



## Practical Implications and Future Research Agenda of Lean Manufacturing: A Systematic Literature Review

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# Practical Implications and Future Research Agenda of Lean Manufacturing: A Systematic Literature Review

## Abstract

Academic literature on Lean Manufacturing (LM) is widely available. However, due to its fragmentation, the contribution of LM from academic and practical perspectives is controversial. This paper establishes the practical implications of LM studies carried out worldwide and identifies novel research streams. A Systematic Literature Review (SLR) of peer reviewed journal articles was conducted. A total of 212 articles published in 52 journals during 2005-2016 were collected from four major management science publishers. An “affinity diagram” was applied to organize the data into natural and logical themes. Conceptual frameworks with regard to LM practical implications and future research direction were formulated. The results revealed the "vital few" academic journals which have published the majority of the LM articles. Meaningful themes of LM practical implications and future research suggestions were revealed and classified into two categories. In category one, themes related to the pre-implementation, implementation and post-implementation phases of LM were identified. In category two, themes related to the country in which the companies operated, the diverse managerial systems available, and the methodological research approach were identified. Main themes supported in the literature by most references were determined. Finally, respective statements of practical implications and future research were also analytically presented.

**Key words** – Lean manufacturing, Systematic literature review, Practical implications, Future research agenda.

## 1. Introduction

The current business environment is characterized by globalization, the opening up of new markets, fierce market competition and more demanding customers (Jasti and Kodali, 2014a). Under such circumstances, companies all over the world are facing many obstacles in their effort to survive and be competitive (Bevilacqua *et al.*, 2016). To find solutions to the challenges that manufacturing companies are subjected to, they need to adapt their management style (Shamah, 2013) and look for new manufacturing strategies (Nawanir *et al.*, 2016). Lean Manufacturing (LM) has been one of the most widely accepted manufacturing strategies and management styles deployed by organisations worldwide to enhance their business performance (Sharma *et al.*, 2016a). For this reason, the application of LM has spread from companies in developed economies, particularly the USA and Europe, to companies in developing economies, particularly in Asia and the Indian subcontinent (Chaplin *et al.*, 2016).

Following the widespread application of LM, its research and academic literature has increased, especially from the beginning of the twenty-first century (Bhamu and Sangwan, 2014; Samuel *et al.*, 2015). In this line, the current literature provides numerous commendable examples of the theory and practices of Lean, especially in discrete manufacturing (Marodin and Saurin, 2013; Camuffo *et al.*, 2015; Panwar *et al.*, 2015). The plethora of the LM studies carried out worldwide constitute the basis on which the present study is able to give insights into LM from a practical and research perspective.

Due to the various meanings, and their evolvement, in the literature around Lean philosophies, principles, and measurement, LM has not been clearly and consistently defined

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3 (Stone, 2012). According to Pettersen (2009), authors seem to have different opinions on  
4 which characteristics should be associated with the LM concept. Stone (2012) notes that  
5 confusion surrounding exactly what LM means has resulted in numerous implementation  
6 approaches often starting and ending with misguided efforts. For instance, Narayanamurthy  
7 and Gurumurthy (2016a) support the view that the diverse leanness assessment methodologies  
8 available in the literature have created complexities and confusion among both academicians  
9 and practitioners when they have to choose a suitable assessment method. Therefore, the  
10 confusion on a theoretical level is also problematic on a practical level when organizations  
11 aim to implement the concept (Pettersen, 2009; Narayanamurthy and Gurumurthy, 2016a).  
12 There are also considerable differences between LM as practiced in reality compared to many  
13 descriptions in the literature (Langstrand and Drotz, 2016). According to Stone (2012), the  
14 term Lean, and its association with “Japanese management” techniques, has caused confusion  
15 and difficulty when addressing LM outside of the manufacturing context. Langstrand and  
16 Drotz (2016) state that the ambition of predicting the output results based on a general  
17 concept such as Lean is unreasonable, given that what is done under the LM banner differs  
18 from case to case. Lean takes many different forms (i.e. context, implementation and practice)  
19 which will have different effects on employees’ working environments, health and well-  
20 being. In this way, the relationship between LM and the working environment is not a simple  
21 one (Hasle *et al.*, 2012).  
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24 From the aforementioned discussion it is apparent that research on the implementation  
25 of LM needs to go beyond the ‘label’ and consider the operationalised practices associated  
26 with the general concept (Langstrand and Drotz, 2016). In light of this suggestion, and having  
27 in mind that LM is still a controversial concept in both academic and business environments  
28 (Hasle *et al.*, 2012), this study deals with its practical implications already provided by  
29 researchers to practitioners and identifies the need for future research studies. The results of  
30 study could therefore enrich the LM practical and theoretical implications. In so doing, the  
31 foundations are being set for clarifying the above mentioned controversies.  
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34 In contrast to the growth of publications, very few literature review articles on LM  
35 have been published (Jasti and Kodali, 2015). It is worth noting that there is a limited  
36 understanding of LM across industries at a conceptual and technical levels. This fact is  
37 supported by Abolhassani *et al.* (2016) studying US manufacturing, Jasti and Kodali (2016)  
38 examining Indian manufacturing, and Filho *et al.* (2016) focusing on Brazilian small and  
39 medium-sized enterprises (SMEs). Hence, LM practitioners are still experimenting through  
40 “learning by doing” to see what works and what does not, as practical implementation guide-  
41 lines have not been laid down yet (Anvari *et al.*, 2014; Tyagi *et al.*, 2015). Providing insights  
42 into the practical implications of LM as well as the future research agenda will fill the above  
43 mentioned literature gap and, moreover, make the understanding of LM across industries  
44 clearer, thus reducing the “learning by doing” phenomenon.  
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47 According to Tranfield *et al.* (2003), undertaking a review of the literature to provide  
48 the best evidence for forming policy and practice in any discipline is a key research objective  
49 for the academic and practitioner communities. As far as Lean is concerned, there is a need  
50 for a broader, more in-depth treatment of LM in the scientific literature (Arlbjorn and Freytag,  
51 2013). The substantial number of studies on LM implementation points to the need of  
52 organising the available knowledge and identifying the main research areas pertaining to this  
53 topic together with research opportunities (Marodin and Saurin, 2013). Hence, there is a need  
54 for a thorough review of empirical literature in the field of LM to identify its present practical  
55 approach and propose future research directions (Jasti and Kodali, 2014a). Continually  
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3 reviewing writings on Lean ensures that the learning is disseminated to the community of  
4 improvers (Samuel *et al.*, 2015). The present study follows the above mentioned suggestions  
5 for future literature review studies on LM practical implications and research agenda.  
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7 The Systematic Literature Review (SLR) methodology is applied in the present study.  
8 SLR is a fundamental scientific activity which produces a reliable stock of knowledge and  
9 enhanced practice in the management field. Consequently, practitioners and policy-makers  
10 can be provided with a reliable basis to formulate decisions and take actions (Tranfield *et al.*,  
11 2003). In this context, the present study contributes to the existing body of LM knowledge by  
12 systematically reviewing, firstly, the practical implications of the existing LM studies, i.e.  
13 their valuable insights, messages, guidelines to practitioners with regard to its  
14 implementation, and secondly, the LM's future research agenda. More specifically, the  
15 present SLR study groups the many practical implications of the existing LM studies and the  
16 future research suggestions into meaningful themes, and these themes in turn into broad  
17 categories, based on the use of the "affinity diagram" quality tool. In so doing, structured  
18 conceptual frameworks are formulated. Moreover, based on the themes mostly supported in  
19 the literature, specific LM practical and research guidelines are analytically proposed, so that  
20 LM implementation and research can be promoted among practitioners and research scholars  
21 respectively. In other words, the present SLR aims at answering the following research  
22 questions:  
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25 RQ<sub>1</sub>: What are the main themes of the practical implications of the LM studies carried out  
26 worldwide so far?

27 RQ<sub>2</sub>: What are the main themes of the suggestions for future research in LM proposed by  
28 researchers/authors?  
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31 Table I summarizes the objectives and the main findings of previous literature review  
32 studies on LM and those of the present study. From this table, it is apparent that the present  
33 study goes beyond previous literature reviews on LM, given that their objectives are different  
34 from those of this study. Thus, the originality of the present SLR study is strongly supported.  
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**Table I:** Previous literature review studies in the field of Lean

<b>Authors</b>	<b>Objectives</b>	<b>Main findings</b>
Stone (2012)	Determining the phases of Lean and the core knowledge and voids from the past four decades of scholarly Lean literature (1970- 2009).	Five themes evolved from the analysis starting with the Discovery phase (1970 1990), Dissemination phase (1991-1996), Implementation phase (1997-2000), Enterprise phase (2001-2005), and the most recent phase of Performance (2006-2009). There is a lack of theoretical connections associated with planned organisational change and Human Resource Development interventions.
Hasle <i>et al.</i> (2012)	Studying the effects of Lean on the working environment and employee health and well-being, based on publications from 1999 to 2009.	There is strong evidence for the negative impact of Lean on both the working environment and employee health and well-being in cases of manual work with low complexity. However, examples of positive effects were also found in the literature.
Moyano-Fuentes and Sacristan-Diaz (2012)	Exploring the relationships that arise in the research of Lean Production (LP) from the end of the 1980s to 2009 and the directions for future research.	Research on LP should be viewed in a broader basis than the shop floor and value chain levels. Two new dimensions for the analysis of research on LP are identified: work organisation in Lean environments and the impact of the geographical context on LP.
Powell (2013)	Presenting the most critical areas for further research into the role and implications of ERP (enterprise resource planning) systems in LP, based on the literature published after the year 2000 and up to 2011.	The academic literature on ERP and LP was classified into the most prominent subject areas: combining Lean and ERP for competitive advantage, methods for the concurrent application of Lean and ERP, ERP support for LP, real-time information for intelligent planning and execution of LM operations, ERP systems for the extended Lean enterprise; and e-Kanban as a platform for integrating ERP and pull systems.
Jasti and Kodali (2014a)	Focusing on the research methodologies used in Lean and their related facets as well as the future directions of Lean research, based on publications from 1990 to 2009.	It is concluded from the analysis of the results that: theory building and theory verification articles are equally advanced; the researchers have also failed to explore various aspects of empirical research such as the importance of triangulation of data, alternate research designs other than survey and case studies; contextual focus is mostly on the manufacturing industry; more focus is required on other aspects of empirical research such as collecting the samples from developing and undeveloped countries, a larger sample size, longitudinal data collection methods; there is a need of LM frameworks to remove all kinds of wastes.

(Continued)

**Table I** (continued)

<b>Authors</b>	<b>Objectives</b>	<b>Main findings</b>
Bhamu and Sangwan (2014)	Presenting the divergent definitions, scopes, objectives and tools/techniques /methodologies of LM, published in studies over the period 1988-2012.	There is a plethora of LM definitions with divergent objectives and scope. Theory verification through empirical and exploratory studies has been the focus of research in LM. The automotive industry has been the focus of LM research but LM has also been adopted by other types of industries. One of the critical implementation factors of LM is the simultaneous adoption of leanness in the supply chain. LM has become an integrated system composed of highly integrated elements and a wide variety of management practices. Standard LM implementation process/framework is lacking.
Jasti and Kodali (2015)	Determining the status of LP and its improvement, based on research articles published from 1988 to 2011.	The findings include: an increase in empirical research articles, a need of applying Lean principles in the field of product development and enterprise level areas, a need of more interregional research collaborations, a need of Lean elements as a group instead of an individual element, a need of avoiding seven Lean wastes instead of specific waste and a lack of testing and validation of the proposed frameworks/models by researchers.
Samuel <i>et al.</i> (2015)	Studying patterns and trends of literature from 1987 to 2013, that could explain the acceptance of Lean as an operations management philosophy.	Four key themes have emerged: Lean as a representation of the Toyota Production System which highlighted the origins and antecedents of Lean; Lean as a process improvement methodology which highlighted the need to compare Lean with other process improvement methodologies; Lean as a movement which highlighted the characteristics of Lean's evolution over time; and Lean as an academic body of literature which highlighted the diversity of perspective and opinion that Lean has inspired.

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**Table I** (Continued)

<b>Authors</b>	<b>Objectives</b>	<b>Main findings</b>
Hu <i>et al.</i> (2015)	Studying the implementation of Lean in small and medium sized enterprises (SMEs) (key characteristics, implications for practitioners and future areas of research), based on studies published up to the beginning of 2015.	Four key themes have been drawn from the SLR, including what scope/type of Lean is being adopted by SMEs, how Lean is implemented in SMEs, the impact of Lean on SMEs and the Critical Success Factors for Lean in SMEs. A list of areas for future research is as follows: conducting LM research in SMEs using mixed methods, multiple case study or action research, and in developing regions and service-based organisations; looking into the underlying logic for choosing and deploying Lean tools in SMEs; investigating Lean at higher organisational and theoretical levels; examining issues connected to strategy and philosophy of SMEs and making comparisons between SMEs and large enterprises.
Narayanamurthy and Gurumurthy (2016a)	Studying the evolution of the Leanness assessment literature (research objectives and methodologies and potential future research directions) published before January 2014.	Leanness assessment methodologies developed are wide ranging, varying from a simple qualitative checklist to complex quantitative mathematical models. Lean thinking (LT) assessment literature is also getting transformed from process-level monitoring to enterprise-level monitoring. A simplified leanness assessment framework is proposed for future validation consisting of LT pre-implementation assessment, LT practices implementation assessment, and finally LT outcome assessment. Future research is also suggested in the direction of scale development for assessing Lean in service organizations and explaining the selection of appropriate assessment methodology based on the firm's current position on the Lean implementation journey.
The present study	Identifying the practical implications of the LM studies carried out worldwide so far as well as the future research suggestions, based on studies conducted from 2005 to 2016.	A plethora of practical implications and future research suggestions are identified. Structured conceptual frameworks are formulated presenting key themes of the practical implications and future research suggestions. Furthermore, two broad categories of the themes of the practical implications and future research suggestions are also identified, one concerns the LM approach itself (themes pertaining to the internal nature of LM) and two, factors outside the LM approach (themes pertaining to the external nature of LM).



