

CATEGORISING SOUTH AFRICAN LEAN IMPLEMENTATION FRAMEWORKS: A SYSTEMATIC LITERATURE REVIEW

M. Mangaroo-Pillay^{1*} and R. Coetzee²

¹School of Industrial Engineering
North-West University, South Africa
25038230@nwu.co.za

² School of Industrial Engineering
North-West University, South Africa
Rojanette.Coetzee@nwu.co.za

ABSTRACT

Although Lean has become a global phenomenon, only about 10% of Lean implementations ventures are successful. Ergo, multiple researchers have designed and created specific Lean implementation frameworks, however there is a level of uncertainty regarding which frameworks exist for which application. Therefore, this research aimed to investigate studies on South African Lean implementation frameworks, by conducting a systematic review on applicable literature. It provides a fulsome synthesis and categorization of available Lean implementation frameworks. Furthermore, it was found that there are various types of frameworks, each with a specific target audience. However, it also highlighted the gaps in current research, such as a lack of culture specific frameworks in South Africa. This systematic literature review could support researchers and practitioners in understanding and selecting the Lean implementation framework that would best suit their needs.

1 KEYWORDS: LEAN, IMPLEMENTATION FRAMEWORKS, SOUTH AFRICA, SYSTEMATIC LITERATURE REVIEW

* Corresponding Author



1 INTRODUCTION

The Lean philosophy, developed in Japan during the 1930s [1], is a business management philosophy that is used to eradicate wastes and increase profits. Since then it has gained global recognition due to its organisational benefits (i.e. continuous improvements). Although Lean has become a global phenomenon, only about 10% of Lean implementations ventures are successful [2, 3].

Authors [4, 5, 6, 7, 8, 9, 10, 11, 12] have explained that Lean is a cultural change across an organisation, as it necessitates commitment from all levels within an organisation. They have also noted that Lean implementation differs in companies and/or industries, because the companies and industries are unique in structures and standards. Due to this, they explain that Lean requires some degree of customisation, as opposed to just utilising it as a simple toolbox.

Thus, there has always been a need for creating different implementation frameworks, that customise Lean implementations to certain aspects, such as different industries or knowledge areas. However, considering that there are several implementation frameworks available, a level of uncertainty exists regarding which frameworks should be used for which application.

Based on this background, this research paper intends to explore the available Lean implementation frameworks available in the South African context, in order to allow for the categorisation of them in terms of their application.

For purposes of this paper, a Lean implementation framework will be considered as a structured outline or figure, that is used to present actions and tasks that need to be implemented for Lean. Furthermore, it will contain some direction or incrementation of steps that must be followed at different stages or levels. Lean implementation models will not be included in the study since these models usually include optimisation models, which are more mathematical in nature and outside the scope of this study. Additionally, this study will not include Lean implementation roadmaps, as these are strategic tools for a specific project (which are not often reused). On the other hand, frameworks will be the focus, as these usually include practical steps for implementation on an organisational level.

2 RESEARCH METHOD

In order to achieve the aim, a systematic literature review (SLR) was conducted on applicable literature. It took the form of a scoping SLR, with a view to explore the scopes of various studies and the purpose of the designed frameworks within each study [13]. The SLR method utilised in this study was based on the proposed method by Albliwi et. al. [14]. The sequence and grouping of the steps into research phases are illustrated in figure 1, while the detail of each step is as follows:

- **Step 1: Develop a research purpose and/or objective** - Clearly state the goal of the SLR
- **Step 2: Develop research protocol** - Create a research protocol that includes the purpose, inclusion criteria, exclusion criteria, databases, keywords and quality assessment criteria
- **Step 3: Establish relevance criteria** - State the reasoning for if a resource is relevant to this study
- **Step 4: Search and retrieve the literature** - Conduct searches on applicable scientific databases to find literature
- **Step 5: Selection of studies** - Use the inclusion and exclusion criteria to select studies
- **Step 6: Quality assessment for relevant studies** - Assess the quality of each paper
- **Step 7: Data extraction** - Extract relevant information from the papers



- **Step 8: Analysis and synthesis of findings** - Analyse and synthesise the data from the papers in order to find themes and patterns
- **Step 9: Report** - Report the review in detailed results
- **Step 10: Dissemination** - Publish the SLR

The outcomes of step 1- 6 are discussed in the sub-sections to follow, while the findings of the study (step 7 & 8) are documented in section 3. Steps 9 and 10 are addressed by publishing this research paper.

