Lean Frameworks: A Systematic Literature Review (SLR) Investigating Methods and Design Elements

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Abstract:

Purpose: Despite the influx of Lean frameworks in literature, there seems to be no standardised or established methods for designing them. Therefore, the purpose of this research is to investigate what design methods and design elements are utilised in creating Lean frameworks.

Design/methodology/approach: A systematic literature review (SLR) was conducted to find all the available studies on Lean frameworks.

Findings: This study found that the formation of the framework could be broken down into four different categories; namely: approaches or methods for designing, design elements to include, theory to investigate during the literature studies and framework testing methods for evaluating the framework.

Research limitations/implications: While this research focused on Lean frameworks, it is recommended that future studies look at Lean models and roadmaps.

Practical implications: The artefact created in this study, the House of Guidance, will provide future researchers with a guideline on how to go about designing a Lean framework.

Social implications: N/A

Originality/value: The SLR looked at pre-existing framework, in order to extract the categories for the development of Lean frameworks. This study presents the House of Guidance (an original artefact), to aid in the design and creation of future Lean Frameworks.

Keywords: lean philosophy, lean frameworks, lean framework design, systematic literature review, SLR

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1. Introduction

Lean has been adopted by various organisations, as a management approach to give a competitive advantage by increasing efficiency via waste elimination (Nordin, Deros, Wahab & Rahman, 2012), but why are more than 90% of Lean implementations unsuccessful? Miina (2012) reports that less than 10% of Lean implementations are

successful. As for the high failure rate, researchers are exploring the barriers to Lean implementation (Amer & Shaw, 2014). Some barriers include low involvement from leaders, poor employee attitudes, insufficient resources and organisational cultural issues (Amer & Shaw, 2014).

In previous research, it was noted that Lean is an overall cultural change within an organisation, as it demands commitment from all organisational levels for success (Ahmad, 2013; Alkhoraif & McLaughlin, 2016; Bhasin, 2012; Keiser, 2012; Mangaroo-Pillay & Coetzee, 2020; Martins, Affonso, Tamayo, Lamouri, & Ngayo, 2015; Nordin et al., 2012; Yamamoto & Bellgran, 2010). Additionally, these authors have supported that Lean implementation is different for each organisation and/or industry, ergo Lean requires some measure of customisation, as it cannot be utilised as a standalone toolbox for success (Ahmad, 2013; Alkhoraif & McLaughlin, 2016; Bhasin, 2012; Keiser, 2012; Mangaroo-Pillay & Coetzee, 2020; Martins et al., 2015; Nordin et al., 2012; Yamamoto & Bellgran, 2010). Due to the ever-growing need of Lean, many academics and scholars have developed various Lean frameworks (Anand & Kodali, 2009). Lean frameworks can be found in several industries, with some of the most well-noted ones being in healthcare, manufacturing, accounting, service industries, management, supply chain and human factor engineering to name a few.

However, despite the influx of Lean frameworks in literature, there seems to be no standard, established methods or guidelines for designing these important frameworks. Additionally, it is unclear what the design elements of such a framework should be. Without this guidance on the methods and elements, it is also difficult to verify and validate Lean frameworks for their applicability.

Therefore, this study plans to investigate the available literature on the design method and design elements for developing Lean frameworks.

For the purpose of this study, it is imperative to clarify some terminology used within design literature. While there is no all-inclusive definition of what a framework is, various authors have included their interpretations of frameworks in their research. Yusof and Aspinwall (2000) expressed that a framework is a prescriptive set of things to do, and that frameworks may be a diagram or graphic representation of a theory. Correspondingly, Hakes (1991) agrees that frameworks are there to translate a theory into something practical for implementation in a systematic manner. In a more comprehensive effort, Aalbregtse, Hejka, and McNeley (1991) and Anand and Kodali (2009) articulated that frameworks must:

- Depict an outline of a philosophy
- Communicate a change process that should be adopted in order to achieve a new vision
- Compel different parties within an organisation to address a substantial list of key issues

Some literature may use the terminology 'framework' and 'model' as interchangeable terms or synonyms, although there is a significant difference between these terms. According to Difference Between (2013), a framework is a means of demonstrating the empirical relations amongst every aspect of inquiry in terms of scientific theory or research, ergo it illustrates the general direction and the constraints of a theory. Whereas a model is described as something which is used to explain the operation and mechanisms of something (Difference Between, 2013). Therefore, a framework is better suited for creating a general plan for implementation of a theory in a nonspecific organisation. Furthermore, because various studies utilised mathematical and programming models as lean models, this study will focus on Lean frameworks solely.

2. Research Aim

Therefore, the aim of this research is to conduct a Systematic Literature Review (SLR) to investigate which design methods and design elements were used for established frameworks.