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3 The rest of the paper is divided as follows: in Section 2 the SLR conducted, and its phases, are  
4 described; the results of the SLR are then analytically presented in Section 3 by describing the  
5 profile of the articles reviewed, the practical implications of the studies carried out to date and  
6 the future research agenda. In Section 4, the results are discussed and the conclusions and  
7 implications of the present study are presented. Finally, the limitations of the study and the  
8 proposal of the authors for further research are presented in Section 5.  
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## 10 **2. Methodology**

11 A huge amount of literature exists in numerous databases and journals regarding LM. This  
12 body of knowledge, however, is not easily accessible to policymakers and practitioners.  
13 Moreover, the process of locating, retrieving and reading the literature is time-consuming for  
14 academicians (Thomas *et al.*, 2004). Thus, to achieve the aims of the present study and  
15 provide practitioners and academics useful insights into the practical implications of LM  
16 studies and the future research agenda, a comprehensive review of the existing literature of  
17 LM was undertaken. It is worth noting that in the field of LM, the existing literature review  
18 studies are either traditional or systematic (Table I). A SLR was adopted in the present study  
19 for the following reasons. First, a SLR differs from traditional literature reviews as it adopts a  
20 more replicable, scientific and transparent process for the literature search and analysis  
21 (Tranfield *et al.*, 2003; Hu *et al.*, 2015). Second, it provides clearer and more detailed  
22 guidance to assist researchers in how to conduct the literature review and present results, and  
23 gives a more comprehensive discussion about how to analyse the literature (Hu *et al.*, 2015).  
24 Third, it minimizes bias and errors providing a review with high-quality evidence and an audit  
25 path of the reviewers' decisions, procedures and conclusions (Tranfield *et al.*, 2003). Finally,  
26 it has been widely applied in various fields of management research, including those  
27 concerned with supply chain, operations management (Hu *et al.*, 2015) and Lean (Hu *et al.*,  
28 2015; Albliwi *et al.*, 2015).  
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32 In the following sections, the stages of the SLR methodology suggested by Tranfield  
33 *et al.* (2003) and adopted in the present study are presented. Previous SLR studies on LM, e.g.  
34 Albliwi *et al.* (2014), Hu *et al.* (2015), and Albliwi *et al.* (2015), were also conducted based  
35 on such methodology.  
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### 37 *Stage I – Planning the review*

38 Having identified the need for a literature review study in LM, the main phase of this stage  
39 includes the preparation and the development of the review protocol (Tranfield *et al.*, 2003).  
40 The authors formed a review team and held meetings to direct the review process. The team  
41 then discussed the research problem, identified the previous debates surrounding the field and  
42 formulated the research questions based on the objectives of the study. The population of the  
43 present study, the search strategy for the identification of relevant studies, the criteria for  
44 inclusion/exclusion of studies as well as their quality assessment method were also  
45 determined at this stage (Tranfield *et al.*, 2003).  
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48 Explicitly, four well-known management science publishers of peer-reviewed  
49 academic journal articles, namely: Emerald, Science Direct, Springer and Taylor&Francis,  
50 were employed, following the approach adopted by Jasti and Kodali (2014a; 2015) and due to  
51 the limitations presented by incomplete access to several other databases. In order to avoid  
52 missing relevant literature, the search was extended to the entire database of the publishers  
53 but not to certain specialist journals in the field (Saggese *et al.*, 2015). Similar to the  
54 literature review study of Bhamu and Sangwan (2014), literature review, conceptual,  
55 descriptive, exploratory, and empirical papers including case studies, surveys and best  
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practices were considered in the sample. In order to restrict the search to articles relevant to the scope of this study, inclusion and exclusion criteria were formulated by the review team (Table II).

**Table II:** Inclusion and exclusion criteria for the literature review

Inclusion criteria	Exclusion criteria
Articles published between 2005 and 2016	Any publication before the year 2005 and after 2016
Well-known databases: Emerald Online, Science Direct, Springer Link and Taylor & Francis	Non-academic databases
Academic journals	Books, online sites and grey literature (conferences, master's theses, doctoral dissertations, textbooks, reports, working papers from research groups, technical reports, etc.)
Fully accessed articles	Non-fully accessed articles
Articles studying Lean implementation issues (e.g. Lean principles, tools/techniques, performance, assessment, Leanness)	Articles studying an individual Lean principle or tool/technique
	Articles studying Lean-Six Sigma, Lean-Agile and Lean-Green implementation issues
Articles highlighting practical implications and/or future research agenda	Articles not highlighting practical implications and future research agenda
Articles related to the manufacturing sector	Articles related to the services sector
The unit of the analysis is the organization itself	The unit of the analysis is the supply chain network
Articles written in the English language	Articles written in a language other than English

The the period for the present study was established to comprise from 2005, given that before that year LM research was in its infancy. Stone (2012) and Bhamu and Sangwan (2014) noted that from 2005 onwards the number of LM articles increased substantially. Similarly, the literature analysis of Samuel *et al.* (2015) indicated that the highest peaks of the curve displaying the evolution of LM publications were observed after 2005. Reviewing a long period of LM contemporary publications, where LM transformations were more successful due to its strategic alignment throughout the enterprise, was also an objective of this SLR. According to Stone (2012) and Bhamu and Sangwan (2014), the focus period 2000-2005 was the shift from implementing LM exclusively on the manufacturing shop-floor to other areas of the enterprise, including product development, marketing, sales, service, accounting, and other white collar jobs.

The literature search was based on the following terms: Lean manufacturing, Lean production, Lean principles and practices/tools/techniques in manufacturing. Articles related to specific Lean tools were not taken into consideration since, nowadays, most of the empirical studies consider LM from a multidimensional perspective covering a variety of highly inter-related individual management practices in an integrated system (Camacho-Minano *et al.*, 2013). The review team made their decisions with regard to the main phases of this stage by consensus and any significant omissions or oversights resulting from the

selection of search terms, time periods, databases were properly addressed. This strengthened the quality of the systematic review process (Hu *et al.*, 2015).

### *Stage II – Conducting the review*

The main phases of this stage were: identification of research, selection of studies, quality assessment, data extraction & monitoring progress and data synthesis (Tranfield *et al.* 2003). In order to create the article sample and conduct the systematic review, search strings were constructed based on the search terms identified at the planning stage. An example of a search string included: (Lean) or (Lean manufacturing) or (Lean production) and (principles) or (practices) or (tools) or (techniques) and (manufacturing companies). The search strings were input into the bibliographic databases, resulting in myriads of related papers. Taking into consideration the title, abstract and keywords and, if these were not clear enough, reading the full paper, the articles were screened and examined for their fit within the research focus of the study. The disciplined screening process resulted in a final sample of 212 articles published in 52 journals (Table III), all of which were considered to be relevant. The process of article search and selection was checked by the review team while the results were discussed and any disputes over the inclusion and exclusion of studies were resolved during team meetings (Tranfield *et al.*, 2003; Hu *et al.*, 2015).

**Table III:** The list of journals considered in the present study

<b>Publisher - Journals</b>	<b>Number of articles</b>	<b>Percent</b>
<b>Emerald</b>	<b>87 articles</b>	<b>0.410</b>
Journal of Manufacturing Technology Management	22	0.104
International Journal of Operations & Production Management	16	0.075
International Journal of Lean Six Sigma	11	0.052
International Journal of Productivity and Performance Management	8	0.038
Benchmarking: An International Journal	5	0.024
British Food Journal	2	0.009
Measuring Business Excellence	2	0.009
Supply Chain Management: An International Journal	2	0.009
Management Decision	2	0.009
The TQM Journal	2	0.009
Business Process Management Journal	2	0.009
European Business Review	1	0.005
Grey Systems: Theory and Application	1	0.005
International Journal of Quality & Reliability Management	1	0.005
Management Research News	1	0.005
The International Journal of Logistics Management	1	0.005
Journal of Quality in Maintenance Engineering	1	0.005
Competitiveness Review: An International Business Journal	1	0.005
International Journal of Organizational Analysis	1	0.005
Journal of Engineering, Design and Technology	1	0.005
Journal of Modelling in Management	1	0.005
Research Journal of Textile and Apparel	1	0.005
VINE Journal of Information and Knowledge Management Systems	1	0.005

Industrial Management & Data Systems	1	0.005
<b>Taylor &amp; Francis</b>	<b>66 articles</b>	<b>0.311</b>
International Journal of Production Research	33	0.156
Production Planning & Control	21	0.099
Total Quality Management & Business Excellence	6	0.028
International Journal of Computer Integrated Manufacturing	4	0.019
Construction Management and Economics	1	0.005
Journal of Asia-Pacific Business	1	0.005
<b>Elsevier/Science Direct</b>	<b>43 articles</b>	<b>0.203</b>
International Journal of Production Economics	13	0.061
Journal of Operations Management	10	0.047
Procedia Manufacturing	3	0.014
Expert Systems with Applications	3	0.014
Management Accounting Research	2	0.009
Computers in Industry	2	0.009
Journal of Business Research	1	0.005

*(Continued)***Table III (Continued)**

<b>Publisher - Journals</b>	<b>Number of articles</b>	<b>Percent</b>
<b>Elsevier/Science Direct</b>		
Business Research Quarterly	1	0.005
Review of Applied Management Studies	1	0.005
The International Journal of Information Management	1	0.005
Business Horizons	1	0.005
Accounting, Organizations and Society	1	0.005
The Journal of Engineering and Technology Management	1	0.005
Computers & Industrial Engineering	1	0.005
The Journal of Cleaner Production	1	0.005
The European Management Journal	1	0.005
<b>Springer Link</b>	<b>16 articles</b>	<b>0.076</b>
The International Journal of Advanced Manufacturing Technology	10	0.047
Operations Management Research	2	0.009
The Journal of Intelligent Manufacturing	1	0.005
Systemic Practice and Action Research	1	0.005
Production Engineering Research and Development	1	0.005
The Journal of Business Ethics	1	0.005

The quality of the articles included in the sample was ensured by evaluating the fit between the research methodology used and the respective research questions formulated for the study (Tranfield *et al.*, 2003; Albliwi *et al.*, 2015). An excel spread sheet was created to extract general information from the sampled articles, including thier title, year of publication, journal title, authors, paper type, geographical research area, industry sub-sectors, number of companies or respondents participating in the research study and other features that covered practical implications and future research suggestions (Tranfield *et al.*, 2003; Hu *et al.*, 2015). Practical implications were reported by authors in their reviewed LM articles by using statements such as "a manufacturer can better prioritize implementation efforts and

resources.....", "attention should not only be paid along the production line, but....", "it helps managers overcome difficulties regarding.....", "a platform is provided to practitioners to take appropriate actions.....", "the model can be applied to industries.....", etc. On the other hand, future research suggestions were reported using statements such as "there is a need for further research on this subject .....", "it is necessary to continue studying the.....", "future research should also consider.....", "this is a question that needs to be explored.....", "more conceptual and empirical research is needed in order to clarify and validate the.....", etc. The quality tool "affinity diagram" was applied to organize and group the large number of the practical implications of the LM studies and future research suggestions (He *et al.*, 1996; Moura Sa and Martins, 2016). For this purpose, two excel spread sheets were created, one that included the narrative data of practical implications, and the second, the future research suggestions. Each statement of practical implications or future research was randomly placed in an individual cell. The next step was the grouping of these statements into clusters/themes, based on their affinity or inherent/natural similarity. The final decision for clustering the statements was based on the main element emphasized in each statement. The initial arrangement of these statements into themes, which were labeled according to the content of the respective statements, was reviewed by the team members. Themes supported by few statements were also taken into consideration, since the objective of the authors was to depict any possible dimension of the practical implications and future research of LM. Hence, all data was grouped into meaningful themes and into broad categories, from which structured conceptual frameworks were formulated (Chan *et al.*, 2009).

