meta-analyses of psychological research. *Journal of Child and Family Studies*, Volume 23, pp. 1378-1388.

Benzies, K. M., Premji, S., Hayden, K. A. & Serrett, K., 2006. State-of-the-evidence reviews: advantages and challenges of including grey literature. *Worldviews on Evidence-Based Nursing*, Volume 3, pp. 55-61.

Bhasin, S., 2013. Impact of corporate culture on the adoption of the Lean principles. *International Journal of Lean Six Sigma*, 4(2), pp. 118-140.

Bird, A., 2002. What is in a Paradigm?. *Richmond Journal of Philosophy*, 1(2), pp. 11-20.

Blommerde, T. & Lynch, P., 2016. *A maturity matrix for assessing service innovation capability*, s.l.: Waterford Institute of Technology.

Bortolotti, T., Boscari, S. & Danese, P., 2015. Successful lean implementation: Organizational culture and soft lean practices. *International Journal of Production Economics*, Volume 160, pp. 182-201.

Braun, V. & Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), pp. 77-101.

Braun, V. & Clarke, V., 2019. *Answers to frequently asked questions about thematic analysis*. s.l.:s.n.

Camuffo, A. & Gerli, F., 2018. Modeling management behaviors in lean production environments. *International Journal of Operations and Production Management*, 38(2), pp. 403-423.

Caralli, R. A. et al., 2016. *CERT® Resilience Management Model, Version 1.2*. s.l.:Carnegie Mellon University.

Caralli, R., Knight, M. & Montgomery, A., 2012. *Maturity models 101: a primer for applying maturity models to smart grid security, resilience, and interoperability*, s.l.: Carnegie Mellon University.

Caralli, R., Knight, M. & Montgomery, A., 2012. *Maturity models 101: a primer for applying maturity models to smart grid security, resilience, and interoperability*, s.l.: Carnegie Mellon University.

Carnegie Mellon University Software Engineering Institute, 2014. *Electricity Subsector Cybersecurity Capability Maturity Model (ES-C2M2)*. s.l.:US Department of Energy (DOE).

Carnegie Mellon University Software Engineering Institute, 2017. *Defining a Progress Metric for CERT-RMM Improvement*. s.l.:US Department of Energy (DOE).

Carnegie Mellon University Software Engineering Institute, 2018. *Smart Grid Maturity Model*. s.l.:Carnegie Mellon University.

Coetzee, R., van der Merwe, K. & van Dyk, L., 2016. Lean implementation strategies: how are the Toyota Way principles addressed?. *South African Journal of Industrial Engineering*, 27(3), pp. 79-91.

Coetzee, R., van Dyk, L. & van der Merwe, R., 2018. Towards addressing respect for people during lean implementation. *International Journal of Lean Six Sigma*.

Conn, V. S., Valentine, J. C., Cooper, H. M. & Rantz, M. J., 2003. Grey literature in meta-analyses.. *Nursing Research*, Volume 52, pp. 256-261.

Cooke-Davies, T. J. & Arzymanow, A., 2003. The maturity of project management in different industries: An investigation into variations between project management models. *International Journal of Project Management* , 21(6), pp. 471-478.

Correia, E., Carvalho, H., Azevedo, S. G. & Govindan, K., 2017. Maturity models in supply chain sustainability: A systematic literature review. *Sustainability (Switzerland)*, 9(1), pp. 1-26.

Cresswell, J. & Plano Clark, V., 2007. *Designing and Conducting Mixed Methods Research*. Thousand Oaks, CA: Sage.

- Crosby, P. B., 1979. *Quality is free : The art of making quality certain*. New York: McGraw-Hill.
- Curtis, B., Hefley, B. & Miller, S., 2009. *People Capability Maturity Model (P-CMM) Version 2.0*, Pittsburgh: Software Engineering Institute.
- Dalkey, N. C. & Helmer, O., 1963. An experimental application of the Delphi method to the use of experts.. *Management Science*, 9(3), pp. 458-467.
- De Bruin, T., Freeze, R., Kulkarni, U. & Rosemann, M., 2005. *Understanding the Main Phases of Developing a Maturity Assessment Model*. Sydney, s.n.
- Dombrowski, U. & Mielke, T., 2013. *Lean Leadership fundamental principles and their application*. s.l., Elsevier B.V., pp. 569-574.
- Dombrowski, U. & Mielke, T., 2014. *Lean Leadership - 15 Rules for a sustainable Lean Implementation*. s.l., Elsevier B.V., pp. 565-570.
- Duque, D. F. & Cadavid, L. R., 2007. Lean manufacturing measurement: The relationship between lean activities and lean. *Estudios Gerenciales*, 23(105).
- Emiliani, B., Stec, D., Grasso, L. & Stoddler, J., 2003. *Better Thinking, Better Results: Using the Power of Lean as a Total Business Solution*. s.l.:Center for Lean Business Management.
- Emiliani, B., Stec, D. J. & Grasso, L., 2007. *Better Thinking Better Results: Case Study and Analyze of an Enterprise-Wide Lean Transformation*. LLC Wethersfield: Center for Lean Business Management.
- Erasso, A. & Linnenkamp, M., 2011. *Sales operations maturity - Why does it matter?*, s.l.: Sales Economics Inc..
- Forstner, E., Kamprath, N. & Röglinger, M., 2013. Capability development with process maturity models - Decision framework and economic analysis. *Journal of Decision Systems*, 23(2), pp. 127-150.
- Fraser, P., Moultrie, J. & Gregory, M., 2002. *The use of maturity models / grids as a tool in assessing product development capability: a review*. Cambridge UK, IEEE International Engineering Mangement Conference.