3. Research Method

This study followed the SLR method, as described by Albliwi, Antony, Abdul-Halim-Lim & van der Wiele (2014). The method consists of three phases: Planning, conducting and documenting. The steps within these phases are detailed as follows (Albliwi et al., 2014):

A) **Planning the review**

- **Step 1 – Research purpose and objective** – The purpose of the SLR and the objects must be clearly set out
- **Step 2 – Develop research protocol** – Create the research protocol, which must include the inclusion criteria, exclusion criteria, databases to be searched, keywords and quality assessment criteria.

B) **Conducting the review**

- **Step 3 – Establish relevance criteria** – Establish which types of studies are relevant to the study (Update the inclusion and exclusion criterion)
- **Step 4 – Search and retrieve the literature** - Search the selected electronic databases for literature
- **Step 5 – Selection of studies** – Select literature based on the inclusion and exclusion criteria
- **Step 6 – Quality assessment for relevant studies** – Assess the literature for quality
- **Step 7 – Data extraction** – extract data from the selected literature
- **Step 8 – Synthesis of studies (analysis)** – Extract facts and conclusions from the selected literature

C) **Documenting the review**

- **Step 9 – Reporting** – Report on the SLR in detail
- **Step 10 – Dissemination** – Publish the SLR findings in an academic source

4. Findings

4.1. Step 1: Research Purpose and Objective

The purpose and objectives of the SLR are captured in section 1 and 2 of this research paper: To investigate literature on the design method and design elements for developing Lean frameworks. The aim was dived into the following objectives: (1) to find out what design methods are used to create frameworks and (2) to find design elements are present in established frameworks.

4.2. Step 2: Develop Research Protocol

The review protocol was developed in collaboration with a co-researcher and is indicated in Table 1. As to allow for the inclusion of all existing, relevant literature on the topic, this SLR was not restricted to a specific date range of publication.

Purpose of the study	To establish which design methods and elements are utilised to develop Lean frameworks.
Inclusion criteria	Literature including "Lean framework" in their title, abstract or keywords. Literature should explain the methodology followed to develop the framework
Exclusion criteria	Lean literature related to obesity/weight-loss Literature that utilises a prior developed framework (i.e. If the framework is not developed within the specific study) Literature on Lean Six Sigma frameworks (i.e. This study is focused on purely on Lean frameworks and not hybrids thereof) Non-English literature

Search databases	Searches were conducted on 7 databases, namely: ScienceDirect,
	                Scopus,
	                IEEE Xplore,
	                Web of Science,
	                EBSCOhost
	                Emerald Insight Journals
	                Google scholar

Keywords	All the selected databases were searched using the following key words: "Lean framework"
Quality Assessment Criteria	All duplicate literature was excluded Recovered literature will be checked for relevance (besides inclusion and exclusion criteria)

Table 1. Research protocol

4.3. Step 3: Establish Relevance Criteria

Due to the minimal amount of literature, no alterations were made to the inclusion and exclusion criteria, as to maximise the search outputs. Therefore, the inclusion and exclusion criteria given in Table 1 were utilised, as is.

4.4. Step 4 to 6: Search, Selection and Quality Assessment of the Literature

The literature selection process for steps 4 to 6 are illustrated in Figure 1, which allowed for the search, selection and quality check of the resources found. The initial search resulted in 161 resources from the seven databases. After screening the 161 literature resources (based on the research protocol), only 14 were selected for the quality check. Resources were rejected due to the following reasons:

Identification

Initial search:
Science direct = 0
Scopus = 17
IEEE Xplore = 3
Web of Science = 9
EBSCOhost = 20
Emerald Insight Journals = 40
Google Scholar = 72

Total = 161

Note:
Databases were search in the *title, abstract and keywords* sections, using the keywords: **"Lean framework" NOT "Model"**

Screening

After screening:
Science direct = 0
Scopus = 2
IEEE Xplore = 0
Web of Science = 1
EBSCOhost = 2
Emerald Insight Journals = 1
Google Scholar = 8

Total = 14

Inclusion criteria: "Lean framework" in their title, abstract or keywords; Explain the development method; Discuss design requirements

Exclusion criteria: Related to obesity/weight-loss; Utilising a prior developed framework; Lean Six Sigma frameworks; Non-English literature

Eligibility

After quality check:
Science direct = 0
Scopus = 2
IEEE Xplore = 0
Web of Science = 1
EBSCOhost = 2
Emerald Insight Journals = 1
Google Scholar = 8

Total = 14

Quality assessment criteria:
Remove duplicate literature; Recovered literature was be checked for relevance