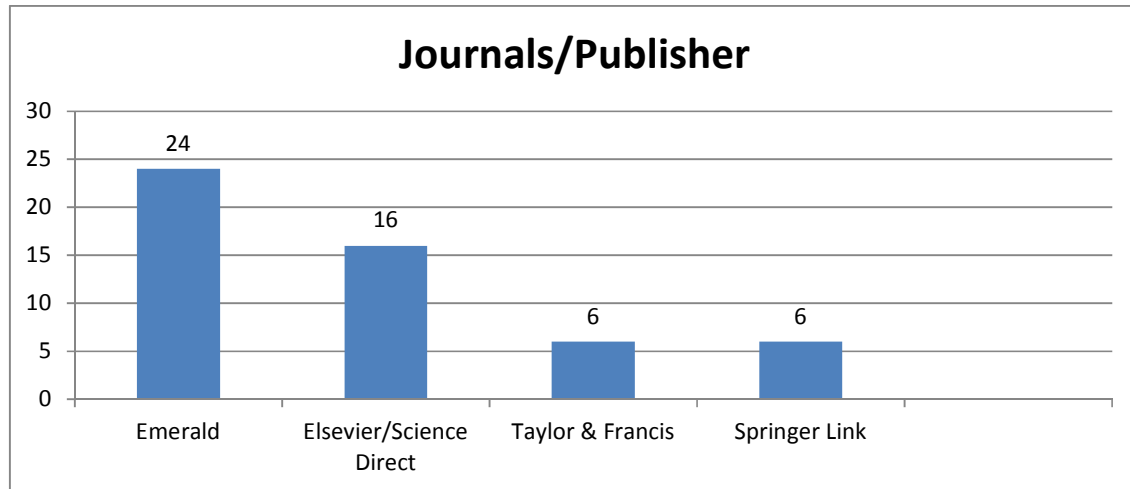
### *Stage III–Reporting and dissemination*

The main aspects of this stage are presenting the report, followed by recommendations and translating this into practice (Tranfield *et al.*, 2003). Based on the excel spread sheets developed during Stage II, the “current map” of the collected articles was critically presented and an in-depth look at the practical implications of the LM studies and the future research agenda was provided. This yielded a clear picture of the main issues for practitioners, research scholars and academics.

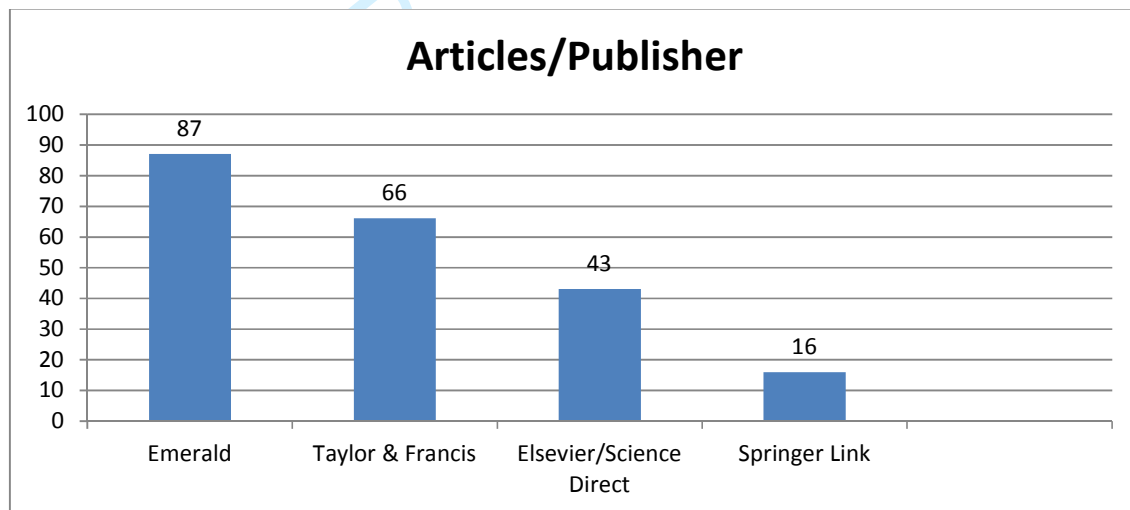
## **3. Results**

### ***3.1 Profile of reviewed articles***

Table III presents the distribution of the reviewed articles in the four publishing houses and the respective academic journals considered. The majority of the articles of each publisher had been issued in a limited number of journals. For example, only 5 out of the 24 journals of Emerald had published 71.3% of the LM articles of this publisher, 2 out of the 6 journals of Taylor&Francis had published 81.8% of the LM articles, 4 out of the 16 journals of Elsevier/Science Direct had published 67.4% of the LM articles, and 1 out of the 6 journals of Springer had published 62.5% of the LM articles. Figure 1 presents the distribution of the journals, whereas Figure 2 illustrates the distribution of the reviewed articles.



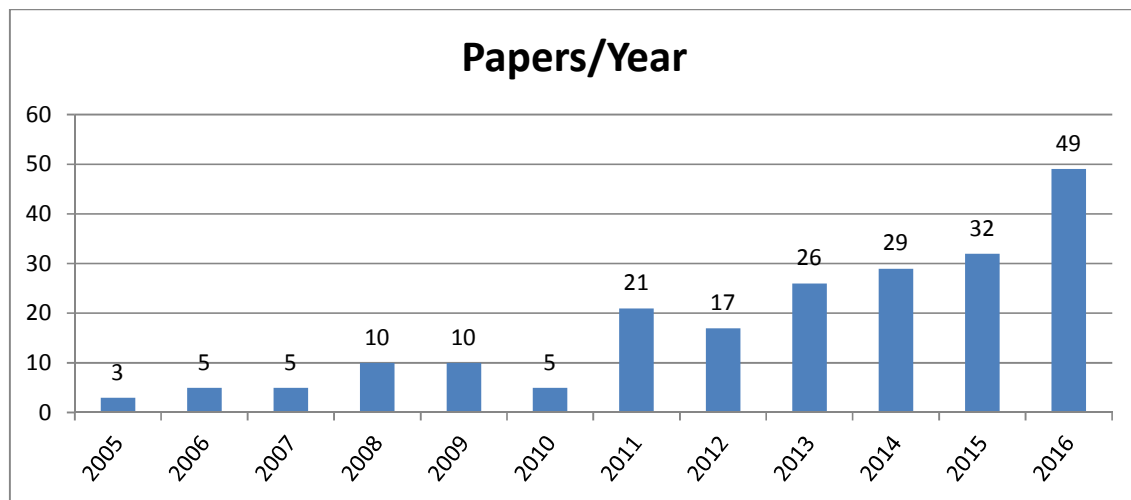
**Figure 1:** Journals per publisher



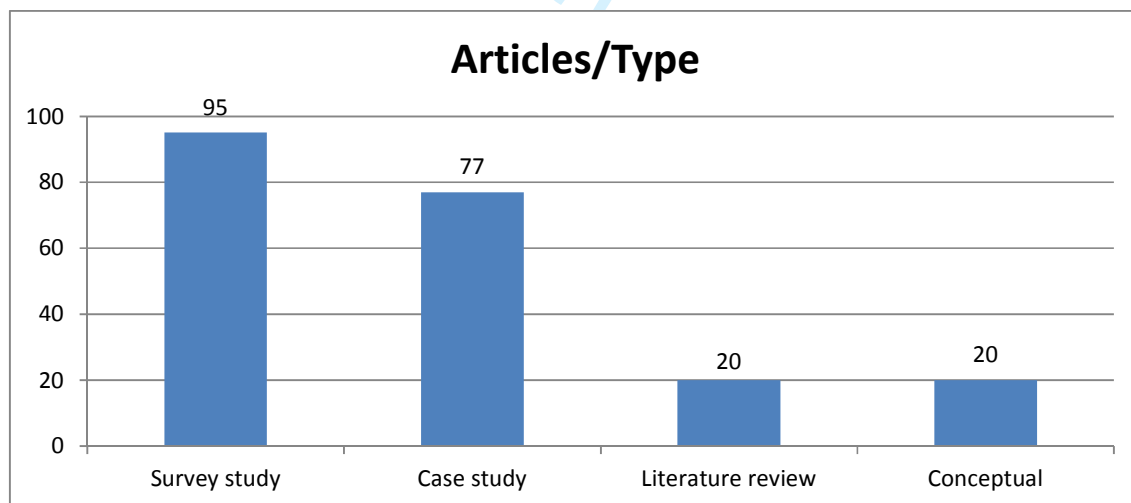
**Figure 2:** Articles per publisher

As far as the diachronic evolution of LM publication is concerned, Figure 3 shows that the number of the published articles increased from 2005 to 2016 while the vast majority of the sample articles (81.7%) had been published from 2011 onwards. Almost half of the sample articles (44.8%) describe surveys, 36.3% case studies, 9.4% literature reviews and 9.4% conceptual studies (Figure 4). Focusing on the articles describing surveys (95) and the research sample used in each survey, it is apparent that almost half of the surveys (46.3%) were based on a small research sample (< 100 samples), while the vast majority of the surveys (81.05%) were based on a research sample that was smaller than 300 (Figure 5). Similarly, focusing on the articles describing case studies (77) and the number of the case organizations studied, it is apparent that the majority of these studies (61%) were based on only one case organization. The remaining studies were multi-case studies (Figure 6). Finally, within the articles describing literature review studies (20), it is apparent that the vast majority of them (85%) had reviewed no more than 200 articles (Figure 7). Automotive, electrical/electronics, machinery, food, textiles and apparel, plastics and rubber, and chemicals were the manufacturing sub-sectors mostly examined in the surveys and case studies presented in the sample articles (Figure 8). Bearing in mind that the country of the sample industry plays a

vital role in LM results due to cultural and economic variations (Jasti and Kodali, 2014a), the present study further concentrated on analyzing the country of the sample industry by following the approach of Bhamu and Sangwan (2014), Jasti and Kodali (2015), and Hu *et al.* (2015). The companies participating in the studies of the sample articles operated in 53 countries on 6 continents (Table IV, Figure 9). The majority of these countries belong to Europe (43.4%) and Asia (30.2%) (Figure 9). Finally, the countries with the highest number of LM surveys and case studies were USA, UK, India, Brazil, Italy, Sweden, Spain and Germany (Table IV).