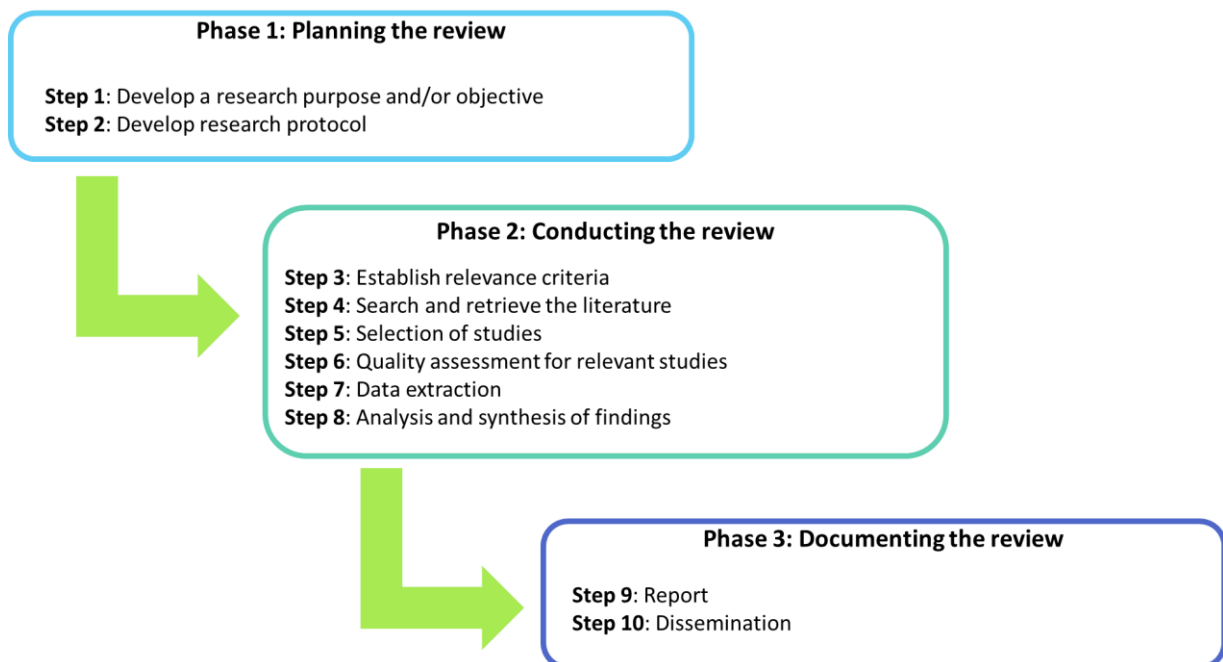


Figure 1 : Research method and phases (Adapted from [14])

The SLR was conducted from February 2020 to June 2020 on the selected databases using the predetermined keywords.

2.1 Step 1: Develop a research purpose and/or objective

The purpose and objective of this research was to investigate the available South African Lean implementation frameworks, in order to allow for the categorisation of said frameworks, according to their purpose or intended application.

2.2 Step 2: Develop research protocol

The research protocol that was developed is captured in table 1. This included the purpose of conducting the study, as to keep the end goal in mind. It also encompassed the inclusion and exclusion criteria, in order to remove researcher bias and increase repeatability of the study. The databases that were selected for this study were based on their incorporation of Industrial engineering themed literature. Key words and quality assessment are included in the research protocol to provide guidance on what to search for and how to assess its quality. Furthermore, the research protocol was validated by a fellow researcher, by means of iterative discussions and deliberations.