Inclusion

Full-text assessment:
Science direct = 0
Scopus = 2
IEEE Xplore = 0
Web of Science = 1
EBSCOhost = 2
Emerald Insight Journals = 1
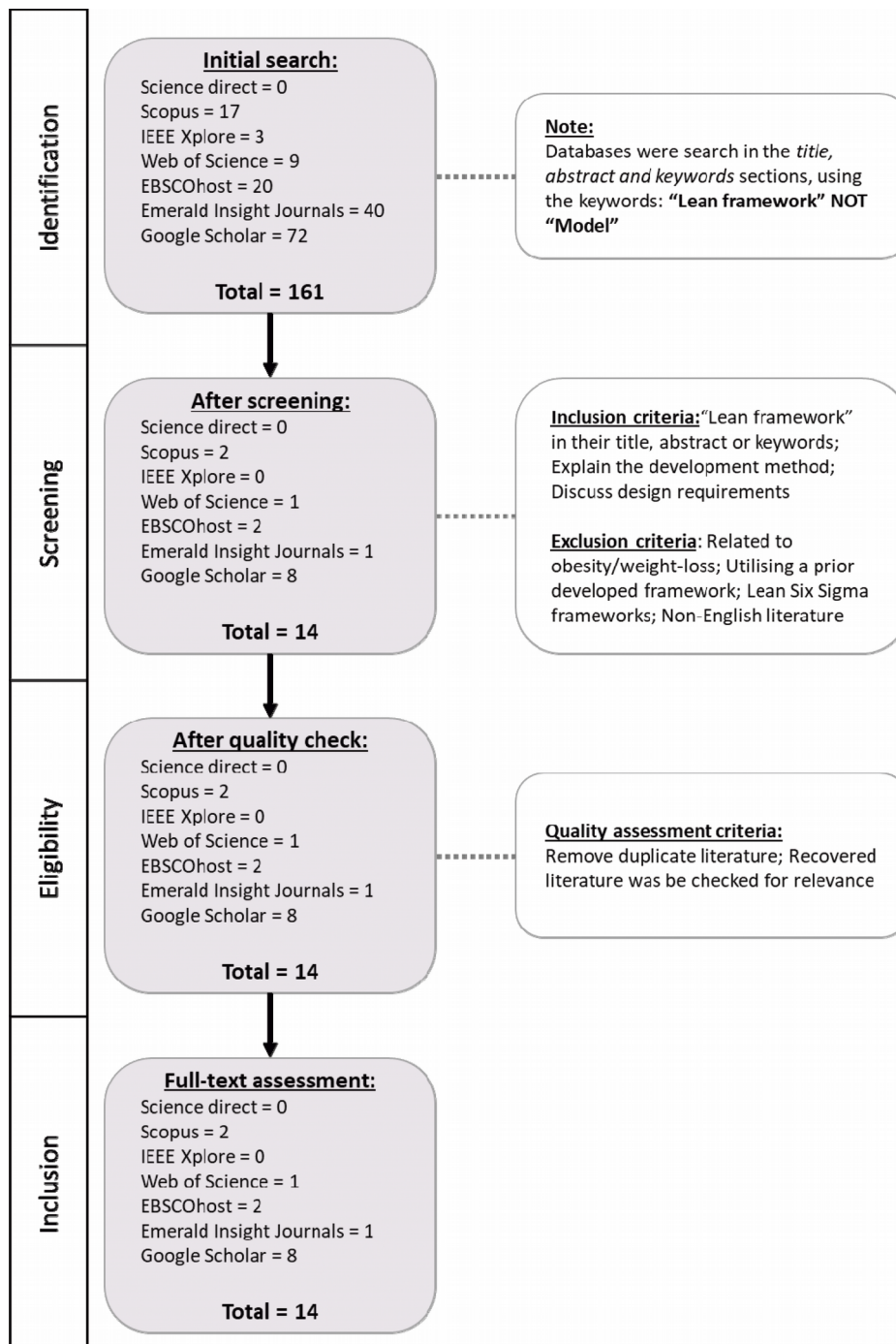Google Scholar = 8

Total = 14

Figure 1. Literature selection process

- Several sources were found to have misunderstood the concept of Lean
- Some sources merged Lean with other continuous improvement theories
- Multiple sources referred to mathematical models as frameworks for reducing time in Lean processes
- Few sources were referring to existing Lean frameworks, which were not designed within that specific study
- Few sources were leading towards the development of Lean frameworks in future studies
- Various sources referred to 'Implementing the Lean framework', when discussing implementation of the Lean philosophy in general
- Few sources referred to value stream maps and facility layouts as Lean frameworks

Thereafter, these 14 resources passed the quality check and were included for full-text assessment. The final selection of resources are detailed in Table 2, indicating the authors, year, title and type of resource.