**Figure 3:** Articles per publication year



**Figure 4:** Article type

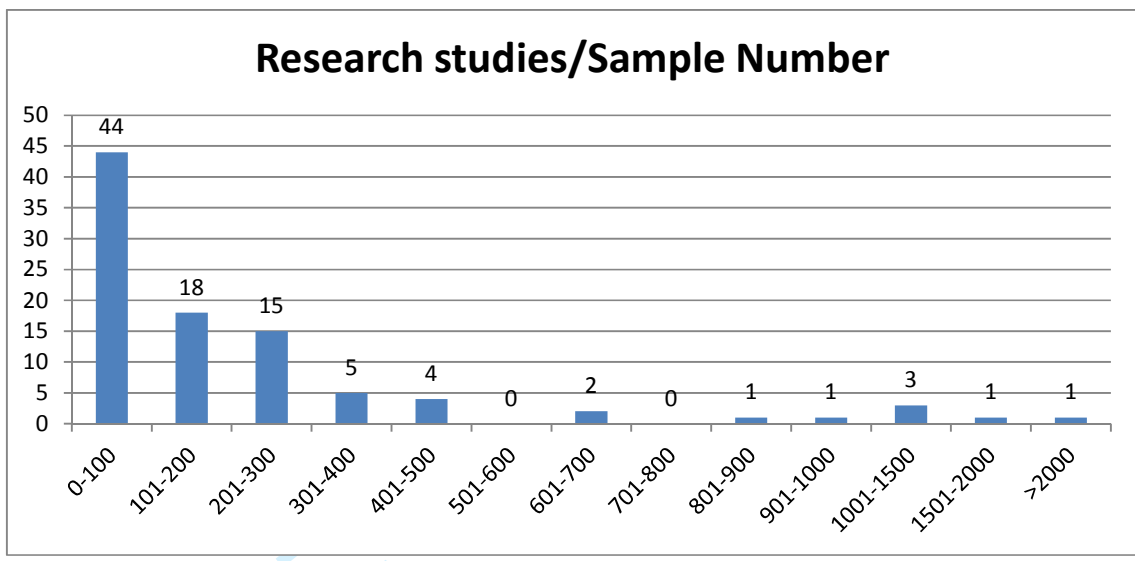


Figure 5: Research studies (surveys) per sample number

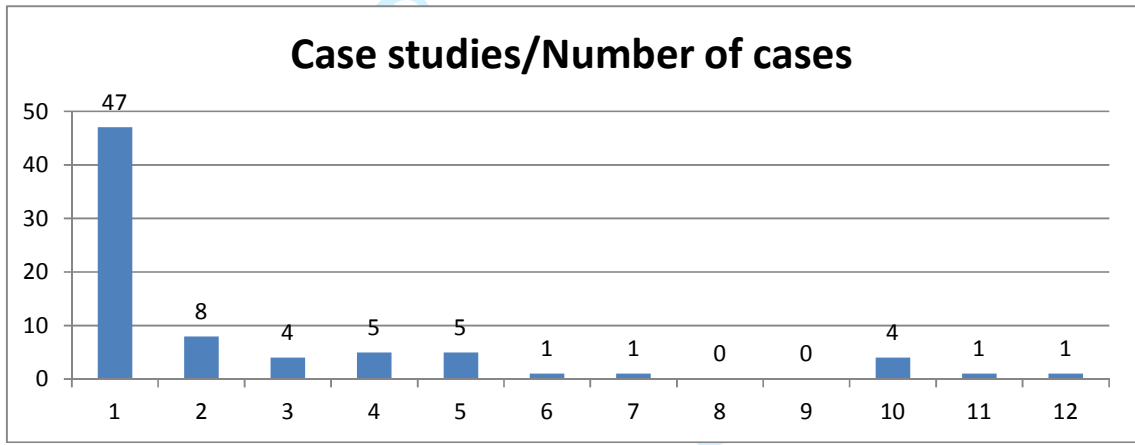


Figure 6: "Case study" articles per number of cases

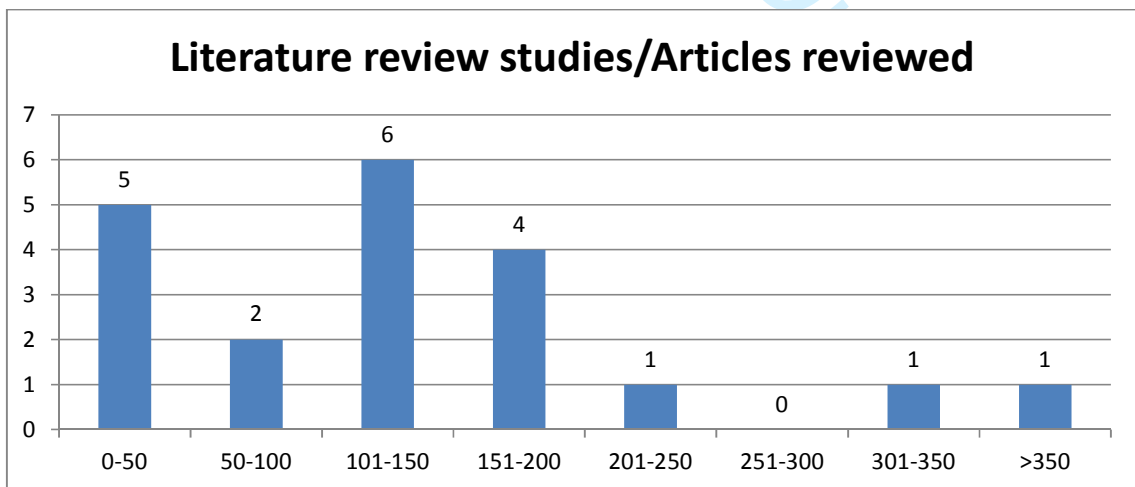


Figure 7: "Literature review" studies per articles reviewed



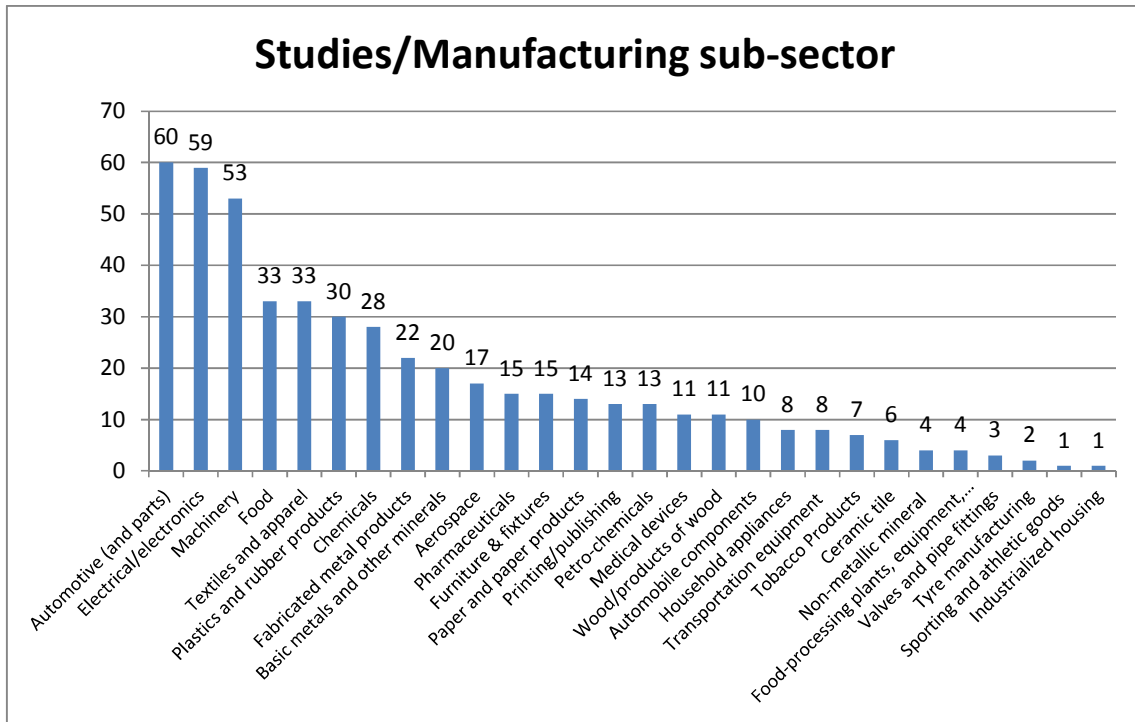


Figure 8: Studies (surveys and case studies) per manufacturing sub-sector

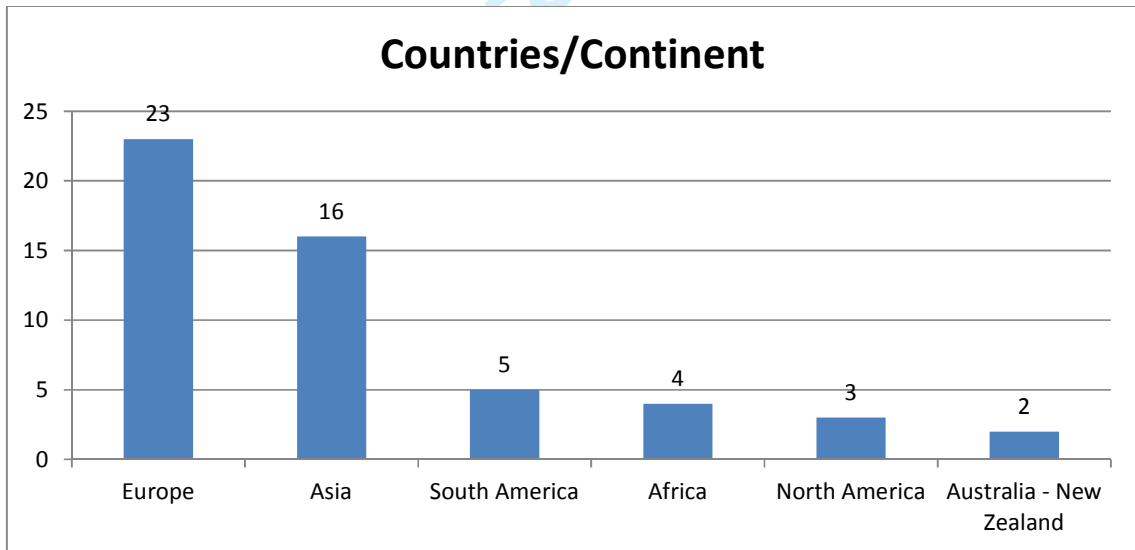


Figure 9: Countries per continent where the studied companies operate

**Table IV:** Geographic research areas

Countries	Number of studies	Countries	Number of studies
USA	34	Finland	3
UK	34	Thailand	3
India	26	Indonesia	3
Brazil	18	Malaysia	3
Italy	14	South Korea	3
Sweden	10	Finland	2
Spain	10	Kuwait	2
Germany	10	Romania	2
China	9	Greece	2
The Netherlands	8	Israel	2
Canada	6	Estonia	2
Turkey	6	South Africa	2
Australia	5	Switzerland	2
Belgium	5	Jordan	2
Ireland	5	Egypt	2
Japan	5	Saudi Arabia	1
Hungary	5	UAE	1
Austria	4	Bulgaria	1
Argentina	4	Poland	1
Sri Lanka	4	Slovakia	1
Iran	3	Nigeria	1
France	3	Pakistan	1
Denmark	3	Libya	1
Norway	3	Paraguay	1
Portugal	3	Uruguay	1
New Zealand	3	Mexico	1
Venezuela	3		

### 3.2 Practical implications of the LM studies

Table V presents the output of the "affinity diagram" and, more specifically, the framework describing the themes of the practical implications of the LM studies carried out worldwide. Examples of grouping the statements of practical implications into themes are given in Table VI. It is apparent that almost half of the themes revealed concerned various LM aspects that included: LM approach itself, and more specifically, in the manufacturing context, waste management, LM barriers-difficulties, the human factor involved in LM implementation, Lean training, Lean product development, Leanness, Lean assessment frameworks and guidelines, Lean benefits and firm performance, the inter-correlations among Lean practices, Lean implementation issues and Lean definition. The remaining themes of the practical implications concerned factors outside the LM approach itself, namely: the governments and the countries in which LM companies operated, the manufacturing sub-sectors where Lean was implemented, SMEs and large companies, the company's customers and supply chains, factors affecting LM implementation, and finally Lean integration with other management

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2  
3 approaches. Figure 10 shows the number of the literature references supporting the practical  
4 implications of the respective themes.  
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**Table V:** The practical implications of the LM studies

<b>Categories of themes</b>	<b>Themes of practical implications</b>	<b>Supporting references</b>
Themes concerning the LM approach itself (pertaining to the internal nature of LM)	Waste management	2,16,22,25,31,52,124,168,204,226
	Lean barriers - difficulties	2,37,45,69,70,99,102,126,128,134,141,154,166,185,189,198,205,207,212,221
	Human factor involved in Lean	2,5,13,17,18,23,31,32,35,37,38,44,45,49,59,62,66,70,71,72,80,81,83,84,87,91,102,109,114,118,120,125,131,132,147,153,159,161,162,166,185,186,189,200,202,209,213,216,221,225
	Lean training	37,38,44,52,87,94,109,116,119,135,147,151,162,190,193,197,202,213,227
	Lean product development	6,78,85,86,110,142,171,206
	Leanness	10,15,20,26,29,64,73,74,89,97,101,110,121,133,134,142,143,152,181,182,214,215,216,219,225
	Lean assessment framework and guidelines	2,12,18,29,32,35,36,37,38,43,44,48,51,53,58,61,66,76,80,84,88,93,97,105,108,121,130,139,145,152,156,158,160,173,179,180,182,183,187,188,191,192,195,200,202,212,219
	Lean benefits and firm performance	1,2,10,14,15,16,25,30,31,34,36,37,39,42,47,48,51,54,55,58,61,64,68,79,81,82,83,93,96,101,112,113,118,126,141,145,146,163,166,175,178,186,193,198,200,201,217,222,224,225,227
	Inter-correlations among Lean practices	53,89,145,146,187,200
	Lean implementation issues	4,22,25,35,36,37,39,43,62,64,65,77,80,81,115,122,131,138,147,148,149,154,166,173,188,201,205,213,219,222,225
	Lean definition	22,160
Themes concerning factors outside the LM approach (pertaining to the external nature of LM)	Countries	5,14,40,44,47,51,53,68,77,78,79,80,87,95,98,104,106,114,129,137,146,154,155,167,180,188,196,202,227
	Manufacturing sub-sectors	6,21,22,24,28,31,41,57,58,63,67,70,85,89,94,123,125,150,163,169,172,175,177,178,190,198,119,210,218
	SMEs - Large companies	2,3,4,7,61,100,129,173
	Customers	40,55,107,213,227
	Supply chain	37,39,55,107,119,211,227
	Government	12,111,176
	Factors affecting Lean	25,27,32,35,40,42,43,52,54,55,60,113,114,120,147,153,160,170,173,175,176,180,205,221,223
	Lean integration with other management approaches	11,46,51,56,85,91,111,137,161,169,226

**Table VI:** Examples of grouping the practical implications into themes

Themes	Practical implications
Waste management	Attention to the importance of searching for and eliminating muda (waste) should not only be paid along the production line, but also inside the information flow (31), there is a lot of scope for achieving a higher degree of LM by focusing on resource flexibility and eliminating different wastes from the manufacturing system (52), developing a process oriented methodology to remove the identified waste increases the productivity of single process steps and provides a greater customer satisfaction (124).
Lean barriers - difficulties	The identification of the barriers that are at the root of some other barriers and those which are most influenced by the others would be helpful for the top management in implementing Lean programs effectively (102), a framework for managing Lean barriers, is comprised of five stages: description of the context, identification of the barriers, analysis of the influence of the context on the barriers, analysis of the relationships among the barriers and a feedback meeting to discuss an action plan to control the barriers (128), based on the situation existing on the shop floor before applying Lean, a number of deficiencies can be identified and overcome (141).
Human factor involved in Lean	Production managers or top level managers of manufacturing companies should pay greater attention to the time reduction aspects of the LP process and a greater degree of management support for LP programs (5), it is vital for managers to seek out the views and feelings of employees with regard to Lean in order to bring their concerns to the surface where they can be addressed (200), suitable managerial attention to factors such as employee mindsets and level of senior management involvement are essential to keep the Lean process moving forward and thriving (200).
Lean training	The implementation of the cross-training employee Lean tool has a positive effect on the knowledge transfer processes in organizations, broadens the knowledge and the competence of employees, and helps the company to manage the tacit knowledge (193), a framework and process is provided (which includes the definition of the training needs, the training design, and the feedback and evaluation) to assist firms in managing and training temporary workers to improve the efficiency and effectiveness of the implementation of Lean improvement initiatives (197), employees need to be educated and informed about the Lean benefits and should be valued when they contribute toward Lean improvements (202).
Lean product development	Lean product development process based on elements such as process, management, structure, people, product, client, supplier and waste, is a simple, useful and reproducible method in every company as well as a structured guide for the implementation of improvements and the evaluation of the product development process itself (78), creating and encouraging high performance teams, helping companies build a Lean and competitive product development group, so Lean product development tells us that focusing on teamwork should be continuously maintained, not taken for granted (171), the efforts to implement concurrent engineering increase three Lean product development problems (project leader without formal authority, lack of communication and feedback and no information technology integration) (206).