Table 1: Research review protocol (Structure adapted from [13])

Purpose of the study	To investigate the available literature on South African Lean implementation frameworks and classification or categorisation them
Inclusion Criteria	• Literature that contains “Lean”, “Framework” and “Implementation” in the title, abstract or keywords • Literature based in South Africa
Exclusion Criteria	• Literature referring to weight-loss/obesity • Non-English literature • Literature based in other countries (not SA) • Lean Six Sigma studies
Search Databases	• Science Direct • Scopus • IEEE Explore • Web of Science • EBSCOhost (Academic search premier, Business source premier, E-journals, MasterFILE premier) • Emerald Insight Journals • Google Scholar
Keywords	“Lean” AND “implementation framework” AND “South Africa”
Quality assessment criteria	• All duplicate literature must be removed • Recovered literature was checked for relevance • Evaluate based on their correct understanding and interpretation of Lean

2.3 Step 3: Establish relevance criteria

When establishing the relevance criteria, it was important to be specific, yet leave room for as many studies to be included as possible [13, 14]. Therefore, the following relevance criteria was developed by which studies were included:

- Literature that contained “Lean”, “Framework” and “Implementation” in the title, keywords or abstract of the study
- Studies and frameworks that are based in or created for South Africa
- Creates and discusses a new framework for Lean implementation

2.4 Step 4: Search and retrieve the literature

The search and retrieving of the literature was initially done by using the databases stated in section 2.2. This yielded 1425 studies, of which 9 met the inclusion criteria. The huge yield was due to databases producing Lean articles that referred to other Lean frameworks (not included in their studies itself) and some frameworks that were not based in South Africa, but mentioned “South Africa” in their paper.



However, after the initial search, it was revealed that some duplicates existed in the 9 selected studies. Ergo, there was a need to conduct a secondary search on different databases.

The secondary search was conducted on the repository websites of universities in South Africa that have Industrial Engineering programs. These repositories include each university's PhD thesis, Masters dissertations, final year projects reports and other major reports. While it is unorthodox to use repositories for an SLR, it was select for the secondary searchers due to its richness in data. This yielded 11 229, of which only 7 additional studies were found that met the inclusion criteria. The large number of papers yielded during the secondary search (11 229) was attributed to the fact that the search function of many repository websites include all studies that contain the search terms (anywhere in the full text), and not just those that have the search terms in their titles or abstracts. The search and retrieval process that was followed, is documented in the "Identification" section of figure 2.

2.5 Step 5: Selection of studies

Once all studies were screened based on step 1's protocol, 16 studies were selected (9 from the initial search and 7 from the secondary search). Again, these studies were evaluated, in order to remove all duplicates, resulting in 8 studies being eligible for inclusion. The outcome of the selection process is captured in the "Screening" and "Eligibility" sections of figure 2, illustrating both the initial and secondary search results per database.

After selecting the studies, information of each study was captured, such as the names of authors, title of studies and year of publication (table 2).

2.6 Step 6: Quality assessment for relevant studies

After all duplicates were removed, the quality of the studies were assessed by reading the full texts. Papers were assessed based on their correct understanding and interpretation of Lean. It was found that all 8 papers were acceptable for inclusion.

Step 4 through to 6 of the selection process, as discussed in section 2.4 - 2.6, is captured in figure 2. It illustrates the different phases of the search at the left of the figure, as well as differentiates between the amount of studies found and selected from each database.