- Fryer, K. J., Antony, J. & Douglas, A., 2007. Critical success factors of continuous improvement in the public sector: a literature review and some key findings. *The TQM Magazine*, 19(5), pp. 497-517.
- Gregor, S. & Hevner, A., 2013. Positioning and Presenting Design Science Research for Maximum Impact. *MIS Quarterly*, 37(2), pp. 337-355.
- Gregory, S. A., 1966. *The Design Method*. 1st ed. NY: Springer Science+Business Media, LLC.
- Guest, G., MacQueen, K. M. & Namey, E. E., 2012. *Introduction to Thematic Analysis. Applied Thematic Analysis*. Thousand Oaks: Sage Publications, Inc.
- Guest, G., MacQueen, K. & Namey, E. E., 2012. Introduction to Applied Thematic Analysis. In: *Applied Thematic Analysis*. Thousand Oaks, CA: Sage Publications, pp. 3-20.
- Håkansson, M., Holden, R., Eriksson, A. & Dellve, L., 2017. Managerial practices that support lean and socially sustainable working conditions. *Nordic Journal of Working Life Studies*, 7(3), pp. 63-84.
- Hallam, C. R., 2003. *Lean enterprise self-assessment as a leading indicator for accelerating transformation in the aerospace industry*, Cambridge, MA: Massachusetts Institute of Technology.
- Hansmann, T., 2017. *Empirical Development and Evaluation of a Maturity Model for Big Data Applications*, s.l.: Leuphana Universität Lüneburg.
- Heifetz, R. A. & Laurie, D. L., 1997. The work of leadership. *Harvard business review*, pp. 124-134.
- Helfert, M., Donnellan, B. & Ostrowski, L., 2012. The case for design science utility and quality - Evaluation of design science artifact within the sustainable ICT capability maturity framework. *An International Journal on Information Technology, Action, Communication and Workpractices*, 6(1), pp. 46-66.
- Herzog, C., Handke, C. & Hitters, E., 2019. Analyzing Talk and Text II: Thematic Analysis. In: *The Palgrave Handbook of Methods for Media Policy Research*. Basingstoke: Palgrave Macmillan.
- Hevner, A., March, S., Park, J. & Ram, S., 2004. Design Science in Information Systems Research. *MIS Quarterly*, 28(1), pp. 75-105.

Hevner, A. R., 2007. A Three Cycle View of Design Science Research. *Scandinavian Journal of Information Systems*, 19(2), pp. 87-92.

Hines, P., Holweg, M. & Rich, N., 2004. Learning to evolve: a review of contemporary Lean thinking. *International Journal of Operations and Production Management*, 10(24), pp. 994-1011.

Holm, M., 2010. Leadership for Lean Operations. *Frontiers in Leadership Research*.

Houmanfar, R. A. & Mattaini, M., 2015. Leadership and Cultural Change. *Journal of Organizational Behavior Management*, 35(1), pp. 1-3.

House, R. J. et al., 2004. *Culture, Leadership and Organizations: The GLOBE Study of 62 Societies*. s.l.:Sage Publications.

Hsu, C. & Sandford, B. A., 2007. The Delphi Technique: Making Sense Of Consensus. *Practical Assessment, Research & Evaluation*, 12(10).

Hunt, W. A., 1941. Recent developments in the field of emotion. *Psychological Bulletin*, 38(5), pp. 249-276.

Inglis, A., 2008. Approaches to the Validation of Quality Frameworks. *Quality Assurance in Education*, 16(4), pp. 347-362.

International Labour Organization, 2017. *Lean Manufacturing Techniques For Textile Industry*. s.l.:s.n.

Jenkins, A., Karjian, R. & Niederkorn, M., 2011. Scaling lean management across the enterprise. *Lean Management: New frontiers for financial institutions*, pp. 6-7.