*(Continued)*

**Table VI (Continued)**

<b>Themes</b>	<b>Practical implications</b>
Leanness	A Lean attributes score based on the most important components of Leanness: lead time, cost, defects, and value, is calculated by using fuzzy membership functions to give managers and decision makers a real insight into the Leanness level and to further improve it by acting appropriately in the manufacturing system (20), a simplified Leanness evaluation metric consisting of both efficiency and effectiveness attributes of manufacturing performance has been developed for continuous evaluation of Lean implementation (108), by monitoring Lean index values through a chart similar to the SPC charts and by finding out the cause of Leanness deterioration, managers can sustain Leanness performance (225).
Lean assessment framework and guidelines	If a company is considering launching Lean programs from scratch, it is important to have a holistic approach and implement JIT and TQM hand in hand (84), Lean guidelines are provided for industry to survive in recession, including cross-trained employees, cut down cost, identification of money drain point, customer communication, flexibility in reacting to changes, vendor support and quality, ISO 2000 and information technology and information library framework, operation cost reduction, overhead cost reduction, pareto principles, reduced obsolescence, reduced scrap and waste, reduction of hold up money, self-directed work teams, total quality management (191), the taxonomy of the core dimensions of Lean can be used by managers as a checklist or aide-memoire to ensure that they are attending to all the necessary facets of their Lean system and as a framework for organisational self-assessment of Lean implementation (including customer focus and co-operation, layout for continuous product and process flow, set up time improvement and SMED, supplier relationships, supplier improvement and development, kanban-based production control, HRM issues, work standardisation, capturing and sharing improvements, operator responsibility and autonomy, performance objectives, measures and KPIs) (200).
Lean benefits and firm performance	The LP, market share and value creation model provides a useful perspective for firms helping them to understand the potential Lean benefits (79), LM practices help in improving the organisational performance of industrial firms (217), LM enables firms to increase their manufacturing strength and competitiveness through the concurrent improvement among the manufacturing objectives (cost, quality, flexibility and environment) (217).
Inter-correlations among Lean practices	Understanding of the inter-relationship between the critical factors of Lean implementation serves as an important tool for taking strategic decisions for improving Lean performance of the organization (89), Lean practices should be holistically implemented because all the practices are interdependent and equally important (146), the multi-faceted nature of Lean highlights the need for managers to focus attention on the interactions and relationships of the core dimensions of Lean which make it work effectively (200).

*(Continued)*

**Table VI (Continued)**

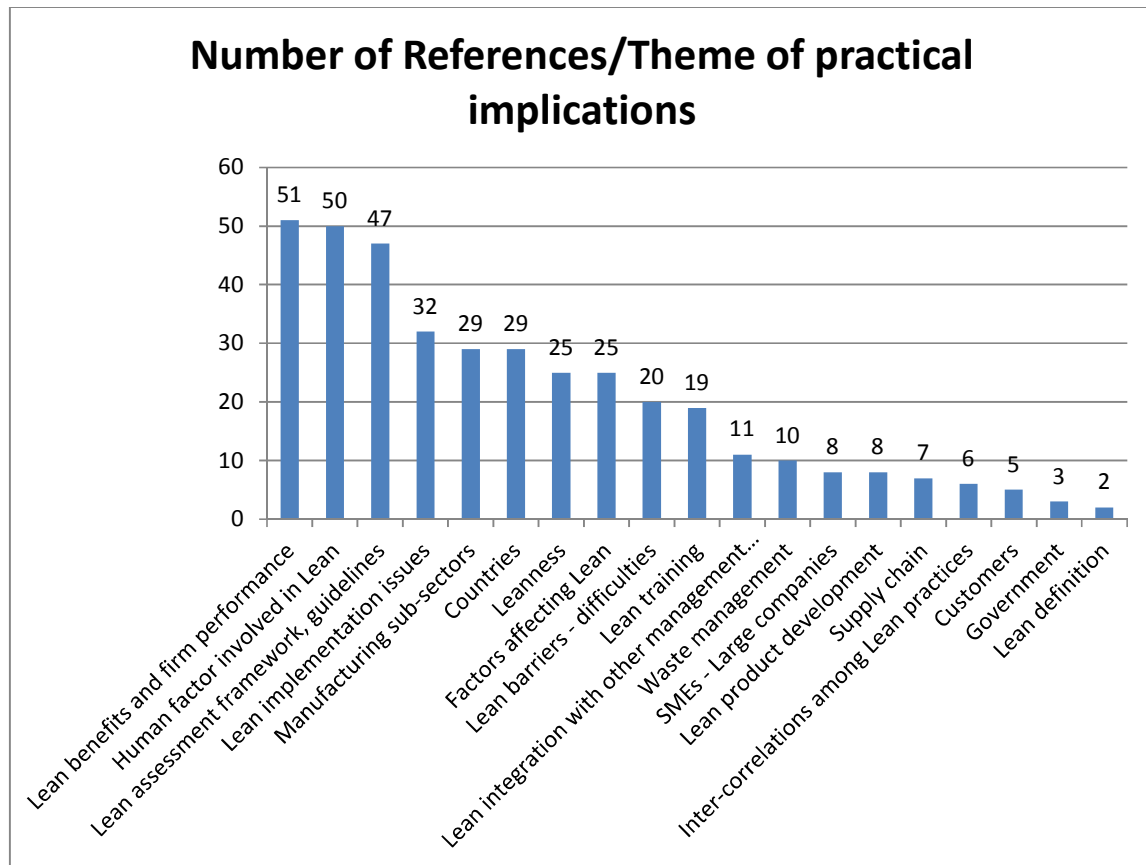
Themes	Practical implications
Lean implementation issues	LM systems should work upstream to smooth demand fluctuation in order for level production operation to be fully successful (64), operations management should not implement a Lean strategy solely on the manufacturing floor, they need to partner with accounting personnel to ensure that Lean management accounting practices such as value stream costing and visual performance measures are implemented in support of the LM processes (81), companies must give Lean initiatives shorter time horizons than they have elsewhere and implement them more swiftly (154).
Lean definition	When embarking on a journey towards Lean, it is important to acknowledge the different perspectives that the concept comprises (160), raising the awareness of the differences of the Lean concept may help make the message clearer and avoid conflicting opinions on which concept the organization is implementing (160).
Countries	The societal benefits gained from adopting a “Lean Lite” programme may ultimately help an SME in a developing nation become much more attractive to a Western organisation looking to improve their own corporate social responsibility policy (51), Lean practices are significant in enhancing operational performance in the Asian context (167), reducing cost is more effective and decreased inventory is less effective on LM implementation in Iranian industries (227).
Manufacturing sub-sectors	Besides organizational factors such as structure, remuneration, and change agent, sector specific factors such as product perishability, behavior of the retailer, traditional production process, and layout play significant roles in Lean implementation in the food sector (70), a hierarchical approach to implementing Lean in textile companies consisting of policy deployment, value stream mapping, visual management, continuous improvement, standardized work, JIT, customer satisfaction (94), the framework consisting of Lean practices in the human resources subsystem, the production planning and control subsystem, and the process technology subsystem has been successfully applied in several real cells and cells from different industries (e.g. auto parts, shoes, electronics) (177).
SMEs - Large companies	A methodology based on factors affecting quality, delivery, flexibility, time, and cost can be used by manufacturing SMEs easily and inexpensively as a decision support system regarding the selection of the most appropriate Lean tool (7), advanced Lean tools (e.g. TPM) and other supporting initiatives (e.g. IT) that require more resources may need to be adopted at later stages of the Lean journey of SMEs (100), it is suggested that SME owners/managers actively seek funding opportunities and support from externals, such as government agencies and consultants on their Lean journey (100).
Customers	Managing and developing strategic relationships with buyers in LM contexts is strongly suggested (55), successful relationships between firms and customers enhance Lean strategies (107), the customer feedback system in the Lean context should be improvised to implement an effective system for handling customer complaints, and proper training should be provided to improve the handling of customer complaints (213).

(Continued)

**Table VI (Continued)**

<b>Themes</b>	<b>Practical implications</b>
Supply chain	Companies need to further exploit Lean practice bundles related to suppliers, along with HRM practice bundles, if not already in place (39), managing suppliers by Lean principles, can contribute to a more stable environment and result in superior indicators (e.g. better quality, faster and more reliable supply) (119), better flow of information, a wider base of suppliers, and more sophisticated evaluation of supplier performance in the Lean context, could make the adaptation to fluctuating conditions easier (119).
Government	The weaknesses of the Kuwaiti manufacturing SMEs can be used by the government to formulate some action points in this direction (12), firms' managers and the Thai government should implement a policy to support Thai manufacturing industries investing in manufacturing technologies, especially among smaller firms, in order to improve their operational performance through the concurrent implementation of Lean practices (111), the correlation among internal, external and policy drivers will enable the policy makers in government and industry to strategically allocate the resources for the successful implementation of Lean in the industry (176).
Factors affecting Lean	Certain organizational culture characteristics are strategic factors that make the difference in Lean implementation (43), environments characterized by technological change can have an impact on the effectiveness of Lean (55), the bundle of three dimensions including the degree of codification, the degree of autonomy, and the prevalent type of ambidexterity can lead plants to achieve the desired performance in the Lean roll-out process (180).
Lean integration with other management approaches	Practitioners and academics can propose new ways of integrating Lean thinking and ISO 9001 (56), a full range of Lean tools and processes (Lean into workplace, Lean into supply chain, and Lean into company strategy) as well as sustainability tools and processes (sustainability in the workplace, sustainability in the supply chain, and sustainability in community) can provide the company with a clear starting point in the improvement across Lean and sustainability agendas (161), LM and environmental management practices are synergistic in terms of their focus on reducing inefficiency (226).





33 **Figure 10:** The number of the literature references per theme of the practical implications

### 34 **3.3 Future research suggestions**

35 Table VII presents the results of the "affinity diagram" and the framework describing the  
 36 themes of future research suggestions. Examples of grouping the future research suggestions  
 37 into themes are provided in Table VIII. Taking into consideration the content of the themes  
 38 revealed, it is apparent that the majority of them were related mainly to LM itself in the  
 39 manufacturing context, Lean literature review, theory, future research agenda, barriers,  
 40 failures, knowledge and training, benefits, effects, definition and motivation, waste  
 41 management, the human factor involved in Lean, Leanness, Lean implementation assessment,  
 42 Lean implementation guidelines, framework and methodology. On the other hand, the remaining  
 43 themes for future research included factors outside the LM approach itself, i.e. supply chains,  
 44 Lean integration with other management approaches, the countries in which companies  
 45 operated, manufacturing sub-sectors, factors affecting Lean, research methodologies and the  
 46 research sample size. Figure 11 shows the number of the literature references supporting the  
 47 future research suggestions.  
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**Table VII:** The future research agenda

<b>Catergories of themes</b>	<b>Themes of future research suggestions</b>	<b>Supporting references</b>
Themes concerning the LM approach itself (pertaining to the internal nature of LM)	Lean literature review	103,119,127,175
	Lean theory	103,105,115,178, 210
	Lean future research agenda	103
	Waste management	17,32,46,103,124,143,204
	Lean barriers	27,32,37,38,77,99,102,106,126,127,133,198,227
	Lean failures - negative side	22,32,92,126,127,192,205
	Lean knowledge, training	5,44,46,62,93,99,127,128,137,151,193,197,200, 207
	Lean benefits	2,22,30,34,44,48,81,83,93,100,126,141,143,155, 159,161,192
	Human factor involved in Lean	2,5,23,42,44,48,49,56,59,71,72,87,91,95, 99,118, 120,125,127,132,141,143,147,148,163,171,180, 185,189,197,200,221,222,223
	Leanness	10,20,26,29,35,73,97,101,108,121,133,134,143, 144,156,186,213,214,216,219,225
	Lean implementation assessment	2,24,33,46,48,53,58,77,93,107,108,126,137,141, 145,152,159,162,175,177,183,188,200,219,225
	Lean effects	6,13,14,15,16,20,22,24,25,30,32,34,39,41,42,43, 46,47,48,49,51,54,56,61,64,65,82,83,91,96,100, 111,114,115,119,123,126,129,130,131,137,143, 145,148,150,152,155,156,161,162,175,182
	Lean Implementation issues and inter-relationships among Lean elements	13,14,16,17,22,25,29,30,32,44,52,62,65,71,84,86, 92,100,101,106,110,112,126,131,135,137,138, 141,143,147,148,149,161,165,170,173,177,178, 183,196,200,201,205,206,218
	Lean implementation guidelines, framework, methodology	4,6,7,11,24,27,33,34,35,44,46,58,60,61,66,70,78, 81,82,99,103,104,105,106,108,110,114,123,155, 157,158,192,200,212
Lean definition	14,22,54,55,87,115,149,160,183,200	
Lean motivation	82,200,209	