#	Author(s) and Year	Title	Type of source
1	Alkhoraif, McLaughlin and Rashid (2019)	A framework to improve lean implementation by review leveraging aspects of organisational culture: the case of Saudi Arabia.	Journal article
2	Almutairi, Salonitis & Al-Ashaab, (2019)	A framework for implementing lean principles in the supply chain management at health-care organizations.	Journal article
3	Alturkistani (2018)	Development of a lean principles framework for ERP implementation process.	Thesis
4	Anand and Kodali (2009)	Development of a framework for lean manufacturing systems.	Journal article
5	Bhamu, Singh-Sangwan and Mehta (2013)	Development and validation of lean manufacturing drivers, barriers and framework with a focus on ceramic industry.	Thesis
6	Lermen, Echeveste, Peralta, Sonego & Marcon (2018)	A framework for selecting lean practices in sustainable product development: The case study of a Brazilian agroindustry.	Journal article
7	Macias de Anda (2018)	Integrate National Culture in the Design of Lean Systems.	Thesis
8	Malaeb and Hamzeh (2018)	Evaluating PPP projects using a lean framework.	Journal article
9	Maqbool, Rafique, Hussain, Ali, Javed, Amjad et al. (2019)	An Implementation Framework to Attain 6R-Based Sustainable Lean Implementation—A Case Study	Journal article
10	Mirdad and Eseonu (2015)	A conceptual map of the lean nomenclature: comparing expert classification to the lean literature.	Journal article
11	Mostafa, Dumrak & Soltan (2013)	A framework for lean manufacturing implementation	Journal article
12	Perez (2014)	Enterprise Architecture Framework of a Lean Enterprise Transformation	Thesis
13	Welo, Olsen & Gudem (2012)	Enhancing product innovation through a customer-centered, Lean framework	Journal article
14	Yang (2012)	A lean framework for tooling design process in Chinese aerospace.	Thesis

Table 2. Resources found

4.5. Step 7 to 8: Data Extraction and Synthesis (Analysis) of Studies

The resources found (Table 2) were investigated and the relevant information was extracted. Resources were loaded in the Atlas Ti software, thereafter they were coded and analysed to find recurring themes or patterns (allowing for synthesis of the literature). Upon reviewing each resource, it was evident that the formation of Lean frameworks could be divided into four different categories, namely:

1. **Literature studies** - Topics considered during the literature study when design lean implementation frameworks.
2. **Approaches or methods** - Design methods or approaches utilised to create the framework
3. **Design elements** – Aspects or elements that were included within the framework
4. **Framework testing** - Evaluation methods used to validate the framework

After the initial coding process in Atlas Ti, a network (relationship) model was generated to understand the correlations between the different categories. The network model generated post coding (Figure 2) illustrate the aforementioned categories (dark black borders), along with their themes (red dotted lines) and connections (black solid lines) to one another. Thereafter, a matrix was created to illustrate the breakdown of each category in relation to each resource found (Figure 3). Following the figure, each category is discussed with respect to the themes found.
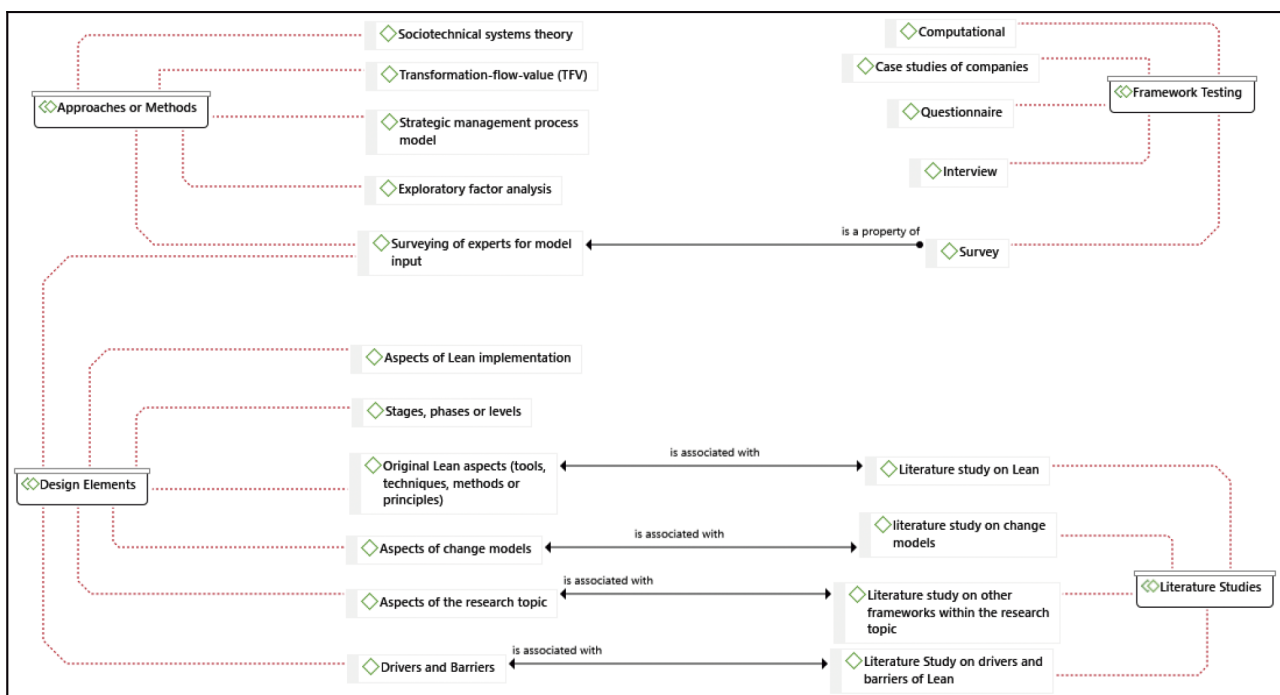