Joe, M., Nightingale, D., Taneja, A. & Tonaszuck, D., 2000. *Transitioning to a Lean Enterprise: A Guide for Leaders, Volume I, Executive Overview*, Massachusetts MA: MIT.

Johannesson, P. & Perjons, E., 2014. *An introduction to design science*. s.l.:Springer International Publishing.

Kaliprasad, M., 2006. The human factor II: Creating a high performance culture in an organization. *Cost Engineering*, 48(6), pp. 27-34.

Kitchenham, B. & Charters, S., 2007. Guidelines for performing Systematic Literature Reviews in Software Engineering. Volume 2, p. 1051.

Kumar, R. & Kumar, V., 2014. Barriers in Implementation of Lean Manufacturing System in Indian industry: A survey. *International Journal of Latest Trends in Engineering and Technology (IJLTET)*, 4(2), pp. 243-251.

Kundu, G. & Manohar, B. M., 2012. Critical success factors for implementing lean practices in IT support services. *International Journal for Quality Research*, 6(4), pp. 301-312.

Kuznets, S., 1965. *Economic Growth and Structure*. London, UK: Heinemann Educational Books.

Lander, E. & Liker, J. K., 2007. The Toyota Production System and art: Making highly customized and creative products the Toyota way. *International Journal of Production Research*, 45(16), pp. 3681-3689.

Lasrado, L. A., Vatrappu, R. & Andersen, K. N., 2015. Maturity Models Development in IS Research: A Literature Review. *Association for Information Systems AIS Electronic Library (AISeL)*, Issue 6, pp. 1-12.

Lasrado, L. A., Vatrappu, R. & Andersen, K. N., 2015. Maturity Models Development in IS Research: A Literature Review. *Proceedings of the 38th Information Systems Research Seminar in Scandinavia (IRIS 38)*, 6(August 9-12), pp. 1-12.

Laureani, A. & Antony, J., 2012. Critical success factors for the effective implementation of Lean Sigma: Results from an empirical study and agenda for future research. *International Journal of Lean Six Sigma*, 3(4), pp. 274-283.

Leedy, P. D. & Ormrod, J. E., 2012. *Practical research: Planning and design*. 10th ed. Upper Saddle River: Pearson Education.

Leite, H., Bateman, N. & Radnor, Z., 2016. *Lean implementation and sustainability: a classification model of the main organizational barriers and enablers*. Orlando, FL, USA, s.n.

Leyer, M. & Moorman, J., 2014. How lean are Financial Companies really? Empirical evidence from a large scale study in Germany. *International Journal of Operations and Production Management*, 34(11), pp. 1366-1388.

Liberati, A. et al., 2009. The PRISMA statement for reporting systematic reviews and metaanalyses of studies that evaluate health care interventions: Explanation and elaboration.. *Journal of Clinical Epidemiology*, 62(10), pp. 1-34.

Liker, J. K. & Convis, G. L., 2012. *The Toyota way to lean leadership*. NY: McGraw-Hill.

Maier, A. M., Clarkson, P. K. & Clarkson, P. J., 2012. Assessing organizational capabilities: Reviewing and guiding the development of maturity grids. *IEEE Transactions on Engineering Management*, 59(1), pp. 138-159.

Maier, A. M., Moultrie, J. & Clarkson, P. J., 2012. Assessing organizational capabilities: Reviewing and guiding the development of maturity grids. *IEEE Transactions on Engineering Management*, 59(1), pp. 138-159.

Maijala, R., Eloranta, S., Reunanen, T. & Ikonen, T. S., 2018. Successful Implementation of Lean As A Managerial Principle in Health Care: A Conceptual Analysis from Systematic Literature Review. *International Journal of Technology Assessment in Health Care*, 34(2), pp. 134-146.

Mann, D., 2005. *Creating a Lean Culture: Tools to Sustain Lean Conversions*. New York, NY: Productivity Press.

Mann, D., 2009. The Missing Link: Lean Leadership. *Frontiers of Health Services Management*, 26(1), pp. 15-26.

March, S. T. & Smith, G. F., 1995. Design and natural science research on information technology. *Decision Support Systems*, Volume 15, pp. 251-266.

Maslow, A., 1954. *Motivation and personality*. New York: Harper.

McCormack, K. et al., 2009. A global investigation of key turning points in business process maturity. *Business Process Management Journal*, 15(5), pp. 792-815.

Mehravari, N., 2013. *Everything You Always Wanted to Know About Maturity Models*. s.l.:Carnegie Mellon University .

Mettler, T., 2011. Maturity Assessment Models: A Design Science Research Approach. *International Journal of Society Systems Science*, 3(1-2), pp. 81-98.