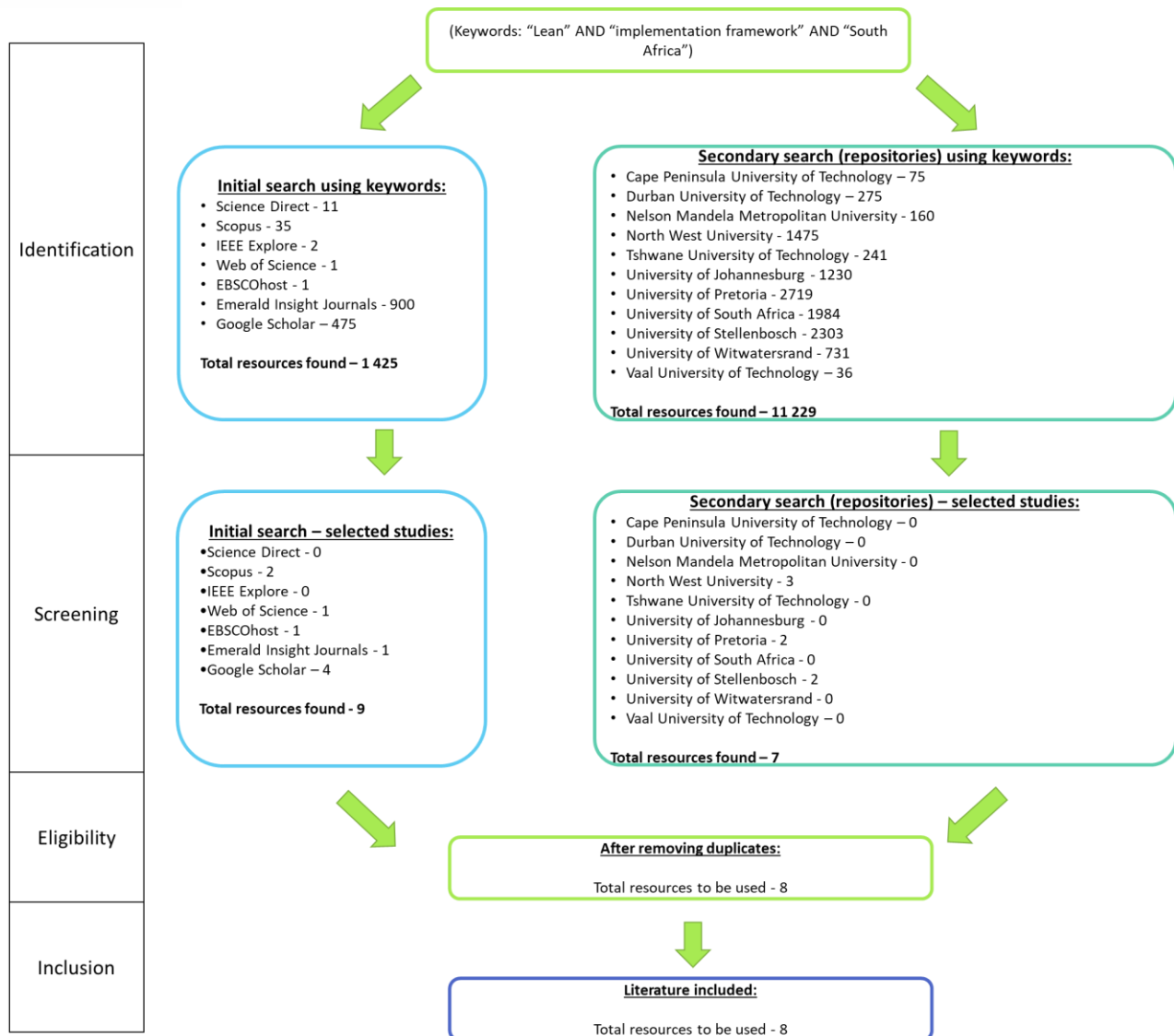


Figure 2: Selection process chart

3 FINDINGS

The findings (step 7 and 8) from following the aforementioned SLR methodology are discussed in the following sub-sections.

3.1 Step 7: Data extraction

Upon finalising the list of studies to be included and studying their full texts, a summary was developed explaining the Lean frameworks that were created in each study (Table 2). The summaries included (1) the knowledge areas that the implementation frameworks were created for, (2) a summary of elements (e.g. objects or tools), (3) the framework structure (e.g. cyclical or linear), (4) the research discipline the work was published in and (5) the type of study (Masters or Doctoral). Table 2 captures this information together with the author(s) details, year of publication and study title.



