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SUCCESS CONDITIONS FOR LEAN MANAGEMENT IMPLEMENTATION, A MULTIFACED LITERATURE REVIEW

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Purpose: Lean Management is a widely implemented and very promising methodology for increasing productivity. However, only certain Lean initiatives bring real benefits. This study aims to identify the most important factors for determining successful Lean implementation in organisations.
Design/methodology/approach: This study employs the literature review methodology, including a narrative literature review and a systematic one. The text mining method with a specialised software is employed to perform a semantic interrelation analysis.
Findings: This study concludes that the primary success condition is top management engagement with Lean transformation in organisations. Lean needs to be treated as a strategic initiative with a real focus on operational performance. However, practically in Lean projects, managers should remember appropriate training, success criteria, effective communication and employee focus. The Lean Culture is also important for Lean success; however, it is not underlined on the practical level.
Practical implications: This study provides a practical guide to what managers need to pay attention to when leading a Lean transformation and considers both the general and operational factors for the implementation of Lean tools.
Originality/value: The research consolidates Lean critical success factors that are common and specific across industry sectors. This study proposes an original systematic review of Lean success conditions along with an evaluation of their importance.

Keywords: Lean, Lean implementation, critical success factors.

Category of the paper: Research paper, literature review.

1. Introduction

Achieving operational excellence is still a real challenge for many organisations. Even highly knowledgeable and well-organised companies often struggle with it. Organising the process flow across a company's departments quickly, effectively and efficiently is an issue of crucial importance that fundamentally influences business profitability and competitiveness. Researchers suggest many factors that might help with Lean implementation. They differ in many ways, such as plant size, product complexity/variety and companies' experience level with process improvement projects (Emiliani, Stec, 2005; Shah, Ward, 2003; Fulleron et al., 2014). The literature consensus is that the Lean philosophy requires a long-term view, respect for employees, a level of patience, a focus on processes and the ability to understand where waste happens in the company to use effective Lean tools. Various types of tools and techniques for improving processes have been proposed in the literature. Manuals and consulting industries can help managers and production workers understand how to implement these techniques successfully.

However, these tips and explanations are still not quite sufficient, and many fields of doubtfulness exist. It needs to be underlined that the main target of the Lean Manufacturing system is to accomplish more with less time and human effort while giving the customer what they want in a highly economical manner (Paranitharan et al., 2011). The vital question is, what are the crucial issues to be met by the organisation to introduce and perform Lean in such a manner? Today's literature output on Lean implementation appears plentiful and comprehensive enough to find an answer to this question. This study aims to identify Lean implementation success conditions. It employs the literature review methodology, including a narrative literature review and a systematic one. These are supported by automatic text mining with specialised software.

2. Bibliometric interrelation analysis

Nowadays, organisations are trying to apply traditional and modern management concepts to ensure a competitive advantage and increase the probability of survival and development. Among these concepts, Lean takes a significant position. In industrialised countries where year-by-year costs of production are rising, companies are required to reassess Manufacturing business models to be competitive in the market. To achieve assumed targets, organisations are looking for opportunities to reduce production costs and increase quality by implementing Lean (Connor, Cormican, 2021). Many researchers have discussed the effectiveness of the implementation of Lean in manufacturing companies, showing that 50% of North American

companies fail to achieve their goals (Richter, 2011), 2% of US enterprises achieve their goals fully, 24% achieve their goals partially (Pay, 2008) and 10% of UK businesses are fully achieving Lean Manufacturing targets (Bhasin, 2008).

Despite many implementation difficulties, organisations are still trying to improve business performance and processes. To identify the current state of Lean Manufacturing research and trends, a bibliometric analysis was conducted.

2.1. Database and inclusion criteria

To obtain information pertinent to this bibliometric interrelation research, data has been analysed from the Scopus database, a multidisciplinary database with more than 70 million records that includes the domains of science, technology, social sciences, medicine arts and humanities, and the WoS core collection, which is the world's best database for published articles and citations (Singh, Ravi, 2022). This study narrowed down the scope of the search to 'article title', 'abstract' and 'keywords' and included the words 'Lean', 'success factor*' and 'implementation'. The search was limited to only research publications in the English language.

The output of the search provided 614 records in WoS and 539 records in the Scopus database (a total of 1,153 publications). The initial data analysis proved that the proportion of articles in the total records was higher in WoS (77%) than in Scopus (67%). In cases of conference proceedings, more were in Scopus (21%) than in WoS (16%). Moreover, more book chapters were found in Scopus (5%) in comparison to WoS (2%).