*(Continued)*

**Table VII:** (Continued)

Categories of themes	Themes of future research suggestions	Supporting references
Themes concerning factors outside the LM approach (pertaining to the external nature of LM)	Supply Chain	2,55,63,100,107,130,131,141,143,161,170,182
	Lean integration with other management approaches	33,40,48,56,81,85,135,166,169,180,183
	Countries	2,5,32,43,53,68,69,78,79,95,100,103,105,106,114,115,129,130,132,141,142,146,176,188,202
	Manufacturing sub-sectors	30,34,41,44,47,61,62,67,69,70,79,100,103,105,106,129,131,132,137,138,142,155,156,158,177,182,188,197,198,210,218,224
	Factors affecting Lean	2,3,12,25,36,37,38,39,40,42,43,44,45,54,55,58,63,64,65,68,73,76,77,79,83,84,85,93,99,100,110,111,114,126,127,128,129,130,147,149,153,155,162,163,176,178,180,205,212
	Research methodologies	5,7,14,26,30,39,42,43,47,49,54,55,56,66,67,68,72,78,81,96,100,102,103,104,105,111,118,121,123,130,131,132,137,138,147,149,176,177,182,185,188,192,200,207,212,215,219,222,223
Research sample size	39,40,43,45,49,54,55,72,81,96,103,105,111,113,114,118,126,130,145,146,176,177,182,200,207,219,221,222,223	

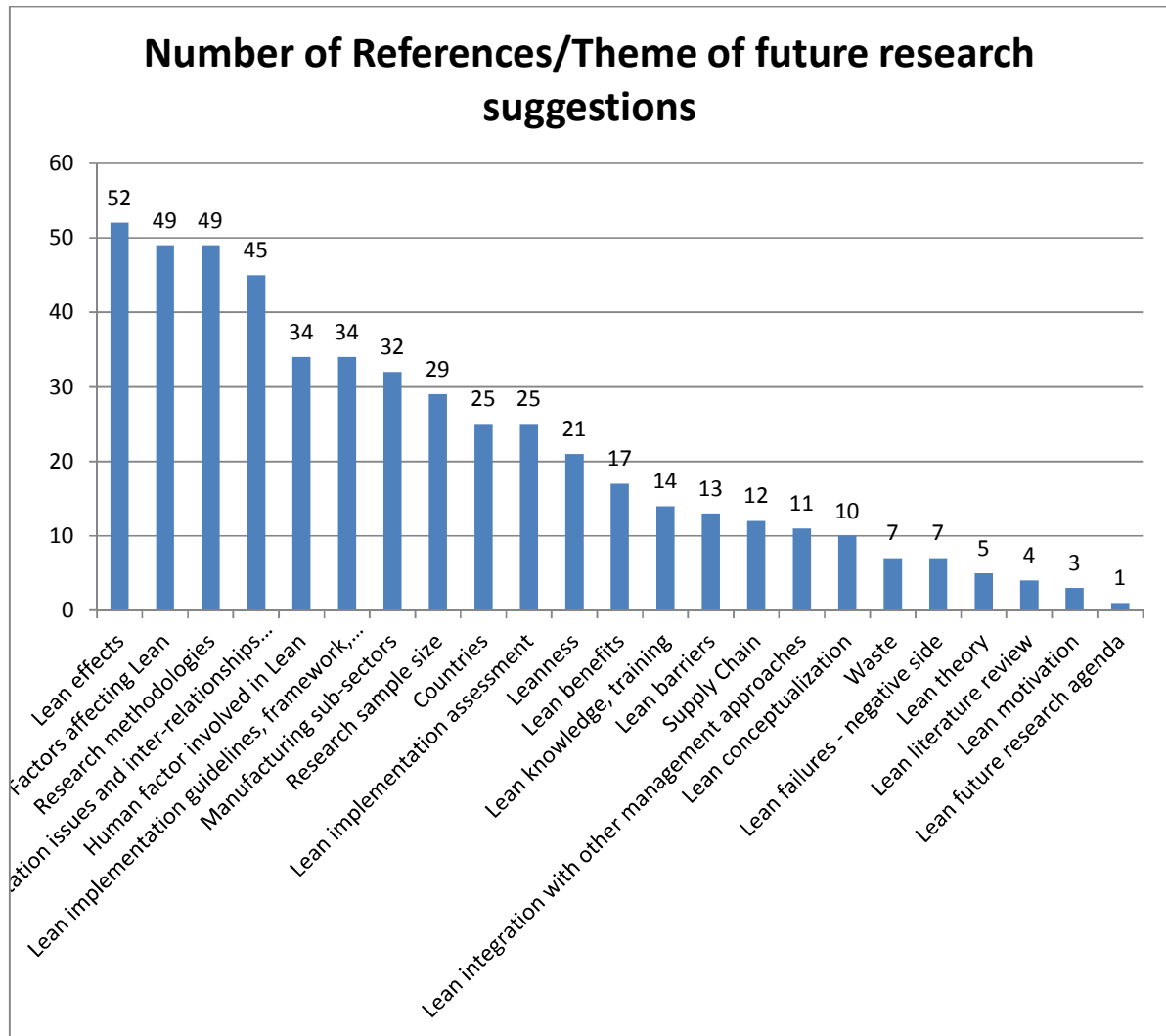
**Table VIII:** Examples of grouping the future research suggestions into themes

<b>Themes</b>	<b>Future research suggestions</b>
Lean literature review	Thorough review of empirical Lean literature (103), strategic management literature in the context of Lean (119), writings on Lean (175).
Lean theory	Build and verify Lean theory (103,105), analyse Lean theory from the perspective of other theories on systems functioning (e.g. system dynamics, systems engineering and soft systems methodology) (178), study Lean new product development theory (210).
Lean future research agenda	Propose future research directions (103).
Waste management	Determine a systematic methodology and stepwise process to remove all kinds of wastes in a sustainable manner (103), the potential wastes and their root causes (124), metrics of the individual seven wastes and total amount of wastes (143).
Lean barriers	Identify the interactions among Lean barriers using modeling techniques (102), the mechanisms for monitoring the changes of Lean barriers (128), the Lean barriers (133).
Lean failures - negative side	Examine the reasons for failures of Lean in different contexts (32), the possible negative sides of Lean (91), the cases of failed Lean transformations (192).
Lean knowledge, training	Study the training methods for all hierarchical levels involved in Lean (127), the design of serious games for teaching Lean (128), the Lean knowledge transfer measurement in the whole organization (193).
Lean benefits	Determine the operational benefits beyond efficiency improvement from Lean (100), the benefits of Lean across a full range of sustainability issues (161), how to maintain the gains made through Lean (192).
Human factor involved in Lean	Examine social performance measures such as employee and other stakeholders' satisfaction and well-being in the context of Lean (49), the leadership attributes in Lean production (87), whether the dedicated teams are more effective at the early stages of Lean than they are at later stages (148).
Leanness	Determine the criteria and key factors of Leanness (20), extend the measure of the overall Leanness to measure the improvement in any specific area of an organization or measure departmental effectiveness (26), examine aspects of Leanness other than inventory Leanness (73).
Lean implementation assessment	Develop standard/critical metrics for Lean evaluation before its implementation, during implementation, and after implementation (33), understand how Lean manufacturing can be measured (Chauhan 53), develop means to investigate the level of maturity of Lean (177).
Lean effects	Examine the impact of selected Lean tools on performance metrics (16), how internal Lean practices affect operational, environmental and social performance (55), the contribution of Lean to performance measures related to different business dimensions, such as human and financial (126).

*(Continued)*

**Table VIII:** (Continued)

<b>Themes</b>	<b>Future research suggestions</b>
Lean implementation issues and inter-relationships among Lean elements	Study the process time of Lean (62), the interaction between Lean practices and principles (126), the balance in the implementation of Lean practices with a technical emphasis and practices that have an impact on human and organisational aspects (126), the relationships between the human and organisational dimensions of Lean (200).
Lean implementation guidelines, framework, methodology	Consider elements in order to have the optimum route of implementing Lean such as cost, benefits, time of completion, technological capabilities, administrative constraints, and the degree of risk involved (11), find out the “best fit” solution for Lean implementation (27), develop a stepwise guideline/process, a standard framework for Lean transformation (33), develop frameworks with Lean enterprise approach instead of particular activity of the organisation (105).
Lean definition	Explore different interpretations of the Lean concept and understand why it is important to name process improvements Lean (22), define the characteristics and the specific objectives of Lean (88), define the theoretical and rhetorical foundation of Lean (115).
Lean motivation	Determine why firms implement Lean (82), the motivational potential of the Lean system (200), the Lean production intrinsic motivation (209).
Supply Chain	Study Lean across the supply chain of manufacturers who are successful in Lean (2), the impact of the supply chain relationships on internal Lean practices (55), Lean from manufacturing to other stages of the supply chain, retail and service businesses (161).
Lean integration with other management approaches	Determine the common and different elements of Lean, agile manufacturing, six sigma, and green manufacturing (33), how Lean interrelates with other management practices (48), new ways of integrating Lean thinking and ISO 9001, ISO 14001, ISO 18001 (56,169).
Countries	Understand how to adjust Lean to succeed in developed countries other than Japan (68), study Lean using samples from developing (like India and China) and undeveloped countries (103), study the relationships between Lean and contextual factors in emergent economies such as China and India, and also in developed countries, such as the USA and Europe (129).
Manufacturing sub-sectors	Study Lean application in several manufacturing sectors (106), the pharmaceutical industry (155), the steel and textile industry (155), food processing SMEs (218).
Factors affecting Lean	Examine factors such as industry type, ownership, and type of management, which could affect Lean (12), the role of technological turbulence and environmental dynamism in Lean implementation (55), how facility culture interacts with national culture to influence Lean effectiveness (114).
Research methodologies	Study Lean using quantitative and qualitative data-sets tested through rigorous statistical methods (30) case studies (103); surveys (130), multiple levels of analysis, such as in plant, departmental and individual level (207).
Research sample size	Research Lean using a variety of samples (45), large cross-sectional random samples (81,113), a large set of experts (177), large samples of companies (200).



**Figure 11:** The number of the literature references per theme of future research suggestions

## 4. Discussion

### 4.1 Profile of the reviewed articles

A range of meaningful insights were gained from the profile of the articles reviewed. Taking into consideration, for each publisher, the number of the articles as well as the number of the journals which have published these articles, the Pareto principle 80/20 is reflected. Hence, for each publisher, the "vital few" journals which have published the majority of the LM articles are clearly distinguished from the "useful many" which have published the minority of these articles. In other words, the former can be considered as more LM oriented journals than the latter. Thus, authors wishing to conduct future studies on LM can base them firstly on these "vital few" journals.

"Vital few" journals publishing many LM articles are also presented in the literature review studies of Jasti and Kodali (2014a; 2015). The journals found to have published the majority of the LM articles are also among the top journals of the literature review studies of Jasti and Kodali (2014a; 2015), Bhamu and Sangwan (2014), and Narayanamurthy and

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3 Gurumurthy (2016a). None of the above mentioned studies have specifically highlighted the  
4 application of the Pareto principle to the journals publishing LM articles.  
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6 The diachronic increase of the published LM articles, which is higher in the last years  
7 of the period considered in the present SLR, is also observed in the literature review studies of  
8 Stone (2012), Jasti and Kodali (2014a; 2015), Bhamu and Sangwan (2014), Samuel *et al.*  
9 (2015) and Narayanamurthy and Gurumurthy (2016a). The several manufacturing sub-sectors  
10 participating in the surveys and case studies reviewed in the present SLR, confirm the wide  
11 applicability of LM throughout the manufacturing sector. It is also worth noting that the  
12 manufacturing sub-sectors mostly examined in the surveys and case studies were also  
13 examined by Moyano-Fuentes and Sacristan-Diaz (2012), Jasti and Kodali (2015) and  
14 Narayanamurthy and Gurumurthy (2016a). Similar to the present study, in the literature  
15 reviews of Hu *et al.* (2015) and Jasti and Kodali (2015), Europe and Asia were the continents  
16 with the majority of the countries where LM research was conducted. Finally, similar to the  
17 literature review studies of Jasti and Kodali (2014a) and Bhamu and Sangwan (2014), in the  
18 present SLR, USA, UK and India were the top three countries where LM research had taken  
19 place.  
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#### 22 **4.2 Practical implications**

23 The two broad categories of practical implications themes, i.e. those concerning LM itself and  
24 those concerning factors outside LM, can be considered as categories pertaining to the  
25 internal and external nature of LM respectively. The practical implications themes which  
26 reflect the internal nature of LM concern issues with regard to the *pre-implementation phase*  
27 (e.g. Lean definition, barriers-difficulties, training, guidelines, the human factor involved), *the*  
28 *implementation phase itself* (e.g. waste management, assessment framework, product  
29 development, the inter-correlations among LM practices) and the *post-implementation phase*  
30 (e.g. Leanness, benefits) of LM in the manufacturing sector (Bhamu and Sangwan, 2014).  
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33 On the other hand, the practical implications themes of the external nature were more  
34 related to a company's context (e.g. its size, sector, customers, supply chain, internal  
35 influencing factors), the diverse managerial systems available and the external environment of  
36 of a company's sector (e.g. the country where the company operates in and its respective  
37 government). The structure of the practical implications themes was similar to that revealed  
38 considering only the research articles of the LM sample. It is also similar to the structure of  
39 the themes which was shown considering only the case studies and the literature review  
40 articles. In other words, in each theme, there were practical implications from articles  
41 describing research studies, case studies and literature review studies.  
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44 Moreover, the themes of practical implications structure revealed from all the LM  
45 articles of the sample was similar to the structure of themes considering only LM articles  
46 from North and South America. This was also similar to the structure of the themes  
47 considering only LM articles from Europe and Asia. This suggests that, in each theme, there  
48 were statements of practical implications from articles studying LM in America, Europe and  
49 Asia.  
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51 Taking into consideration all the articles reviewed, it is apparent that the practical  
52 implications regarding the internal LM's nature were supported in the literature more than  
53 those concerning to its external nature. Moreover, the themes which were supported by most  
54 references (Figure 10) corresponded to: benefits and firm performance, human factors, and  
55 assessment frameworks and guidelines. Table A 1 in Appendix 1 presents the practical  
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3 implications statements of these themes. With this, practitioners are provided with detailed  
4 guidelines in terms of specific practical implications. Thus, they can firstly focus their efforts  
5 for the improvement of LM implementation on the three themes of practical implications  
6 previously established. These practical implications, as well as those concerning companies  
7 belonging to several manufacturing sub-sectors and operating in various economies of the  
8 developed and developing world, are justified due to the many LM studies which have  
9 already been conducted in several manufacturing sub-sectors (Figure 8) and countries (Table  
10 IV).