Figure 2. Network model generated in Atlas Ti

4.5.1. Literature Review

Amongst the themes found, the literature studies of the various resources (Alkhoraif et al., 2019, Alturkistani, 2018, Macias de Anda, 2018, Welo et al., 2012, Yang, 2012) discussed **(a) Lean theory** in varying levels of detail. These resources explored and established views on Lean history, definitions and principles. They further went on to discuss **(b) barriers and drives of Lean**, this allowed them to understand what factors to include and exclude from their frameworks, thereby increase the rate of success when implemented (Yang, 2012, Mostafa et al., 2013, Macias de Anda, 2018, Bhamu et al., 2013, Alturkistani, 2018). Another strategy applied by many authors was to investigate **(c) other frameworks within the research topic**, thus allowing them to establish norms of the field and lean frameworks (Alturkistani, 2018, Almutairi et al., 2019, Anand & Kodali, 2009, Bhamu et al., 2013, Lermen

et al., 2018, Maqbool et al., 2019, Perez, 2014, Welo et al., 2012, Yang, 2012). Additionally, some papers inspected change models, in order to allow for the incorporation of **(d) change management aspects** into the developed Lean framework (Alturkistani, 2018).

Categories found \ Author(s)	Alkhoraif et al. (2019)	Almutairi et al. (2019)	Alturkistani (2018)	Anand and Kodali (2009)	Bhamu (2013)	Lermen et al. (2018)	Macias de Anda (2018)	Malaeb and Hamzeh (2018)	Maqbool et al. (2019)	Mirdad and Eseonu (2015)	Mostafa et al. (2013)	Perez (2014)	Welo et al. (2012)	Yang (2012)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Literature Studies														
(a) Lean	X		X				X			X			X	X
(b) Drivers and barriers to Lean			X		X		X				X			X
(c) Other frameworks within the research topic		X	X	X	X	X			X			X	X	X
(d) Change models			X											
2. Approaches or Methods														
(a) Transformation-flow-value (TFV)								X						
(b) Sociotechnical systems theory							X							
(c) Exploratory factor analysis					X									
(d) Strategic management process model							X							
(e) Surveying of experts for input			X											
3. Design Elements														
(a) Surveying of experts for input			X							X				
(b) Stages, phases or levels		X	X	X	X	X	X	X	X	X	X	X	X	X
(c) Aspects of Lean implementation		X		X	X				X			X		X
(d) Original Lean aspects (tools, techniques, methods or principles)	X	X	X	X	X	X	X	X		X				X
(e) Drivers and barriers	X		X		X		X				X			X
(f) Aspects of the research topic	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(g) Aspects of change models		X												
4. Framework Testing														
(a) Interviews														X
(b) Case studies of companies			X	X		X			X				X	
(c) Questionnaires							X							X
(d) Computational											X			
(e) Surveys			X								X			

Figure 3. Breakdown of categories and themes found in the resources

4.5.2. Approaches or Methods

Upon studying the various approaches or methods utilised to create the Lean frameworks, it could be seen that authors have their individual methods and that there is no standard/generic method to utilise. One paper utilised the **(a) transformation-flow-value (TFV)** method, which allows for the evaluation of Lean KPIs in the three perspectives (Transformation, Flow and Value). Where transformation evaluates the inputs and outputs of a process, flow studies all the flows between processes, and value considers the customers' requirements. The TFV method allowed for the development of a Lean Framework that works on all three levels (Malaeb and Hamzeh, 2018).

Another study (Macias de Anda, 2018) applied **(b) Sociotechnical Systems Theory** as an approach to developing a Lean framework. This incorporates four subsystems: Humans, Work Organisation, External Environment and Technology, which when utilised together with Lean philosophy gives a holistic view of how the Lean framework will function. Macias de Anda (2018) explains that Sociotechnical Systems Theory allowed for integration of national culture, Lean and the manufacturing system within the design framework.

The same study (Macias de Anda, 2018) also used **(c) Strategic Management Process** as another method due to its ability to determine the effects of Lean by analysing its influence on the organisational performance. This method consists of four phases: Intent, Formulation, Implementation and Evaluation (Macias de Anda, 2018), which allowed for the development of the Lean Framework and evaluation on a strategic level.

Bhamu et al. (2013) used the method of **(d) Exploratory Factor analysis**, which permitted the analysis of various factors on Lean (Bhamu et al., 2013). This study explored three factors and developed the framework around that, namely: Organisational policies, External and Internal drivers of Lean implementation (Bhamu et al., 2013). This study also utilised the barriers and drivers of Lean, by translating them into factors that should be incorporated into the framework, thus ensuring a higher success rate of Lean (Bhamu et al., 2013).

A study by Alturkistani (2018) utilised **(e) surveying experts** as a means for input for the frameworks structure and content (Alturkistani, 2018). This study designed and conducted surveys on experts to investigate the requirements for the field specific Lean framework, which allowed for the inclusion of factors that often contribute to the success of an implementation.