Table 2: Data extracted from applicable literature

#	Author(s)	Year	Research Title	Knowledge Area	Summary of elements	Framework structure	Discipline	Study type	Ref
1	I Maradzano, RA Dondofema & S Matope	2019	Application of lean principles in the South African construction industry	Construction	Lean implementation framework for construction. It contains phases, objective and tools for each step of the framework.	Cyclical	Industrial Engineering	Masters	[15]
2	R Coetzee	2019	Development of the Respect for People model for lean implementation in the South African context	Respect for people	Lean implementation framework that incorporates respect for people. It contains phases, value streams, organisational levels, respect for people themes and steps.	Cyclical	Industrial Engineering	PhD	[16]
3	K Sekoto	2019	A lean management framework for orthopedic operating theatres of a level three public hospital, North West Province	Scheduling in health care	Lean implementation framework for scheduling in an orthopedic theatre. It contains stages and objectives.	Cyclical	Business	MBA	[17]
4	E Zeelie	2019	A lean project management framework for additive manufacturing	Additive manufacturing project management	Lean implementation framework for project management in additive manufacturing. It contains knowledge areas and groups for the various stages of project planning.	Cyclical	Engineering management	Masters	[18]



5	JM de Villiers	2018	A Framework for Implementing Lean Practices and Tools to support ISO 55000 Compliance for Physical Asset Management	ISO 55000 compliance for asset management	Lean implementation framework to support ISO 55000 compliance. It contains Lean tools for ISO standards, in different aspects of asset management.	Cyclical	Engineering management	Masters	[19]
6	TG Tendayi	2013	An Investigation into the Applicability of Lean Thinking in an Operational Maintenance Environment	Maintenance	Lean implementation framework for Lean thinking in maintenance. It contains maintenance criteria, Lean principles and tools.	Cyclical	Science and Engineering	Masters	[20]
7	S Phelta	2016	Building Lean and Agile supply chains for food fast moving consumer goods manufacturers and food retailers in South Africa	Supply chain	Lean implementation framework for integrating Lean and Agile into the supply chain. It contains levels and aspects of theory.	Cyclical	Business	MBA	[21]
8	A Christodoulou	2010	Factors of success for the effective implementation of lean manufacturing projects within the banking sector in South Africa	Banking industry	Lean implementation framework for projects within the banking industry. It contains levels and aspects of theory.	Cyclical	Business	MBA	[22]



3.2 Step 8: Analysis and synthesis of findings

The following sections analyse and discuss the various columns in table 2.

3.2.1 Distribution of studies

While the searches and inclusion of studies were not limited to specific years, the data shows that the earliest publication was in 2010 and the majority of the studies were published later in 2019. This could attest to Lean implementation in South Africa being a relatively new field of study, and it could suggest that the need for Lean implementation frameworks in the South African industry has increased significantly in the last decade. The number breakdown of the publication found per year group are illustrated in figure 3.