Mettler, T. & Rohner, P., 2009. *Situational Maturity Models as Instrumental Artifacts for Organizational Design*. s.l.:DESRIST.

Mettler, T., Rohner, P. & Winter, R., 2010. *Management of the Interconnected World*. s.l.:Springer-Verlag Berlin Heidelberg.

Mokgoantle, O. J., 2012. *Risk maturity at a life insurer*, Johannesburg, South Africa: University of Johannesburg.

- Moyersoen, S., 2017. *The development of a lean maturity model in the context of nurse problem-solving*, s.l.: Universiteit Gent.
- Neff, A. et al., 2014. Developing a maturity model for service systems in heavy equipment manufacturing enterprises. *Information and Management*, 51(7), pp. 895-911.
- Nesensohn, C., 2014. *An innovative framework for assessing lean construction maturity*, s.l.: Liverpool John Moores University.
- Netland, T. H., 2016. Critical Success Factors for Implementing Lean Production: The Effect of Contingencies. *International Journal Production Research*, 54(8), pp. 2433-2448.
- Netland, T. H., Powell, D. J. & Hines, P., 2019. Demystifying lean leadership. *International Journal of Lean Six Sigma*.
- Nguyen, A., Gardner, L. & Sheridan, D., 2019. Towards Ontology-Based Design Science Research for Knowledge Accumulation and Evolution. *Proceedings of the 52nd Hawaii International Conference on System Sciences*, January, pp. 5755-5764.
- Nolan, R. L., 1973. Managing the computer resource: a stage hypothesis. *Communications of the ACM*, 16(7), pp. 399-405.
- Nolan, R. L., 1979. Managing the crisis in data processing. *Harvard Business Review*, 57(2), pp. 115-126.
- Nordin, N., Deros, B. M., Wahab, D. A. & Rahman, M. Z., 2012. Validation of Lean Manufacturing Implementation Framework Using. *Jurnal Teknologi*, Volume 59, pp. 1-6.
- Northouse, P. G., 2012. *Leadership: Theory and Practice*. Thousand Oaks, CA: Sage Publications.
- Oliveira, J., Sa, J. C. & Fernandes, A., 2017. *Continuous improvement through "Lean Tools": An application in a mechanical company*. Vigo (Pontevedra), Elsevier B.V..
- Pearce, A. & Pons, D., 2013. Implementing Lean Practices: Managing the Transformation Risks. *Journal of Industrial Engineering*, pp. 1-19.
- Poksinska, B., Swartling, D. & Drotz, E., 2013. The daily work of leaders: lessons from manufacturing and healthcare. *Total Quality Management*, 24(8), pp. 886-898.

Pöppelbuß, J. & Röglinger, M., 2011. *What makes a useful maturity model? A framework of general design principles for maturity models and its demonstration in Business Process Management*. s.l., AIS Electronic Library.

Poppendieck, M. & Poppendieck, T., 2003. *Lean Software Development: An Agile Toolkit*. 1st ed. Crawfordsville, Indiana: Upper Saddle River, NJ 07458.

Rathil, R. & Singh, S., 2018. A Lean Six Sigma framework to enhance the competitiveness in selected automotive component manufacturing organisations. *South African Journal of Economic and Management Sciences*, 21(1).

Richardson, G. L., 2010. *Project management theory and practice*. Boston: Auerbach: CRC Press.

Röglinger, M., Pöppelbuß, J. & Becker, J., 2012. Maturity Models in Business Process Management. *Business Process Management Journal*, 18(2), pp. 1-19.

Rosemann, M., 2003. Application Reference Models and Building Blocks for Management and Control. In: *Handbook on Enterprise Architecture*. s.l.:Springer, Berlin, Heidelberg, pp. 595-615.

Rother, M., 2010. *Toyota kata: Managing people for improvement, adaptiveness and superior results*. New York, NY: McGraw-Hill.

Roy, S., 2016. *Process Excellence Network*. [Online]
Available at: <https://www.processexcellencenetwork.com/lean-six-sigma-business-performance/articles/hansei-continuously-engaging-people-in-improvement>
[Accessed 13 04 2020].

Samuel, D., Found, P. & Williams, S. J., 2015. How Did the Publication Of the Book the Machine That Changed the World Change Management Thinking?. *International Journal of Operations and Production Management*, 35(10), pp. 1386-1407.

Schlichter, J., 1999. Surveying project management capabilities. *PM NETWORK*, 13(1), pp. 39-40.

Schlichter, J., McEver, J. & Hayes, R. E., 2010. *Maturity frameworks for enterprise agility in the 21st century*. s.l.:PA: Project Management Institute..

Schutte, C. & Van Dyk, L., 2013. *The Telemedicine Service Maturity Model: A Framework for the Measurement and Improvement of Telemedicine Services*. s.l.:s.n.