In the next step, data from the WoS and Scopus databases were combined into one Excel file. Subsequently, filtering was applied to exclude duplicate publications, and the final Excel file included 940 publications. The final file has been uploaded to VOSviewer.

2.2. Keyword analysis

The text mining VOSviewer software searches specific parts of papers, such as a title or abstract, and displays its results as a map showing the frequency of search word appearance along with the co-appearance of automatically identified key notions. Passing through analytical procedures, the incidence was set at a minimum of 15 notions, and 80 notions have been passed to the map creation. However, many of these notions were excluded because they did not carry a substantial meaning in terms of studied issues; mostly, they were notions referring to the methodology, types of statistical analysis, etc. Established restrictions allow sufficient insights into the examined issue, as well as readability and ease of the understanding of the analysis output. The final network map is shown in Figure 1 below.

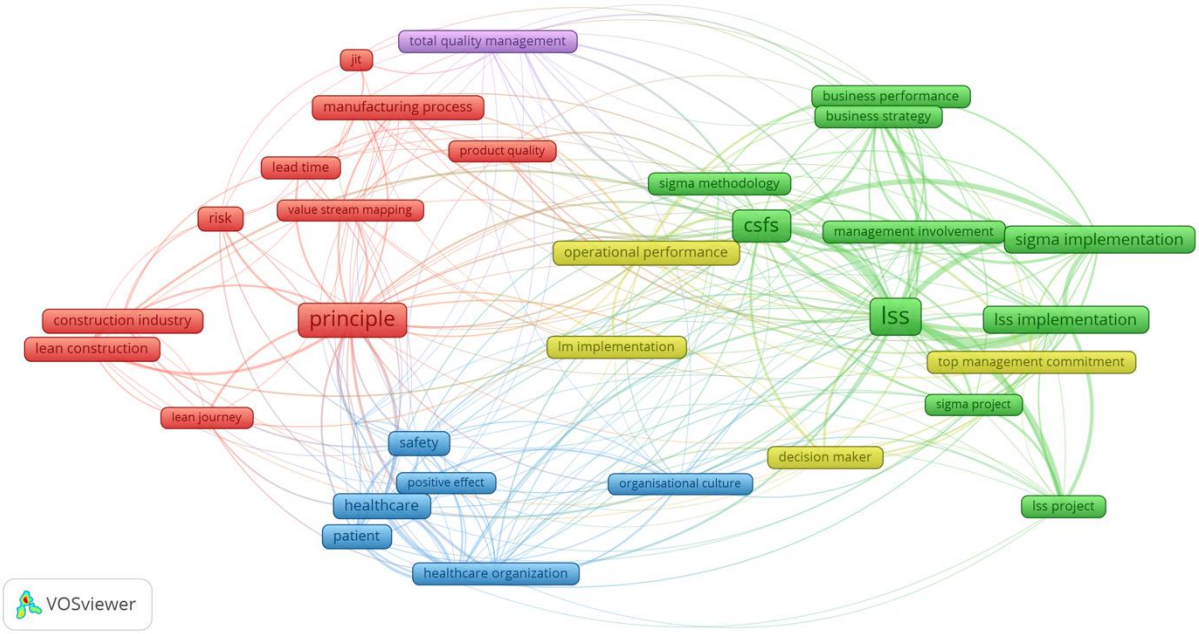

Figure 1. Bibliometric network map.

The size of the item's boxes and lines connecting them, along with its colours and locations, allow for an in-depth understanding of a semantic map (Figure 1). Critical success factors ('csfs' on the map) are in the centre of the map and are closely related to Lean Six Sigma ('lss') and words related to implementation. However, another important notion is 'principle', which expresses the five widely known Lean principles by Womack and Jones (1996). The literature shows that successful Lean implementation is very closely related to meeting the organisation's Lean principles, especially when considering Lean Six Sigma implementation.

The network map shows several issues that are noticeably related to the success factors of Lean. (1) Manager engagement in Lean initiatives appears to be a primary factor when it comes to Lean success. On the map, one can see the 'management involvement' item, and not far from it, the 'top management commitment'. The item 'decision maker' identified by the mining algorithm also leads to decision making at the management level. Another issue is (2) a strategic approach to Lean implementation in the organisation. The map shows two closely related items, 'business strategy' and 'business performance'. This suggests that the success of Lean may require the organisation to treat the system as a business strategy. (3) The focus on operational performance is seen by the literature as an inherent element of successful Lean implementation. 'Product quality' could also be considered an essential element of operational performance. (4) The organisational culture, according to the map, is also an issue playing an important role in successful Lean projects within organisations.