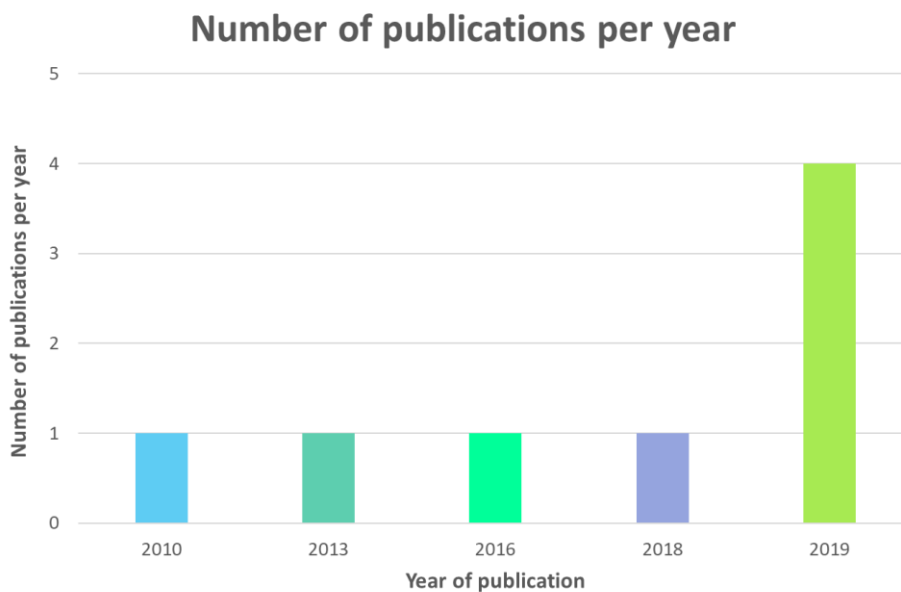


Figure 3: Bar graph of number of publications per year

3.2.2 Framework structure

From the analysis, it could be seen that all frameworks were cyclical in nature. This demonstrates the notion that Lean implementation is achieved through iterative cycles of improvement and adaption, as Lean is viewed as a cultural transformation rather than a simple set of (once-of) tools for improvement. Furthermore, this demonstrates that authors are staying true to the Lean philosophy when designing their frameworks.

3.2.3 Research discipline

This SLR was written as part of an Industrial Engineering study, as Lean is a popular branch in Industrial Engineering. However, it is well known that Lean is not purely an Industrial Engineering field of research, since it is recognised as a business philosophy as well. In a similar vein, the analysis of the selected literature, illustrated that 35.7% of the studies were in the business discipline, while only 25% was exclusively conducted in the industrial engineering discipline. Moreover, 25% of the studies were within the engineering management discipline and 12.5% of the studies was in the science and engineering discipline. The composition of publications per discipline are depicted in figure 4. This is an indication that Lean is mostly



researched in the context of business, ergo highlighting the opportunity to explore it from the industrial engineering perspective in other ways.

Percentage of publications per discipline

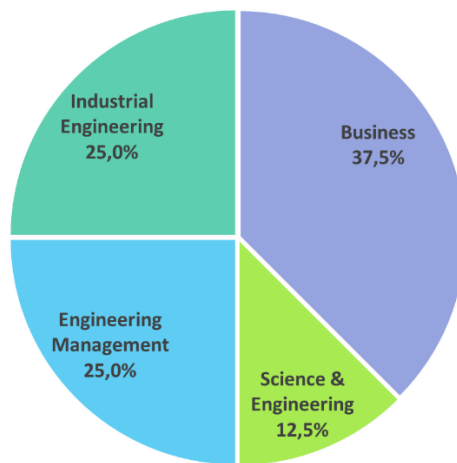


Figure 4: Pie Chart of percentage of publications per discipline

3.2.4 Study types

When analysing the studies, it was also found that the study type was heterogenous. Majority of the studies (50%) were masters studies in the engineering discipline, while 37.5% of the studies were in masters of business administration (MBA) and the remaining 12.5% were doctoral studies in engineering. This is indication that very few studies explore Lean implementation at a PhD level. This breakdown of publications per type of study is captured in figure 5.

Percentage of publications per study type

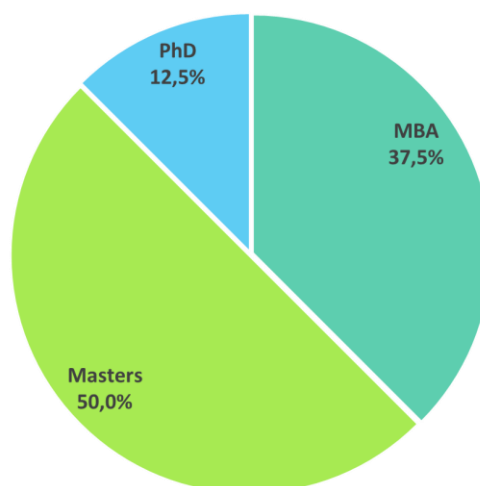


Figure 5: Pie chart of percentage of type of studies



3.2.5 Knowledge areas

When analysing the studies, the most prevalent fact was the diversity of Lean applications in different knowledge areas. Each Lean implementation framework was based in a different knowledge area (categories), with the knowledge areas being very vast. Knowledge areas of Lean applications included the following:

- Additive manufacturing project management
- Banking industry
- Construction industry
- ISO 55000 compliance in asset management
- Maintenance
- Respect for people
- Scheduling in Health care
- Supply chain

The aim of the study was to explore the available Lean implementation frameworks available in the South African context, in order to allow for the categorisation of them in terms of their application. The categorisation of the Lean implementation frameworks is captured in table 3. This diversity attests to the ability to apply Lean in a wide range of different type of industries and knowledge areas. However, each of these studies also validated the idea that Lean implementations need to be customised for different organisations and/or industries.