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13 In line with the practical implications described in the articles, the literature review of  
14 Hu *et al.* (2015), which focused specifically on SMEs, also revealed some practical  
15 implications concerning both the LM approach itself and factors outside of it, without  
16 however covering the extent of the themes of the practical implications presented in this SLR.

### 17 18 **4.3 Future research agenda**

19 In line with the broad categories of practical implications themes, the two broad theme  
20 categories for suggested future research include those concerning LM itself and those  
21 concerning factors outside the approach. The internal themes reflect the internal nature of LM,  
22 i.e. *the pre-implementation phase* (e.g. literature review, theory, future research agenda,  
23 barriers, failures of implementation, knowledge and training, definition and motivation,  
24 human factors, implementation guidelines, frameworks and methodology), *the*  
25 *implementation phase itself* (e.g. waste management, implementation assessment and issues  
26 and the inter-relationships among LM elements) and *the post-implementation phase* (e.g.  
27 Leanness, benefits and effects) of LM in manufacturing environments (Bhamu and Sangwan,  
28 2014). The themes for suggested future research from the external aspect of LM refer to the  
29 company (e.g. its sector, supply chain, internal influencing factors), the country where the  
30 company operates in, the diverse managerial systems available and the methodological  
31 research approach.

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34 The future research structure is similar to that considering only the research, case  
35 studies and literature review articles of the sample. In other words, future research directions  
36 derived from each theme. Moreover, this structure is similar to the structure of themes  
37 exposed considering only LM articles from North and South America. It is also similar to the  
38 structure of the themes which was revealed considering only LM articles from Europe and to  
39 the structure of the themes revealed considering only LM articles from Asia. In other words,  
40 in each theme, there were future research suggestions from articles studying LM in America,  
41 Europe and Asia.

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44 Taking into consideration all the literature references supporting the future research  
45 suggestions of the two respective broad categories of themes, it was apparent that the future  
46 research suggestions concerning the LM approach itself (pertaining to the internal nature of  
47 LM) were supported in the literature more than the future research suggestions concerning  
48 factors outside the LM approach (pertaining to the external nature of LM). Moreover, based  
49 on the literature references supporting the future research themes of LM, research areas of  
50 high priority were defined as: LM effects, factors affecting it, research methodologies used,  
51 and LM implementation issues and inter-relationships among LM elements (Figure 11). Table  
52 A2 in Appendix 1 presents analytically all the future research statements of these themes.  
53 Thus, researchers and academics can firstly focus on these themes mostly supported in the  
54 literature and follow the specific future research directions. It is also worth noting that,  
55 although many LM studies have already been conducted in many manufacturing sub-sectors  
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(Figure 8) and countries of North and South America, Europe and Asia until now (Table IV), the present SLR revealed that future research should be further conducted on several manufacturing sub-sectors of these continents, and more specifically on companies operating in both developed and developing economies that are characterized by a different cultural and economic status.

Future research suggestions reflecting the two broad categories of themes mentioned above had also been presented in literature review studies published so far. However, no previous study had presented the future research suggestions thoroughly, meaning in a structured framework consisting of suggestions-themes-categories, as it was formulated in the present study. Unlike the present SLR, the vast majority of the future research suggestions presented in the studies of Bhamu and Sangwan (2014) and Narayanamurthy and Gurusurthy (2016a) concerned the internal nature of the LM approach, while those of the literature review studies of Jasti and Kodali (2014a) and Hu *et al.* (2015) concerned mostly the external nature of LM. On the other hand, the studies of Moyano-Fuentes and Sacristan-Diaz (2012) and Jasti and Kodali (2015) provided, similarly to the present SLR, a more balanced distribution of future research suggestions between the two broad categories mentioned above.

## 5. Conclusions, limitations and agenda for future research

A number of authors and experts in the field of Lean support the view that there is a dearth of thorough SLR studies which emphasise its practical implications and future research agenda. Thus, we were strongly motivated to systematically review the literature, setting objectives which were substantially different from those of previous literature review studies on LM. Moving a step further than simply presenting the large number of the practical implications of the existing LM studies and the future research suggestions, an "affinity diagram" was applied and respective structured conceptual frameworks were formulated. Thus, a meaningful and summarized picture of practical implications and future research suggestions was provided. From the above it is apparent that the present SLR fills a research gap and extends our knowledge by:

- Providing significant and original insights on LM, from both practical and academic perspectives, to establish the practical implications of LM studies carried out worldwide and identify novel research streams;
- Structuring and defining potential research topics for LM, which in turn can stimulate researchers to further study certain issues in depth, leading to a better understanding of the dynamics of implementing LM;
- Providing practitioners with a general overview of LM so they can develop a more robust knowledge on this approach, and its characteristics, to help them formulate more effective strategies for its deployment.

The Pareto principle was reflected in the published LM articles as well as the respective journals of each publishing house considered in the present SLR. This means that the "vital few" journals of each publishing house contributed mostly to the evolution of the LM publication, which has increased in the last five years of the last decade. Confirming the existing literature, the UK, USA and India were the top countries where LM research had been carried out.

Based on the structured conceptual frameworks that presented the themes of practical implications and future research suggestions, a similar picture emerged. More specifically, two broad categories of themes were identified, namely the LM approach itself (pertaining to the internal nature of LM) and factors outside the LM approach (pertaining to the external

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3 nature of LM). With regard to the former, the pre-implementation, implementation and post-  
4 implementation phases of Lean in manufacturing were identified. With regard to the latter, the  
5 countries where companies operated in, the diverse managerial systems available, and the  
6 methodological research approach were determined. Practical implications and the future  
7 research agenda concerning the LM approach itself were supported in the literature more than  
8 those concerning factors outside the LM approach. Themes of practical implications which  
9 were supported by most literature references concerned Lean benefits and firm performance,  
10 the human factor involved in Lean, and Lean assessment frameworks and guidelines. On the  
11 other hand, themes of future research supported mostly in the literature were related to Lean  
12 effects, factors affecting Lean, the research methodologies used, and Lean implementation  
13 issues and inter-relationships among Lean elements.  
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16 Studies, including literature reviews, suffer from limitations and the present study is  
17 no exception. The main limitation of the present SLR is that only four academic publishing  
18 houses were used for article collection, excluding some significant publishers. The exclusion  
19 of books, online sites and grey literature (e.g. conferences, master's theses, doctoral  
20 dissertations, textbooks and working papers) is also a limitation of the present SLR. The  
21 articles were also reviewed based on only two topics, namely the practical implications  
22 and the future research agenda. Excluding studies examining an individual Lean principle  
23 or tool/technique and studies related to Lean-Six Sigma, Lean-Agile manufacturing and  
24 Lean-Green management may conceal significant practical implications and future  
25 research suggestions. Moreover, excluding the supply chain network as well as the  
26 services and public sector is also a limitation of the present SLR. Finally, the subjectivity  
27 in applying the "affinity diagram", and more specifically, the subjectivity of grouping the  
28 large number of practical implications and future research suggestions based on their  
29 affinity is an issue that should be carefully considered while utilizing the present study  
30 findings.  
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33 Based on the above limitations, future literature review studies can be designed.  
34 For example, it is strongly suggested that a SLR study be carried out on LM based on  
35 more academic publishing houses than those used in the present study, books and grey  
36 literature as well. SLR studies should consider articles examining not only LM as an  
37 integrated system but individual Lean principles or tools/techniques. Future literature  
38 review studies on the practical implications and the research agenda of LM should also  
39 consider the supply chain network of a company as well as the service business  
40 environment. Focusing on the practical implications and the research agenda of Lean and  
41 Six Sigma, Lean and Agile manufacturing and Lean and Green management is also an  
42 interesting avenue for future literature review studies. The above suggested future  
43 literature review studies can also further analyze the practical implications and future  
44 research of LM by supporting the respective themes by distinct theories and formulating  
45 casual relationships among them. In so doing, academics and practitioners will be provided  
46 with a clearer picture with regard to the LM practical implications and future research. It  
47 is also worth taking into consideration the suggestion of Ansari *et al.* (2010) for further study  
48 in the field of LM. More specifically, reviewing the literature and studying the dynamic fit  
49 between LM practices and the adopting organization and how this fit is influenced by  
50 technical, cultural, and political factors would open up an interesting new avenue for future  
51 research.  
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**Table I:** Previous literature review studies in the field of Lean

<b>Authors</b>	<b>Objectives</b>	<b>Main findings</b>
Stone (2012)	Determining the phases of Lean and the core knowledge and voids from the past four decades of scholarly Lean literature (1970- 2009).	Five themes evolved from the analysis starting with the Discovery phase (1970 1990), Dissemination phase (1991-1996), Implementation phase (1997-2000), Enterprise phase (2001-2005), and the most recent phase of Performance (2006-2009). There is a lack of theoretical connections associated with planned organisational change and Human Resource Development interventions.
Hasle <i>et al.</i> (2012)	Studying the effects of Lean on the working environment and employee health and well-being, based on publications from 1999 to 2009.	There is strong evidence for the negative impact of Lean on both the working environment and employee health and well-being in cases of manual work with low complexity. However, examples of positive effects were also found in the literature.
Moyano-Fuentes and Sacristan-Diaz (2012)	Exploring the relationships that arise in the research of Lean Production (LP) from the end of the 1980s to 2009 and the directions for future research.	Research on LP should be viewed in a broader basis than the shop floor and value chain levels. Two new dimensions for the analysis of research on LP are identified: work organisation in Lean environments and the impact of the geographical context on LP.
Powell (2013)	Presenting the most critical areas for further research into the role and implications of ERP (enterprise resource planning) systems in LP, based on the literature published after the year 2000 and up to 2011.	The academic literature on ERP and LP was classified into the most prominent subject areas: combining Lean and ERP for competitive advantage, methods for the concurrent application of Lean and ERP, ERP support for LP, real-time information for intelligent planning and execution of LM operations, ERP systems for the extended Lean enterprise; and e-Kanban as a platform for integrating ERP and pull systems.
Jasti and Kodali (2014a)	Focusing on the research methodologies used in Lean and their related facets as well as the future directions of Lean research, based on publications from 1990 to 2009.	It is concluded from the analysis of the results that: theory building and theory verification articles are equally advanced; the researchers have also failed to explore various aspects of empirical research such as the importance of triangulation of data, alternate research designs other than survey and case studies; contextual focus is mostly on the manufacturing industry; more focus is required on other aspects of empirical research such as collecting the samples from developing and undeveloped countries, a larger sample size, longitudinal data collection methods; there is a need of LM frameworks to remove all kinds of wastes.

*(Continued)*



**Table I** (continued)

<b>Authors</b>	<b>Objectives</b>	<b>Main findings</b>
Bhamu and Sangwan (2014)	Presenting the divergent definitions, scopes, objectives and tools/techniques /methodologies of LM, published in studies over the period 1988-2012.	There is a plethora of LM definitions with divergent objectives and scope. Theory verification through empirical and exploratory studies has been the focus of research in LM. The automotive industry has been the focus of LM research but LM has also been adopted by other types of industries. One of the critical implementation factors of LM is the simultaneous adoption of leanness in the supply chain. LM has become an integrated system composed of highly integrated elements and a wide variety of management practices. Standard LM implementation process/framework is lacking.
Jasti and Kodali (2015)	Determining the status of LP and its improvement, based on research articles published from 1988 to 2011.	The findings include: an increase in empirical research articles, a need of applying Lean principles in the field of product development and enterprise level areas, a need of more interregional research collaborations, a need of Lean elements as a group instead of an individual element, a need of avoiding seven Lean wastes instead of specific waste and a lack of testing and validation of the proposed frameworks/models by researchers.
Samuel <i>et al.</i> (2015)	Studying patterns and trends of literature from 1987 to 2013, that could explain the acceptance of Lean as an operations management philosophy.	Four key themes have emerged: Lean as a representation of the Toyota Production System which highlighted the origins and antecedents of Lean; Lean as a process improvement methodology which highlighted the need to compare Lean with other process improvement methodologies; Lean as a movement which highlighted the characteristics of Lean's evolution over time; and Lean as an academic body of literature which highlighted the diversity of perspective and opinion that Lean has inspired.