Lean success-related issues are often considered in the literature along with Six Sigma, Lean Six Sigma and total quality management. It appears that these management concepts are preserved by authors as one family. Thanks to the network map, it is possible to identify some industry-oriented trends of Lean implementation studies. It contains three item clusters

reflecting some intensive industry-oriented research: namely, the construction, healthcare and manufacturing industries. The last one brings some more success-oriented items, as the manufacturing industry is the oldest and most experienced sector in terms of Lean studies. These are Lean technique-related issues, such as value stream mapping (VSM), lead time, awareness and measure and the 'just in time' method. (5) Lean techniques designed in the manufacturing industry are another Lean success-related issue. Continuing this industry-oriented view on Lean success, it is necessary to consider two more items: risk and safety. According to the map, these factors are close to the construction and healthcare industry studies on Lean. Risk and safety are of primary importance for these industries. They could be considered equal to or perhaps more specific than the Lean implementation success measure. It implies that (3, the factor mentioned above) operational performance has different meanings in different industries, which needs to be considered when introducing a Lean transformation.

3. Differentiation of Lean implementation

An analysis of the literature reveals comprehensive factors of managerial aspects that need to be in place to support the successful implementation of Lean practices. It is important to note and emphasise, among scientific publications focused on Lean implementation, that there are discussions about sectors, regions and areas where Lean is implemented. Depending on the company, market and specific needs, Lean may take a different form, and other factors may be key to achieving success.

Table 1.
Key factors in Lean implementation based on sector

Author	Sector	Key factors in implementation
Al-Balushi et al. (2014) Kollberg et al. (2007)	Healthcare	• Bottleneck in process identified by loss analysis • Experienced project manager responsible for applied Lean • Activities and tools fitted to company needs (as part of the Lean concept) • Measurement of basic indicators defining results of the application of Lean
Murmura et al. (2021)	Metal industries	• Engagement production employees in identification losses • Scope of training carried out among all employees • Simplification of the production process – elimination of ineffective activities • High level of engagement of top management in the implementation process

Cont. table 1.

Veile et al. (2020)	FMCG (Fast Moving Customer Goods)	• Business needs to be identified and Lean tools need to be customised • Cultural changes since beginning of implementation – full engagement with whole company • Implementation leading by example and providing an unambiguous vision • Promotion of creativity and idea generation
Omotayo et al. (2018); Shurrab and Hussain (2018)	Construction	• Lean project manager and whole team has in-depth knowledge of production process • Flexible organisation policy • Measuring performance against predefined targets to check Lean progress • Ideas/suggestions from workers treated seriously to increase engagement in continuous improvements

Every sector has different business needs and bottlenecks to solve. Table 1 shows the main aspects defined by researchers during the implementation of a Lean initiative in particular case studies and specific sectors. Some aspects are the same in any case, like proper identification of losses in a company, and after that, choosing the best tool to reduce or eliminate loss.

Table 2.
Key factors in Lean implementation based on region

Author	Region	Key factors in implementation
Shokri et al. (2016)	Germany	• In preparation stage – understanding business needs and choosing proper tools • Rewards and recognition for fully engaged employees • Standardisation of key elements for Lean implementation
Taj and Morosan (2011)	China	• Lean project prioritisation to achieve success • Identification of cultural barriers in Lean implementation • Regular measurement of operational results of Lean initiative
Hoffman and Torres (2019)	Brazil	• Understanding business needs based on loss analysis • Standardisation of key principles for Lean implementation • Key role of managers in Lean promotion in whole company

In different regions due to cultural issues, some projects are managed by following a specific sequence and technique. Table 2 shows key factors of Lean implementation based on region. Similar to the sector context, the researchers are focused on confronting expectations from Lean implementation with its results.

Mostly, Lean scientific publications indicate production workers as a key point of success in Lean implementation. Proper understanding and engagement have a huge impact on results. Functional team leaders have a very important role in this process. Their main role is to convey the design assumptions set by management to all employees, who mostly represent a negative

approach towards change. Companies often forget to clearly define the responsibilities of individual units during the implementation of Lean tools. Most of the research focuses on the unit of analysis at the company level rather than at the level of the most important implementation positions. This makes it difficult to understand what is happening on the front line of implementation, as company-level analyses often fail to capture the insights and practices of on-the-shop floor levels. It seems that this gap needs to be filled. Most studies at present take a broad perspective when analysing critical implementation factors. Leadership practices are presented as a general list of recommendations (Katayama, 2017). Therefore, to gain a more thorough understanding of specific relevant factors, it is necessary to focus on the subset of factors that are most relevant to the organisation and study them in further detail during practical implementation.