- Schwagerman, W. S. & Ulmer, J. M., 2013. The A3 Lean Management and Leadership Thought Process. *The Journal of Technology, Management, and Applied Engineering*, 29(4), pp. 2-10.
- Seddon, J. & Caulkin, S., 2007. Systems thinking, lean production and action learning. *Action Learning: Research and Practice*, 4(1), pp. 9-24.
- Seidel, A., Saurin, T., Marodin, G. & Ribeiro, J., 2017. Lean leadership competencies: a multi-method study. *Management Decision*, 55(10), pp. 2163-2180.
- Seidel, A., Saurin, T., Tortorella, G. & Marodin, G., 2019. How can general leadership theories help to expand the knowledge of lean leadership?. *Production Planning and Control*, 30(16), pp. 1322-1336.
- Sethuraman, K. & Suresh, J., 2014. Effective Leadership Styles. *International Business Research*, 7(9), pp. 165-172.
- Sisson, J. & Elshennawy, A., 2015. Achieving success with Lean: An analysis of key factors in Lean transformation at Toyota and beyond. *International Journal of Lean Six Sigma*, 6(3), pp. 263-280.
- Skulmoski, G. J., Hartman, F. T. & Krahn, J., 2007. The Delphi Method for Graduate Research. *Journal of information technology education*, Volume 6.
- Solli-Sæther, H. & Gottschalk, P., 2010. The Modeling Process for Stage Models. *Journal of Organizational Computing and Electronic Commerce*, 20(3), pp. 279-293.
- Stone, K. B., 2012. Four decades of lean: a systematic literature review. *International Journal of Lean Six Sigma*, 17(4), pp. 460-471.
- Sundareshan, S. D., Swamy, T. S. & Swamy, D. R., 2015. A Literature Review on Lean Implementations – A comprehensive summary. *Journal of Engineering Research and Applications*, 5(11), pp. 73-81.
- Sun, M., Vidalakis, C. & Oza, T., 2009. *Sun, M., Vidalakis, C. and Oza, T. (2009). A change management maturity model for construction projects*. UK, s.n., pp. 803-812.
- The Shingo Prize, 2013. *SCOPE: Shingo cultural online performance evaluation*.. Utah, USA: Jon M. Huntsman School of Business.

- Toledo, J. S., Gonzalez, R. V., Lizarelli, F. L. & Pelegrino, R. A., 2018. Lean production system development through leadership practices. *Management Decision*, 57(5), pp. 1184-1203.
- Tortorella, G., Fettermann, D., Anzanello, M. & Sawhney, R., 2017. Lean manufacturing implementation, context and behaviors of multi-level leadership. *Journal of Manufacturing Technology Management*, 28(7), pp. 867-891.
- Tortorella, G. & Fogliatto, F., 2017. Implementation of lean manufacturing and situational leadership styles: An empirical study. *Leadership and Organization Development Journal*, 38(7), pp. 946-968.
- Tortorella, G., van Dun, D. H. & de Almeida, A. G., 2019. Leadership behaviors during lean healthcare implementation: a review and longitudinal study. *Journal of Manufacturing Technology Management*, 31(1), pp. 193-215.
- Urban, W., 2015. *The Lean Management Maturity Self-assessment Tool Based on Organizational Culture Diagnosis*. s.l., Elsevier Ltd., pp. 728-733.
- Vaishnavi, V. & Kuechler, W., 2004. *Design Science Research in Information Systems*, s.l.: s.n.
- Van de Ven, A. H., 2007. *Engaged Scholarship: A Guide for Organizational and Social Research*. 1st ed. s.l.:Oxford University Press.
- van Dun, D. H., Hicks, J. N. & Wilderom, C. P., 2017. Values and behaviors of effective lean managers: Mixed-methods exploratory research. *European Management Journal*, 35(2), pp. 174-186.
- van Dyk, L., 2013. *The Development of a Telemedicine Service Maturity Model*, Stellenbosch, SA: Stellenbosch University.
- van Steenberg, M. et al., 2010. *The Design of Focus Area Maturity Models*. s.l., s.n.
- Vänje, A. & Brännmark, M., 2017. Walking around the pyramids: Managers' shop-floor activities in Lean-inspired organizations. *Economic and Industrial Democracy*, 38(3), pp. 495-512.
- von Wangenheim, C. G., Hauck, J. C., Zoucas, A. & Salviano, C. F., 2010. Creating Software Process Capability/Maturity Models. *IEEE Software*, 27(4), pp. 92-94.

Wahlgren, G., 2020. *A Maturity Model for Measuring Organizations Escalation Capability of IT-related Security Incidents*, s.l.: Stockholm University, Sweden.