4.5.3. Design Elements

When analysing the various frameworks found during the SLR, trends and patterns in terms of design elements began to emerge. One study (Alturkistani, 2018) utilised **(a) input from surveys with experts** as design elements for the Lean framework. This created design requirements from the survey inputs. Furthermore, almost all the studies reviewed had a common design element as almost all frameworks contained **(b) stages, phases or levels** (Alturkistani, 2018, Almutairi et al., 2019, Anand and Kodali, 2009, Bhamu et al., 2013, Lermen et al., 2018, Macias de Anda, 2018, Malaeb and Hamzeh, 2018, Maqbool et al., 2019, Mirdad and Eseonu, 2015, Mostafa et al., 2013, Perez, 2014, Welo et al., 2012, Yang, 2012). The various stages, phases or levels convey the complexities and requirements of the framework for different parties within the organisation.

Multiple studies utilised **(c) aspects of Lean implementation** in their Lean frameworks, which enables authors to create design requirements that aid in Lean implementation, thereby increasing the chance for a successful Lean implementation of the Framework (Almutairi et al., 2019, Anand and Kodali, 2009, Bhamu et al., 2013, Maqbool et al., 2019, Perez, 2014, Yang, 2012). Moreover, most Lean frameworks also contained **(d) original aspects of Lean**, such as tools, techniques, methods and principles (Alkhoraif et al., 2019, Almutairi et al., 2019, Alturkistani, 2018, Anand and Kodali, 2009, Bhamu et al., 2013, Lermen et al., 2018, Macias de Anda, 2018). By doing this, authors ensure that their framework stays true to the intended philosophy of Lean, whilst incorporating their new work.

Numerous frameworks (Alkhoraif et al., 2019, Alturkistani, 2018, Bhamu et al., 2013, Macias de Anda, 2018, Mostafa et al., 2013, Yang, 2012) made use of the **(e) drivers and barriers of Lean** as design elements. This entailed researcher converting barriers into design requirements and utilising the drivers as design requirements, thus ensuring a better chance of a successful implementation. All the studies made use of **(f) aspects of the research topic** as a design element in their frameworks, thereby incorporating recognisable elements of the relevant field in which the framework will be implemented. However, only one study (Alturkistani, 2018) used the important **(g) aspects of change models** as a design element. This study aimed to incorporated aspects of change management into the framework, as to ensure a smoother transition when utilising this framework.

4.5.4. Framework Testing

There is an abundance of methods to test a developed framework. One study (Yang, 2012) utilised **(a) interviews** with academic experts and administered **(c) questionnaires** to industry experts to validate the Lean framework. This allowed for feedback from experts to incorporated into the framework, thereby improving it (Yang, 2012). Likewise, another study (Macias de Anda, 2018) utilised a questionnaire to validate its framework. It is imperative to note the difference between questionnaires and surveys: Questionnaires are designed and analysed via statistical analysis (Bartolucci, Bacci & Gnaldi, 2015), whereas surveys do not need to be designed via statistical methods. Additionally, some studies (Mirdad and Eseonu, 2015, Alturkistani, 2018) made use of **(e) surveys** in order to

validate their frameworks. In a similar vein to the questionnaires, these studies surveyed experts to gain feedback on the frameworks, and as such to incorporate it.

One study (Mostafa et al., 2013) conducted **(d) computational testing** on their framework, by using mathematical models to analyse the trade-offs between aspects within the framework concerning Lean and Lean practices (Mostafa et al., 2013). In Addition, several studies (Alturkistani, 2018, Anand and Kodali, 2009, Lermen et al., 2018, Maqbool et al., 2019, Welo et al., 2012) conducted their testing via **(b) case studies of companies**, where the frameworks were implemented at organisations and altered based on implementation results.

4.6. Step 9: Reporting

After the SLR was conducted, it became evident that there were various aspects that play a role in the formation, creation or designing of a Lean framework. The various aspects (mentioned in section 4.5) were utilised to design the House of Guidance for designing a Lean framework (Figure 4), providing guidance for future researchers when designing a Lean framework. Figure 4 was fashioned in the image of the Toyota way house, which is an iconic artefact in Lean philosophy (Liker, Hoseus, People & Organizations, 2008). It starts off by creating a strong foundation that is grounded in research, by suggesting that researchers explore some specific aspects during their literature study phase. Thereafter, Pillar A and Pillar B should be considered in parallel. Scholars should select a design method to follow, and design elements to include when creating their framework. Lastly, the house is sealed off with a sturdy roof in the form of testing the framework. Researchers are prompted to select an appropriate strategy for evaluating the applicability and reliability of their designed frameworks.