4. Lean success factors

The decision about the implementation of Lean into a manufacturing company is extremely challenging and requires perfect preparation. The most important component is a comprehensive cultural shift at all levels of the organisation. Unsuccessful implementation impacts high implementation costs and employee resistance (Sreedharan et al., 2020). Morito et al. (2017) identified that failed initiatives influence employee confidence and anxiety to continue trying. Sometimes, a delay in termination of the Lean project is the first indication that a bottleneck in the process was wrongly defined or the chosen tools have not met company needs. Fullerton et al. (2014) assessed that Lean must be implemented as a whole, rather than as a partial business strategy. To achieve success in implementation, an organisation must tailor its tools to their unique context, and additionally, their approach must be part of a continuous journey rather than a short-term project. Netland et al. (2019) identified that leadership practices are normally presented as a generic list, arguing that they do not perfectly suit unique circumstances of the different hierarchical levels of management. Therefore, to gain more effective results, it is essential to focus on a subset of factors that are mostly relevant to the company and define the key success factors in this case.

A systematic literature review was conducted to identify key Lean success factors. After a thorough analysis of 28 articles, 16 factors have been identified:

1. Commitment of top management.
2. Realistic success criteria.
3. Appropriate communication models.
4. Training and education.
5. Effective system of awards and recognitions.
6. Appropriate selection of the implementation team.

7. Performance management system.
8. Concentration on production workers.
9. Sufficient resources.
10. Cultural change.
11. Project management skills.
12. Data-based approach and link to business strategy.
13. Lean project prioritisation.
14. Benchmarking system.
15. Precise selection of Lean tools.
16. Lean projects tracking and review.

Table 3.
Lean success factors identification

Article	Lean key success factors															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Achanga et al. (2006)		x		x			x	x	x			x	x			
Ahmad, Elhuni (2014)	x			x			x				x				x	x
Arumugam et al. (2012)		x			x			x		x		x				
Azyan et al. (2017)	x	x		x					x							x
Brun (2011)	x		x		x		x			x	x		x			
Connor, Cormican (2021)	x	x	x	x	x	x			x		x	x			x	
Coronado, Antony (2002)	x		x		x				x				x			x
Garcia et al. (2014)		x				x		x								x
Jedynak (2015)	x			x			x				x		x			
Jeyaraman, Kee Teo (2010)	x		x		x	x				x				x	x	
Karuppusami et al. (2006)	x	x		x				x		x		x	x			
Knol et al. (2018)		x	x	x				x			x			x	x	
Kwak, Anbari (2006)	x			x						x						x
Laureani and Antony (2017)			x	x	x		x	x		x		x			x	x
Losonci et al. (2017)			x		x				x	x						
Manville et al. (2012)			x			x			x	x	x					
Marodin, Tarcisio, (2015)		x		x				x				x			x	
Morito et al. (2017)	x	x		x		x	x		x			x	x			
Motwani (2001)	x		x	x							x					
Naslund (2013)						x								x		

Cont. table 3.

Netland (2016)	x			x		x		x	x			x			x	x
Rymaszewska (2014)	x	x	x		x		x	x					x			
Salaheldin (2009)	x	x		x		x						x			x	
Sila, Ebrahimour (2003)	x	x						x				x	x			x
Sim, Rogers (2008)	x		x		x		x	x	x							
Tari (2005)		x				x	x		x		x		x			x
Yadav, Desai (2016)			x		x	x			x	x			x			x
Zargun, Al-Ashaab (2013)	x			x			x	x			x				x	x
Total	17	13	12	15	10	10	10	12	11	9	9	10	10	3	9	11

Lean is an initiative aimed to fully understand processes and improve efficiency. Processes are influenced by many factors, and companies often have trouble identifying the root cause of process inefficiencies. Most activities are focused on production line operators and their team leaders who are responsible for the production of finished products. Therefore, responsibility for management consists of creating an environment in which employees want to come up with initiatives for changes and identify processes that do not provide any value to the manufactured product. To support this, managers need to choose the appropriate Lean tools to solve the identified problem. To identify the key success factors during Lean implementation, a review of scientific articles published in the last 20 years was carried out. Table 3 shows factors that are defined by various studies. As many as 17 authors identify ‘commitment of top management’, and 15 authors identify ‘training and education’ as crucial points during Lean projects. It is worth noting that both factors were defined 10 times in the same articles. Very often (eight times), authors identified the factors ‘realistic success criteria’ and ‘data-based approach to link to business strategy’ together and a strong connection between ‘Lean project prioritisation’ and ‘Lean project tracking and review’ (seven times). This means that these factors are strongly connected, and if both are achieved, the chances of success for Lean implementation increase. Many authors identified 5–9 Lean success factors in their research. It can depend on the scope of the Lean project, the number of engagement participants or the complexity of the Lean tool.