Wajdi, M. B., 2017. The differences between management and leadership. *Singeri*, pp. 75-84.

Walentynowicz, P., 2014. Lean organizational culture as an example of a positive organizational culture. Proposal of a tool for measuring it. *Journal of Positive Management*, 5(1), pp. 1-12.

Wangwacharakul, P., Berglund, M., Harlin, U. & Gullander, P., 2014. Cultural Aspects when Implementing Lean Production and Lean Product Development: Experiences from a Swedish Perspective. *Quality Innovation Prosperity*, 18(1), pp. 125-140.

Wechsler, D., 1950. Intellectual Development and Psychological Maturity. *Child Development*, 21(1), pp. 45-50.

Wendler, R., 2012. The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, 54(12), pp. 1317-1339.

Wilson, F., 2013. *The quality maturity model: assessing organisational quality culture in academic libraries*, s.l.: School of Information Systems, Computing and Mathematics: Brunel University.

Wißotzki, M. & Koç, H., 2013. A project driven approach for enhanced maturity model development for EAM capability evaluation. *Proceedings - IEEE International Enterprise Distributed Object Computing Workshop, EDOC*, November, pp. 296-304.

Womack, J. P. & Jones, D. T., 1996. *Lean Thinking*. 2nd ed. New York, NY: Simon & Schuster.

Womack, J. P., Jones, D. T. & Roos, D., 1990. The Machine that Changed the World. In: New York: Simon & Schuster, p. 13.

Xiao, Y. & Watson, M., 2019. Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, 39(1), pp. 93-112.

Zaleznik, A., 2004. Managers and leaders: Are they different?. *Harvard Business Review*, p. 1.

APPENDIX A – DELPHI QUESTIONNAIRE

Lean Leadership Maturity Model

This questionnaire forms part of the research dissertation; Development of a Lean Leadership Maturity Model. (Ethics Number: NWU-00263-19-A1)

The purpose of this questionnaire is to determine the validity of the above research.

Please note that all personal information submitted will be treated with strict confidentiality.

Thank you in advance for taking the time to complete this questionnaire.

*** Required**

1. Email address *

2. Name and surname *

3. How many years of experience do you have in a lean environment? *

Mark only one oval.

☐ 0-5

☐ 6-10

☐ 11-15

☐ 16-20

☐ 20+

1. This section relates to the RESEARCH PROBLEM's VALIDITY

4. Please answer all of the following questions: *

Check all that apply.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Lack of lean leadership is a barrier to the success of lean implementation	☐	☐	☐	☐	☐
To date, no artefact or model exists that is solely dedicated to describe or assess lean leadership maturity within an organisation	☐	☐	☐	☐	☐

5. Additional Comments (Optional)

2. This section relates to the PROSPECTIVE APPLICATION DOMAIN and CONDITIONS FOR APPLICATION of the LLMM

6. Please answer all of the following questions: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The LLMM describes lean leadership	☐	☐	☐	☐	☐
The model can be applied to an organisation regardless of their lean implementation phase	☐	☐	☐	☐	☐

7. Additional Comments (Optional)

3. This section relates to the PURPOSE of use of the LLMM

8. Please answer all of the following questions: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The LLMM enables the assessment of lean leadership within an organisation	☐	☐	☐	☐	☐
The LLMM can be used to educate stakeholders about lean leadership	☐	☐	☐	☐	☐

9. Additional Comments (Optional)

4. This section relates to the TARGET GROUP of the LLMM

10. Please answer the following question: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Role players from different functional areas and levels can use the LLMM to assess lean leadership maturity, either as a team or individually	☐	☐	☐	☐	☐

11. Additional Comments (Optional)

5. This section relates to the CLASS OF ENTITIES considered for the LLMM

12. Please answer the following question: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Lean leadership of multiple organizational units can be measured by the LLMM. It is not restricted by the size or location of the applicable organisation.	☐	☐	☐	☐	☐

13. Additional Comments (Optional)

6. This section relates to the LLMM's DESIGN

14. Please answer the following question: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The LLMM design is easily understood and can be followed naturally	☐	☐	☐	☐	☐

15. Additional Comments (Optional)

7. This section relates to the CENTRAL CONSTRUCTS related to
MATURITY and MATURATION of the LLMM

16. Please answer all of the following questions: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The maturity model consists of multiple lean leadership dimensions	☐	☐	☐	☐	☐
The capability statements and maturity levels accumulate progressively from lower- to higher levels	☐	☐	☐	☐	☐

17. Additional Comments (Optional)

8. This section relates to the CENTRAL CONSTRUCTS of the LLMM's APPLICATION DOMAIN

18. Please answer the following question: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
All structural components of the LLMM are clearly defined	☐	☐	☐	☐	☐