The roof – Testing the created framework
(Select a strategy for evaluating the framework)
- Interviews
- Case studies of companies
- Questionnaires
- Computations
- Surveys

Pillar A – Approaches or Methods
(Select a design method)
- Transformation-flow-value (TFV)
- Sociotechnical systems theory
- Strategic management process model
- Exploratory factor analysis
- Surveying of experts for input

Pillar B – Design Elements
(Select elements that may be used as design requirements)
- Surveying of experts for input
- Stage, phases or levels
- Aspects of Lean implementation
- Original Lean aspects
- Drivers and barriers
- Aspects of the research topic
- Aspects of change models

The strong foundation – Literature study or Research
(Research at least these topics for more understanding)
- Lean philosophy
- The drivers and barriers of Lean
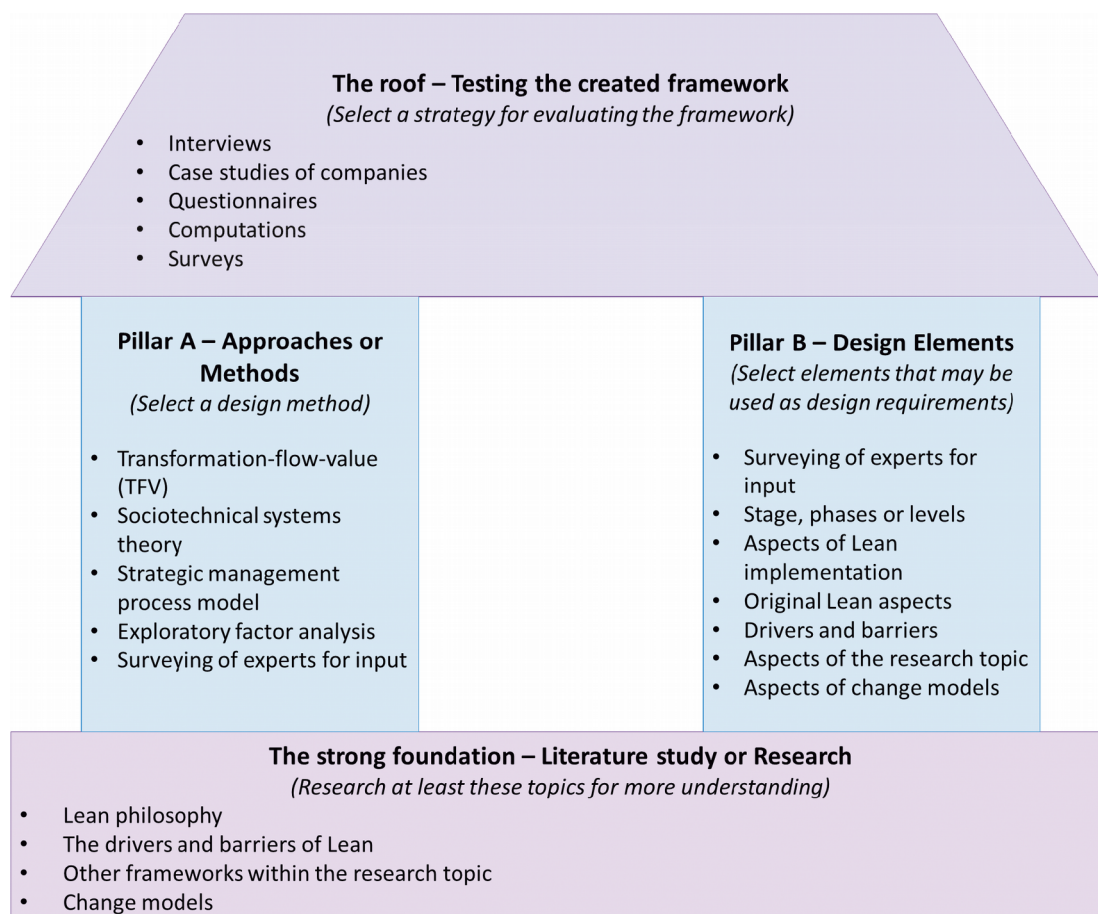- Other frameworks within the research topic
- Change models

Figure 4. House of guidance for designing a Lean framework

5. Discussions and Conclusions

Due to the ever-growing interest in the Lean philosophy, a multitude of researchers have designed Lean frameworks, that incorporate aspects of the philosophy. However, there is no standardised/official method for specifically creating a Lean framework. Therefore, this SLR aimed to investigate the design methods and design elements for established Lean frameworks.

Whilst conducting this SLR, the need for an in-depth literature study prior to designing a Lean framework was highlighted. Majority of the studies found in this SLR started with a literature study to investigate aspect such as Lean, barriers and driver of Lean and other frameworks within the research topic. This allowed them to have a foundation of common elements in Lean frameworks and to incorporate factors that will increase the chance of success for their frameworks during implementations. Therefore, it is recommended that when designing a Lean framework, at least the following topics be investigated during the literatures study:

- **Lean philosophy** – In order to understand the various tools and techniques within the Lean philosophy
- **The drivers and barriers of Lean** – In order to incorporate factors to increase success (drivers) and to convert the barrier of Lean into factors to avoid.
- **Other frameworks within the research topic** – In order to understand the elements and standards within the field.
- **Change models** – In order to incorporate elements of change management into a Lean implementation framework, as there will be a changeover period.