5. Lean tool implementation best practices

At present, the development of an effective continuous improvement strategy is a crucial factor of long-term growth in any organisation. More and more companies are looking for opportunities to simplify processes and find solutions to improve efficiency and quality.

Lean initiatives are implemented to support management strategies. Post-implementation targets should focus on maximising customer satisfaction and loyalty to the brand. Additionally, all activities that do not create value for the finished product should be eliminated. The scope of losses, size of processes and variables always are different. For this reason, Lean tools must be customised to business needs (Lande et al., 2016). To choose the best practices of Lean tools, the company must have fully identified the loss that they want to eliminate or reduce. Lean is not only a tool for process improvement, but also a complete paradigm for corporate process management, creating value for customers using the lowest investment possible (Womack et al., 1990).

5.1. 5S

First, 5S describes tools that can be applied in companies at the beginning of a Lean journey. It helps to define the rules to identify waste in processes and maintain safe Lean work environments. This does not require any specific analysis and can be implemented in all types of companies, from small business to large multinational organisations. 5S includes five steps: (Sort) remove everything that is not needed from the work area; (Set) ensure that all equipment is organised and each item has a designated place; (Shine) set new standards for cLeanliness; (Standardise) create a set of standards for both organisation and processes and (Sustain) maintain the new approach and conduct regular audits to ensure discipline (Barraza, Ramis, 2012). 5S helps to reduce costs by maximising process efficiency, safety and quality through the establishment and maintenance of a high-quality, cLean working environment.

5.2. A3 report

Among the various tools created to solve problems and develop best practices is the A3 report. This approach became popular among Japanese companies (Rodrigues, 2014). It is a simple tool to describe a problem on a single page in an easy and logical way. A3 consists of blocks categorised into (1) background, (2) current condition, (3) objectives/goals, (4) basic analysis, (5) proposed countermeasures, (6) implementation plan and (7) follow up. Moreover, A3 is a structured way of thinking rather than a standard document format (Rini, 2021). Thus, the basic elements in the A3 report can be adjusted according to the needs and conditions of each company. The A3 report is a standard format used by Toyota to analyse problems and make decisions aimed at achieving the best possible results and closing systemic inconsistencies. A3 reports focus on objectives and promote concision and focusing on what is truly crucial.

5.3. 8D

The next popular tool is the Eight Disciplines of Problem Solving (8D) method. This is a systematic method used to solve problems. This tool is a detailed, team-oriented approach to solve main problems in the production process by identifying the root cause and accurate definition of actions to prevent similar problems in the future. 8D reports comprise the following eight steps: (1D) team forming, (2D) problem description, (3D) introducing emergency measures, (4D) root cause analysis, (5D) permanent corrective action, (6D) implementation and validation of remedial measures, (7D) preventing recurrence and (8D) closing the case and creating the standard. Performed correctly, an 8D report improves quality and reliability of finished products and prepares engineering teams for future problems (Arumugam et al., 2012).

The main benefits of using an A3 report and 8D tools is the reduction of unplanned downtime and cost savings. Properly identifying the root cause of a problem ensures that the issue is solved and is included in the appropriate systems so that it can be performed once again under the planned working conditions.

5.4. SMED

Lean offers a variety of best practices for identifying and eliminating waste. Another tool is single-minute exchange of die (SMED). This is also known as a quick changeover. This tool refers to the practice of simplifying and improving operational setup activities (Jebaraj et al., 2013). It is a popular approach to eliminating the downtime losses of changeover and setup in the production process. It is focused on identifying activities that can be performed before the brand change or in a different sequence so that the time is as short as possible. SMED is a tool used to reduce the amount of time it takes to change from running one order in an operation to another order. In addition to improving the cycle time in a process, SMED also has an impact on reducing costs and increasing flexibility within a process. A successful SMED implementation will have benefits, such as lower manufacturing costs, faster changeovers and planned downtime reduction.