19. Additional Comments (Optional)

9. This section relates to INTERSUBJECTIVELY VERIFIABLE CRITERIA for each MATURITY LEVEL and LEVEL of GRANULARITY of the LLMM

20. Please answer all of the following questions: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
No combination of the capability statements contradicts each other	☐	☐	☐	☐	☐
The LLMM considers all matters that could have an impact on the success of lean leadership	☐	☐	☐	☐	☐

21. Additional Comments (Optional)

10. This section relates to the VALIDITY of the RESEARCH OUTPUT

22. Please answer all of the following questions: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The LLMM can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders	☐	☐	☐	☐	☐
The LLMM can assess an organisation's current lean leadership maturity in order to determine the status quo and starting point of development	☐	☐	☐	☐	☐
The LLMM could contribute towards more sustainable lean implementation	☐	☐	☐	☐	☐

23. Additional Comments (Optional)

11. This section relates to the EXCLUSIVITY of the LLMM

24. Please answer the following question: *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
To the best of your knowledge, the LLMM is unique and not based on any existing models	☐	☐	☐	☐	☐

25. Additional Comments (Optional)

12.
Conclusion

Thank you again for taking the time to complete this questionnaire.
Your input is greatly appreciated!

26. Would you be available for follow-up questions related to the questionnaire? *

Check all that apply.

- ☐ Yes - via telephone
☐ Yes - via email
☐ No

27. If "yes - via telephone", please provide contact number

28. Would you like to receive a copy of the final dissertation (via email)? *

Mark only one oval.

- ☐ Yes
☐ No

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APPENDIX B – EXPERT PANEL’S FEEDBACK (QUANTITATIVE)

Questions			Responses per participant													Question average	Section average
			A	B	C	D	E	F	G	H	I	J	K	L	M		
1. Research problem validity	a	Lack of lean leadership is a barrier to the success of lean implementation	4	5	4	5	5	5	4	5	4	5	5	4	5	4.6	4.0
	b	To date, no artefact or model exists that is solely dedicated to describing or assess lean leadership maturity within an organisation.	5	4	3	4	3	3	2	3	4	2	4	3	5	3.5	
2. Application domain and conditions for application	a	The LLMM describes lean leadership	5	5	4	5	4	3	4	4	4	4	4	4	5	4.2	4.2
	b	The model can be applied to an organisation regardless of their lean implementation phase	5	5	4	5	4	4	3	4	3	4	4	4	5	4.2	
3. Purpose of use	a	The LLMM enables the assessment of lean leadership within an organisation	5	5	4	4	5	4	4	5	5	4	5	4	5	4.5	4.4
	b	The LLMM can be used to educate stakeholders about lean leadership	5	4	4	5	4	4	4	4	4	4	5	4	5	4.3	
4. Target group	a	Role players from different functional areas and levels can use the LLMM to assess lean leadership maturity, either as a team or individually	4	3	4	5	4	5	4	4	4	4	5	4	5	4.2	4.2
5. Class of entities considered	a	Lean leadership of multiple organisational units can be measured by the LLMM. It is not restricted by the size or location of the applicable organisation.	4	3	4	5	4	5	4	5	3	3	4	4	5	4.1	4.1
6. LLMM design	a	The LLMM design is easily understood and can be followed naturally	4	5	5	5	4	3	2	3	5	2	4	4	4	3.8	3.8
7. Central constructs related to maturity and maturation	a	The maturity model consists of multiple lean leadership dimensions	4	5	4	4	4	3	4	4	4	4	5	4	5	4.2	4.2
	b	The capability statements and maturity levels accumulate progressively from lower- to higher levels	4	4	4	5	5	2	4	5	5	4	5	4	5	4.3	
8. Central constructs related to the application domain	a	All structural components of the LLMM are clearly defined	5	5	4	5	4	2	4	4	4	2	5	4	5	4.1	4.1
9. Intersubjectively verifiably criteria for each maturity level and level of granularity	a	No combination of the capability statements contradicts each other	5	5	4	5	4	3	3	4	4	3	4	4	5	4.1	4.0
	b	The LLMM considers all matters that could have an impact on the success of lean leadership	5	4	4	5	4	3	1	4	4	3	4	4	5	3.8	
10. Research output validity	a	The LLMM can be used to guide the leadership within an organisation through the different phases of maturing as lean leaders	5	4	4	4	4	4	3	5	5	4	5	4	5	4.3	4.3
	b	The LLMM can assess an organisation's current lean leadership maturity in order to determine the status quo and starting point of development	5	4	4	5	4	4	3	4	5	4	5	4	5	4.3	
	c	The LLMM could contribute towards more sustainable lean implementation.	4	4	4	5	4	5	3	4	4	4	5	4	5	4.2	
11. Differentiation from existing models	a	The LLMM is unique and not based on any existing models	5	5	3	4	4	4	3	4	4	2	5	4	5	4.0	4.0