Table 3: Categorisation of Lean implementation frameworks

Knowledge area (Category)	Title of study
Additive manufacturing project management	A lean project management framework for additive manufacturing
Banking industry	Factors of success for the effective implementation of lean manufacturing projects within the banking sector in South Africa
Construction Industry	Application of lean principles in the South African construction industry
ISO 55000 compliance in asset management	A Framework for Implementing Lean Practices and Tools to support ISO 55000 Compliance for Physical Asset Management
Maintenance	An Investigation into the Applicability of Lean Thinking in an Operational Maintenance Environment
Respect for people	Development of the Respect for People model for lean implementation in the South African context
Scheduling in Health Care	A lean management framework for orthopaedic operating theatres of a level three public hospital, North West Province
Supply chain	Building Lean and Agile supply chains for food fast moving consumer goods manufacturers and food retailers in South Africa

4 CONCLUSIONS AND RECOMMENDATIONS

This paper aimed to explore the various Lean implementation frameworks in South Africa, in order to categorise them based on their application since it is important to understand what is available to be used in practice and industry. The compilation of these categories were presented in table 2 and 3 and found to be diverse in nature.

The aim was accomplished by conducting a scoping systematic literature review, via the methodology adapted from Albliwi et al. [14]. Studies were selected based on a review protocol. Additional to scientific databases, the SLR made use of university repositories for



searches. Utilising university repositories was necessary in order to find more literature, as the primary search on the initial databases resulted in a few resources being found. Searching in these repositories proved to have some of its own challenges. When searching on repositories, one is not given the option to conduct the search in only the keywords, titles and abstracts sections. Rather, a Boolean search expression provides results where the search terms occur in any part of the full text of the publication. Nevertheless, this study highlighted what untapped resources university repositories are for SLRs, as many literature studies fail to utilise them.

The outcomes of this systematic literature review (table 2 and 3) could support researchers and practitioners in understanding and selecting the Lean implementation framework that would best suit their needs, based on the categorisation of knowledge areas.

While this study investigated Lean implementation frameworks in South Africa, it is recommended that future studies explore this on an international level, allowing for the categorisation of their research in the field. Furthermore, future research should also examine Lean implementation models and roadmaps (as opposed to only frameworks). By investigating models and roads researchers may be able to highlight their value and support other researchers and practitioners in understanding and selecting them accordingly. Moreover, this would aid in conceptualising the correlations and variations amongst frameworks, roadmap and models.

This study highlighted that Lean is diverse in its application to knowledge areas, as is displayed in the outcomes of the SLR. From the analysis it was observed that studies were done in various disciplines, such as Industrial engineering, business, management engineering and science and engineering. However, studies are not limited to these disciplines, thus it is suggested that research explore Lean implementation frameworks in other subdisciplines of Lean (e.g. accounting and manufacturing).

Furthermore, the analysis found that Lean studies were done over various qualification levels, such as masters and doctoral level. Still, with only 12.5% of the studies being done at PhD level, it highlights the expertise of the field but also the lack of applied research on this level.

Publications found within this SLR demonstrated the diversity and range of Lean application in numerous knowledge areas within South Africa. However, Lean implementation frameworks are not limited to these knowledge areas, and future research should build on also developing frameworks in other knowledge areas, such as Lean and Green, Lean leadership, Lean accounting, Lean facilities planning or cultural adaptations of Lean.