5.5. Kanban

Another popular tool is Kanban, which focuses on workflow management. Kanban represents a pull system, and it was designed to reduce the idle time in a production process. Its main role is to deliver what the process needs exactly when it is needed. The production process is designed to deliver what exactly is needed to make a business Leaner as a result of not holding excessive stock levels of all elements in production: raw, partly finished or finished materials (Zhang, 2013). Kanban provides the opportunity for more visibility and effective control of production processes. Additionally, production line operators can make related decisions, such as prioritising work and managing production orders. A properly working

Kanban tool improves warehouse management, reduces needed stock and gives alignment between business objectives, key results and delivery work.

5.6. VSM

Many authors indicate that VSM is one of the most fundamental Lean tools (Koenigsaecker, 2006; Jasti, Kodali, 2014; Andrade et al., 2016). Their studies suggest that the first best practice in Lean transformation is to create an enterprise-level VSM to fully understand processes. VSM relies on the detailed definition of each step of the process and then identifies all the important steps of the work processes needed to deliver value from start to finish. It visualises any tasks in the process and enables a full understanding of the influence of this task on the process. After that, it is possible to identify any waste in mapped processes. This best practice can help the organisation to achieve higher efficiency due to systematic capture and data analysis of bottlenecks in processes. VSM ensures that materials and human resources are used efficiently.

5.7. Heijunka

Nowadays, managers and business owners are aware of how difficult it is to maintain a stable workflow. As demand tends to fluctuate, companies should define tact time to keep up with the flow of orders, and with support of that manage to avoid overproduction. The Heijunka tool allows organisations to optimise their capacity in the most effective way to meet demand. It was created to reduce unevenness in a production process and minimise the chance of overburdening. This tool helps to manage production in a way that produces only what was ordered and keeps inventory costs low. The main benefits are efficiently meeting customer demands, a decrease of capital costs and an increase of profitability. According to Lean experts (Olsen et al., 2015), Heijunka is very effective as a later-stage implementation in Lean companies after value streams have been verified, solidified and refined and dependents are fully understood in the production process.

6. Discussion and conclusions

This study tries to put some arrangement into the compound issue of successful Lean implementation in the organisation; however, the main motive is to recognise conditions of Lean success and indicate those of primary importance. The literature indicates that the Lean methodology today needs to be considered wider, along with similar or hybrid methods, including the oldest total quality management. It can be assumed that all of them make a family of continuous process improvement systems. Supposedly, this whole family is characteristic of very similar success criteria.

The bibliometric network map identified several critical factors of successful Lean system implementation, namely:

1. Manager engagement in Lean initiatives.
2. Treating Lean as a strategic component.
3. Real struggle for operational performance; industry specific approach is required.
4. Intentional building of Lean Culture within the organisation.
5. Effective introduction and practice of Lean tools.

The study shows how important industry-specific research is for Lean implementation. Studies focused on the manufacturing industry, which originally created the Lean concept, now they would be rather in the minority. Healthcare and construction industries are also important fields for investigating Lean implementation, along with critical success factors. However, a specific review of chosen publications has shown that differences in success factors are not fundamental.

The systematic literature review along with in-depth critical studies of several sources bring similar views of Lean success factors as the text mining method, but on a deeper level. First, it shows that the most important success factor in Lean transformation is manager engagement. Considering a few items appearing on the network map (Figure 1), including top management commitment, it can be concluded that there is a great deal of agreement here.

The next crucial success factors of Lean bring a refreshed and more practically focused view. The second important factor was found to be ‘training and education’, and the other highly ranked factors were ‘realistic success criteria’, ‘appropriate communication model’ and ‘concentration on production workers’. These factors noticeably reflect the practical journey of Lean transformation in the organisation. Carrying out Lean projects would probably be much more effective if responsible managers had these identified factors in mind. This indicates that the systematic literature review does not value cultural factors or the text mining method. This could have been due to the practical managerial focus that is considered when performing an in-depth literature review. The Lean Culture factor is of primary importance; however, it is not easy to implement or equipped with specific tools dedicated to this factor. Thus, the literature that is focused on practical Lean project implementation (mostly Lean tools projects) does not value this factor as much and does not always mention it directly.

Lean implementation should respond to defined business needs. Appropriately preparing and fully understanding processes are crucial steps to choosing proper Lean tools. The scope of Lean projects should be fit to the organisation. Further studies can focus on different databases to develop the possibilities to find more data about the success conditions for Lean management implementation.

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