Figure 67: Quantitative feedback from the Delphi technique

APPENDIX C – EXPERT PANEL’S FEEDBACK (QUALITATIVE)

Participant	1. Research problem validity
B	Without having done a comprehensive survey of Lean leadership I cannot answer the second question comprehensively, but I have not come across a model to this effect so I am inclined to agree that one might not exist.
G	I am aware of the 3 A approach
H	Some models are available, though they are not specific.
I	There is no prove that researcher investigated second statement
J	See Mary and Tom Poppendieck's model and LeanIT
K	I believe leadership is important to ensure the success of lean implementation, but even more crucial when trying to sustain lean in an organisation.
	2. Application domain and conditions for application
F	The model is well structured with detailed descriptions. This may allow any organisation to utilise the model regardless of their lean implementation phase
I	If you do not understand lean concept - answers could be biased
	3. Purpose of use
F	The structured manner of the model allows for easy understanding
	4. Target group
B	I'm unsure if in this question, the concept of different functional areas implies different functions within an organization, other than manufacturing. If so, concepts related the Gemba for instance, may not be applicable to these other areas, hence not all of the LLMM ratings would apply. If the model is purely talking about direct manufacturing operations however, then I would strongly agree to this question.
	5. Class of entities considered
B	In terms of smaller organizational units, there may be insufficient resources available to prioritize having structures such as LSO's and PRA panels, and as such, it may be off-putting to smaller units.
G	Does the LLMM consider the culture of the country or area? Is it neutral or does this influence the results?
K	I believe the use of quantity descriptors such as some, many and most to establish the level of maturity can become complex. Perhaps a percentage of stakeholders, teams or employees within a division/company can assist.
	6. LLMM design
I	Any model that complex cannot be easily understood
J	Appears complicated
	7. Central constructs related to maturity and maturation
B	Potential to improve the wording of each point to remove ambiguity exists.
	8. Central constructs related to the application domain
	9. Intersubjectively verifiably criteria for each maturity level and level of granularity
B	I feel like the teaching and learning of lean concepts as part of creating and the culture could also be assessed, as it is fundamental in creating and sustaining the lean culture.
	10. Research output validity
	11. Differentiation from existing models

Figure 68: Qualitative feedback from the Delphi technique

APPENDIX D – ETHICS CLEARANCE

8/28/2019

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the North-West University Engineering Research Ethics Committee (NWU-ENG-REC) on 23-Aug-19, the NWU-ENG-REC hereby approves your study as indicated below. This implies that the NWU-ENG-REC grants its permission that, provided the general and specific conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Development of a Conceptual Lean Leadership Maturity Model	
Principal Investigator/Study Supervisor/Researcher: R Coetzee	
Student: Andries Johannes Huyser (huyser.andre@yahoo.com)	
Ethics number:	NWU-00263-19-A1
Institution-Study Number-Year-Status	
<u>Status:</u> S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation	
Application Type: Single	Risk: Low
Approval date: 23-Aug-19	
Expiry date: 8/23/2020	
Approval of the study is provided for a year, after which continuation of the study is dependent on receipt and review of annual monitoring report and the concomitant issuing of a letter of continuation.	

General conditions:
<i>While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:</i>
• The principal investigator/study supervisor/researcher must report in the prescribed format to the NWU-ENG-REC: - Annually on the monitoring of the study, whereby a letter of continuation will be provided annually, and upon completion of the study; and - without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study. • The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the principal investigator/study supervisor/researcher must apply for approval of these amendments at the NWU-ENG-REC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited. • Annually a number of studies may be randomly selected for active monitoring. • The date of approval indicates the first date that the study may be started. • In the interest of ethical responsibility, the NWU-ENG-REC reserves the right to:

- request access to any information or data at any time during the course or after completion of the study;
- to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;
- withdraw or postpone approval if:
 - any unethical principles or practices of the study are revealed or suspected;
 - it becomes apparent that any relevant information was withheld from the NWU-ENG-REC or that information has been false or misrepresented;
 - submission of the annual monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and/or
 - new institutional rules, national legislation or international conventions deem it necessary.
- NWU-ENG-REC can be contacted for further information via ENG-REC@nwu.ac.za or 018 299 2645

Special conditions of the research approval (if applicable): NA

Special in process conditions of the research for approval (if applicable): NA

The NWU-ENG-REC would like to remain at your service and wishes you well with your study. Please do not hesitate to contact the NWU-ENG-REC for any further enquiries or requests for assistance.