Although there were a host of methods and approaches discovered during this SLR, it is imperative to note that there are each specific to the type of study that was conducted. Thus, each of the methods and approaches best suited for the following types of research are:

- **Transformation-flow-value (TFV)** – This method is ideal for a specific organisation, as it considers the process, flows and customer requirements.
- **Sociotechnical systems theory** – This method may be utilised for a generalised framework, as it allows for the integration and consideration of Human elements, working organisation, external environments and technology. Furthermore, this method may allow for the integration of different cultures.
- **Strategic management process model** – This method may be used for a generalised framework, as it allows for the development of a strategic plan.
- **Exploratory factor analysis** – This method may be utilised for a generalised framework, as it allows for the selection between various elements for the framework.
- **Surveying of experts for input** – This method may be utilised for a generalised framework, as it allows for the input (in terms of content and structure) from field experts.

Whilst conducting this SLR, various design elements were observed in the different frameworks. These design elements may be converted into design requirements, in order to guide future Lean framework designs. Therefore, it is recommended that the design elements be considered as requirements, in the following regard:

- **Surveying of experts for input** – It is advisable to allow experts to view and give feedback on the framework. This will allow for the input of their industry experience and may increase the chance of success for the framework.
- **Stage, phases or levels** – Majority of the frameworks incorporate stages, phases or levels. Therefore, it is recommended that future Lean frameworks utilise stages, phases or levels, in order to convey the complexity of the framework, or explain how to implement the framework on different levels of the organisation.
- **Aspects of Lean implementation** – It is suggested that future frameworks incorporate aspects of Lean implementation, as it will make using the framework easier for organisations.

- **Original Lean aspects** – Most of the frameworks contain original aspect of Lean, such as tools and techniques. This allows for keeping true to the original aspects, while developing a new framework. Thus, it is recommended that future frameworks consider this as a design requirement.

- **Drivers and barriers** – It is advisable to utilise drivers and barriers of Lean as a design requirement, because it enable one to develop a contingency plan for barriers whilst enhance drivers, for maximum chances of success.

- **Aspects of the research topic** – All of the frameworks found in the SLR make use of aspects of the research topic, as it enables them to stay true to the content of the research topic whilst designing the new framework. Ergo, it is suggested that future frameworks use this as a design requirement.

- **Aspects of change models** – It is recommended that frameworks utilise aspects of change models as a design requirement, because it will ease organisations into using the framework.

Some of the studies found during the SLR evaluated their designed frameworks. By conducting tests, researchers were able to verify and/or validate their frameworks. The following methods or approaches may be utilised for testing a framework:

- **Interviews** – This method is valuable when one needs to get feedback and open discussions about the framework.

- **Case studies of companies** – This method is ideal for implementing the framework in companies, however, may take significant time to show results and feedback about the framework.

- **Questionnaires** – This method will enable one to get statistical feedback on their framework, which may be incorporated into a redesign of the framework.

- **Computations** – This method allows for the testing of a framework by using mathematical models to test aspects of the framework against current framework.

- **Surveys** – This method will allow one to get feedback on their framework, which may be incorporated into a redesign of the framework.

This SLR study investigated the methods and design elements of Lean frameworks, however it is recommended that future research be done on the method and design elements of Lean models as well. While the SLR only focuses on Lean frameworks, it is therefore suggested that future studies investigate frameworks in general, which may allow for a fulsome overview and comparison of frameworks over various fields of study. This study concentrated on investigating studies that created Lean frameworks, ergo it is advised that future research explore the implementation strategies and outcomes of Lean frameworks.

By investigating and reporting on the methods and design elements utilised for Lean frameworks, this study allows for futures studies to utilise the *House of guidance for designing a Lean framework* (Figure 4) as an overview of the themes in Lean frameworks. Moreover, it could guide future studies on what content to investigate during literature studies in order to create a comprehensive Lean framework. Furthermore, this study may advise academics on appropriate design methods or approaches for creating their specific Lean implementation frameworks. Additionally, the design element highlighted in this paper may be utilised as requirements in future frameworks, and the methods to test design frameworks will allow researchers to validate and/or verify their creations. Lastly, it is recommended that future researchers add onto the House of guidance as and when they discover new important factors in the creation of Lean frameworks.

Finally, considering that Lean is ever-growing and has been adopted by various organisations, the question still stands as to why more than 90% of Lean implementations unsuccessful. Is it possible that researchers and practitioners are missing a fundamental part of Lean during implementation? From this SLR, it is evident that very little focus is placed on change management, moreover none of the studies found discussed Human factor engineering. Thus, it can be deduced that minute emphasis is placed on the Human factors, yet it contribute largely to Lean philosophy in the original literature (Liker et al., 2008). Ergo, it is strongly recommended that future studies focus on the Human factors involved in Lean, in order to address the missing link in its successful implementation.

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