5 REFERENCES

- [1] Holweg,M. 2007. "The genealogy of lean production," *Journal of operations management*, vol. 25, no. 2, pp. 420-437.
- [2] Miina,A. 2012. "Lean problem: why companies fail with lean implementation," *Management*, vol. 2, no. 5, pp. 232-250
- [3] Bhasin,S and Burcher,P. 2006. "Lean viewed as a philosophy," *Journal of manufacturing technology management*, vol. 17, no. 1, pp. 56-72.
- [4] Keiser,J. 2012. "Leadership and Cultural Change: Necessary components of a lean transformation," *Proceedings of the 20 th annual conference of the international group for lean construction*, pp. 1-10.
- [5] Yamamoto,Y and Bellgran,M. 2010. "Fundamental mindset that drives improvements towards lean production," *Assembly Automation*, vol. 30, no. 2, pp. 124-130.
- [6] Bhasin,S. 2012. "An appropriate change strategy for lean success.," *Management Decision*, vol. 50, no. 3, pp. 439-458.
- [7] Nordin,N, Deros,B, Wahab,D and Rahman,M. 2012. "A framework for organisational change management in lean manufacturing implementation," *International Journal of Services and Operations Management*, vol. 12, no. 1, pp. 101-117.
- [8] Erthal,A and Marques,L. 2018. "National culture and organisational culture in lean organisations: a systematic review," *Production Planning & Control*, vol. 29, no. 8, pp. 668-687.
- [9] Martins,A , Affonso,R, Tamayo,S, Lamouri,S and Ngayo,C. 2015. "Relationships between national culture and Lean Management: A literature Review," *International Conference on Industrial Engineering and Systems Management (IESM)*, pp. 352-361.
- [10] Alkhoraif,A and McLaughlin,P. 2016. "Organisational Culture that inhibit the lean implementation.," *The European Business & Management Conference* , pp. 39-58.
- [11] Ahmad,S. 2013. "Culture and lean manufacturing: towards a holistic framework," *Australian Journal of Basic and Applied Sciences*, vol. 7, no. 1, pp. 334-338.
- [12] Taherimashhadi,M and Ribas,I. 2018. "A Model to align the organizational culture to Lean," *Journal of Industrial Engineering and Management*, vol. 11, no. 2, pp. 207-221.
- [13] Xiao,Y and Watson,M. 2019. "Guidance on conducting a systematic literature review," *Journal of Planning Education and Research*, vol. 39, no. 1, pp. 93-112.
- [14] Albliwi,S, Antony,J, Lim,S and van der Wiele,T. 2014. "Critical failure factors of Lean Six Sigma: a systematic literature review," *International Journal of Quality & Reliability Management*, vol. 31, no. 9, pp. 1012-1030.



- [15] **Maradzano, I Dondofema, R and Matope, S. 2019.** “Application of lean principles in the South African construction industry,” *South African Journal of Industrial Engineering*, vol. 30, no. 3, pp. 210-223.
- [16] **Coetzee, R. 2019.** “Development of the Respect for People model for lean implementation in the South African context,” Doctoral dissertation, North-West University (South Africa).
- [17] **Sekoto, K. 2019.** “A lean management framework for orthopedic operating theatres of a level three public hospital, North West Province,” Doctoral dissertation, North-West University (South Africa).
- [18] **Zeelie, E. 2019.** “A lean project management framework for additive manufacturing,” (Doctoral dissertation, North-West University (South Africa).
- [19] **de-Villiers, J. 2018.** “A Framework for Implementing Lean Practices and Tools to support ISO 55000 Compliance for Physical Asset Management,” Doctoral dissertation, Stellenbosch University.
- [20] **Tendayi, T. 2013.** “An Investigation into the Applicability of Lean Thinking in an Operational Maintenance Environment,” Doctoral dissertation, Stellenbosch University.
- [21] **Pheltan, S. 2016.** “Building Lean and Agile supply chains for food fast moving consumer goods manufacturers and food retailers in South Africa,” Doctoral dissertation, University of Pretoria.
- [22] **Christodoulou, A. 2010.** “Factors of success for the effective implementation of lean manufacturing projects within the banking sector in South Africa,” Doctoral dissertation, University of Pretoria.