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**Table I** (Continued)

<b>Authors</b>	<b>Objectives</b>	<b>Main findings</b>
Hu <i>et al.</i> (2015)	Studying the implementation of Lean in small and medium sized enterprises (SMEs) (key characteristics, implications for practitioners and future areas of research), based on studies published up to the beginning of 2015.	Four key themes have been drawn from the SLR, including what scope/type of Lean is being adopted by SMEs, how Lean is implemented in SMEs, the impact of Lean on SMEs and the Critical Success Factors for Lean in SMEs. A list of areas for future research is as follows: conducting LM research in SMEs using mixed methods, multiple case study or action research, and in developing regions and service-based organisations; looking into the underlying logic for choosing and deploying Lean tools in SMEs; investigating Lean at higher organisational and theoretical levels; examining issues connected to strategy and philosophy of SMEs and making comparisons between SMEs and large enterprises.
Narayanamurthy and Gurumurthy (2016a)	Studying the evolution of the Leanness assessment literature (research objectives and methodologies and potential future research directions) published before January 2014.	Leanness assessment methodologies developed are wide ranging, varying from a simple qualitative checklist to complex quantitative mathematical models. Lean thinking (LT) assessment literature is also getting transformed from process-level monitoring to enterprise-level monitoring. A simplified leanness assessment framework is proposed for future validation consisting of LT pre-implementation assessment, LT practices implementation assessment, and finally LT outcome assessment. Future research is also suggested in the direction of scale development for assessing Lean in service organizations and explaining the selection of appropriate assessment methodology based on the firm's current position on the Lean implementation journey.
The present study	Identifying the practical implications of the LM studies carried out worldwide so far as well as the future research suggestions, based on studies conducted from 2005 to 2016.	A plethora of practical implications and future research suggestions are identified. Structured conceptual frameworks are formulated presenting key themes of the practical implications and future research suggestions. Furthermore, two broad categories of the themes of the practical implications and future research suggestions are also identified, one concerns the LM approach itself (themes pertaining to the internal nature of LM) and two, factors outside the LM approach (themes pertaining to the external nature of LM).

**Table II:** Inclusion and exclusion criteria for the literature review

<b>Inclusion criteria</b>	<b>Exclusion criteria</b>
Articles published between 2005 and 2016	Any publication before the year 2005 and after 2016
Well-known databases: Emerald Online, Science Direct, Springer Link and Taylor & Francis	Non-academic databases
Academic journals	Books, online sites and grey literature (conferences, master's theses, doctoral dissertations, textbooks, reports, working papers from research groups, technical reports, etc.)
Fully accessed articles	Non-fully accessed articles
Articles studying Lean implementation issues (e.g. Lean principles, tools/techniques, performance, assessment, Leanness)	Articles studying an individual Lean principle or tool/technique
Articles highlighting practical implications and/or future research agenda	Articles studying Lean-Six Sigma, Lean-Agile and Lean-Green implementation issues
Articles related to the manufacturing sector	Articles not highlighting practical implications and future research agenda
The unit of the analysis is the organization itself	Articles related to the services sector
Articles written in the English language	The unit of the analysis is the supply chain network
	Articles written in a language other than English

**Table III:** The list of journals considered in the present study

<b>Publisher - Journals</b>	<b>Number of articles</b>	<b>Percent</b>
<b>Emerald</b>	<b>87 articles</b>	<b>0.410</b>
Journal of Manufacturing Technology Management	22	0.104
International Journal of Operations & Production Management	16	0.075
International Journal of Lean Six Sigma	11	0.052
International Journal of Productivity and Performance Management	8	0.038
Benchmarking: An International Journal	5	0.024
British Food Journal	2	0.009
Measuring Business Excellence	2	0.009
Supply Chain Management: An International Journal	2	0.009
Management Decision	2	0.009
The TQM Journal	2	0.009
Business Process Management Journal	2	0.009
European Business Review	1	0.005
Grey Systems: Theory and Application	1	0.005
International Journal of Quality & Reliability Management	1	0.005
Management Research News	1	0.005
The International Journal of Logistics Management	1	0.005
Journal of Quality in Maintenance Engineering	1	0.005
Competitiveness Review: An International Business Journal	1	0.005
International Journal of Organizational Analysis	1	0.005
Journal of Engineering, Design and Technology	1	0.005
Journal of Modelling in Management	1	0.005
Research Journal of Textile and Apparel	1	0.005
VINE Journal of Information and Knowledge Management Systems	1	0.005
Industrial Management & Data Systems	1	0.005
<b>Taylor &amp; Francis</b>	<b>66 articles</b>	<b>0.311</b>
International Journal of Production Research	33	0.156
Production Planning & Control	21	0.099
Total Quality Management & Business Excellence	6	0.028
International Journal of Computer Integrated Manufacturing	4	0.019
Construction Management and Economics	1	0.005
Journal of Asia-Pacific Business	1	0.005
<b>Elsevier/Science Direct</b>	<b>43 articles</b>	<b>0.203</b>
International Journal of Production Economics	13	0.061
Journal of Operations Management	10	0.047
Procedia Manufacturing	3	0.014
Expert Systems with Applications	3	0.014
Management Accounting Research	2	0.009
Computers in Industry	2	0.009
Journal of Business Research	1	0.005

*(Continued)*

**Table III (Continued)**

<b>Publisher - Journals</b>	<b>Number of articles</b>	<b>Percent</b>
<b>Elsevier/Science Direct</b>		
Business Research Quarterly	1	0.005
Review of Applied Management Studies	1	0.005
The International Journal of Information Management	1	0.005
Business Horizons	1	0.005
Accounting, Organizations and Society	1	0.005
The Journal of Engineering and Technology Management	1	0.005
Computers & Industrial Engineering	1	0.005
The Journal of Cleaner Production	1	0.005
The European Management Journal	1	0.005
<b>Springer Link</b>	<b>16 articles</b>	<b>0.076</b>
The International Journal of Advanced Manufacturing Technology	10	0.047
Operations Management Research	2	0.009
The Journal of Intelligent Manufacturing	1	0.005
Systemic Practice and Action Research	1	0.005
Production Engineering Research and Development	1	0.005
The Journal of Business Ethics	1	0.005

**Table IV:** Geographic research areas

<b>Countries</b>	<b>Number of studies</b>	<b>Countries</b>	<b>Number of studies</b>
USA	34	Finland	3
UK	34	Thailand	3
India	26	Indonesia	3
Brazil	18	Malaysia	3
Italy	14	South Korea	3
Sweden	10	Finland	2
Spain	10	Kuwait	2
Germany	10	Romania	2
China	9	Greece	2
The Netherlands	8	Israel	2
Canada	6	Estonia	2
Turkey	6	South Africa	2
Australia	5	Switzerland	2
Belgium	5	Jordan	2
Ireland	5	Egypt	2
Japan	5	Saudi Arabia	1
Hungary	5	UAE	1
Austria	4	Bulgaria	1
Argentina	4	Poland	1
Sri Lanka	4	Slovakia	1
Iran	3	Nigeria	1
France	3	Pakistan	1
Denmark	3	Libya	1
Norway	3	Paraguay	1
Portugal	3	Uruguay	1
New Zealand	3	Mexico	1
Venezuela	3		

**Table V:** The practical implications of the LM studies

<b>Catergories of themes</b>	<b>Themes of practical implications</b>	<b>Supporting references</b>
Themes concerning the LM approach itself (pertaining to the internal nature of LM)	Waste management	2,16,22,25,31,52,124,168,204,226
	Lean barriers - difficulties	2,37,45,69,70,99,102,126,128,134,141,154,166,185,189,198,205,207,212,221
	Human factor involved in Lean	2,5,13,17,18,23,31,32,35,37,38,44,45,49,59,62,66,70,71,72,80,81,83,84,87,91,102,109,114,118,120,125,131,132,147,153,159,161,162,166,185,186,189,200,202,209,213,216,221,225
	Lean training	37,38,44,52,87,94,109,116,119,135,147,151,162,190,193,197,202,213,227
	Lean product development	6,78,85,86,110,142,171,206
	Leanness	10,15,20,26,29,64,73,74,89,97,101,110,121,133,134,142,143,152,181,182,214,215,216,219,225
	Lean assessment framework and guidelines	2,12,18,29,32,35,36,37,38,43,44,48,51,53,58,61,66,76,80,84,88,93,97,105,108,121,130,139,145,152,156,158,160,173,179,180,182,183,187,188,191,192,195,200,202,212,219
	Lean benefits and firm performance	1,2,10,14,15,16,25,30,31,34,36,37,39,42,47,48,51,54,55,58,61,64,68,79,81,82,83,93,96,101,112,113,118,126,141,145,146,163,166,175,178,186,193,198,200,201,217,222,224,225,227
	Inter-correlations among Lean practices	53,89,145,146,187,200
	Lean implementation issues	4,22,25,35,36,37,39,43,62,64,65,77,80,81,115,122,131,138,147,148,149,154,166,173,188,201,205,213,219,222,225
	Lean definition	22,160
Themes concerning factors outside the LM approach (pertaining to the external nature of LM)	Countries	5,14,40,44,47,51,53,68,77,78,79,80,87,95,98,104,106,114,129,137,146,154,155,167,180,188,196,202,227
	Manufacturing sub-sectors	6,21,22,24,28,31,41,57,58,63,67,70,85,89,94,123,125,150,163,169,172,175,177,178,190,198,119,210,218
	SMEs - Large companies	2,3,4,7,61,100,129,173
	Customers	40,55,107,213,227
	Supply chain	37,39,55,107,119,211,227
	Government	12,111,176
	Factors affecting Lean	25,27,32,35,40,42,43,52,54,55,60,113,114,120,147,153,160,170,173,175,176,180,205,221,223
	Lean integration with other management approaches	11,46,51,56,85,91,111,137,161,169,226

**Table VI:** Examples of grouping the practical implications into themes

Themes	Practical implications
Waste management	Attention to the importance of searching for and eliminating muda (waste) should not only be paid along the production line, but also inside the information flow (31), there is a lot of scope for achieving a higher degree of LM by focusing on resource flexibility and eliminating different wastes from the manufacturing system (52), developing a process oriented methodology to remove the identified waste increases the productivity of single process steps and provides a greater customer satisfaction (124).
Lean barriers - difficulties	The identification of the barriers that are at the root of some other barriers and those which are most influenced by the others would be helpful for the top management in implementing Lean programs effectively (102), a framework for managing Lean barriers, is comprised of five stages: description of the context, identification of the barriers, analysis of the influence of the context on the barriers, analysis of the relationships among the barriers and a feedback meeting to discuss an action plan to control the barriers (128), based on the situation existing on the shop floor before applying Lean, a number of deficiencies can be identified and overcome (141).
Human factor involved in Lean	Production managers or top level managers of manufacturing companies should pay greater attention to the time reduction aspects of the LP process and a greater degree of management support for LP programs (5), it is vital for managers to seek out the views and feelings of employees with regard to Lean in order to bring their concerns to the surface where they can be addressed (200), suitable managerial attention to factors such as employee mindsets and level of senior management involvement are essential to keep the Lean process moving forward and thriving (200).
Lean training	The implementation of the cross-training employee Lean tool has a positive effect on the knowledge transfer processes in organizations, broadens the knowledge and the competence of employees, and helps the company to manage the tacit knowledge (193), a framework and process is provided (which includes the definition of the training needs, the training design, and the feedback and evaluation) to assist firms in managing and training temporary workers to improve the efficiency and effectiveness of the implementation of Lean improvement initiatives (197), employees need to be educated and informed about the Lean benefits and should be valued when they contribute toward Lean improvements (202).
Lean product development	Lean product development process based on elements such as process, management, structure, people, product, client, supplier and waste, is a simple, useful and reproducible method in every company as well as a structured guide for the implementation of improvements and the evaluation of the product development process itself (78), creating and encouraging high performance teams, helping companies build a Lean and competitive product development group, so Lean product development tells us that focusing on teamwork should be continuously maintained, not taken for granted (171), the efforts to implement concurrent engineering increase three Lean product development problems (project leader without formal authority, lack of communication and feedback and no information technology integration) (206).

*(Continued)*



**Table VI (Continued)**

Themes	Practical implications
Leanness	A Lean attributes score based on the most important components of Leanness: lead time, cost, defects, and value, is calculated by using fuzzy membership functions to give managers and decision makers a real insight into the Leanness level and to further improve it by acting appropriately in the manufacturing system (20), a simplified Leanness evaluation metric consisting of both efficiency and effectiveness attributes of manufacturing performance has been developed for continuous evaluation of Lean implementation (108), by monitoring Lean index values through a chart similar to the SPC charts and by finding out the cause of Leanness deterioration, managers can sustain Leanness performance (225).
Lean assessment framework and guidelines	If a company is considering launching Lean programs from scratch, it is important to have a holistic approach and implement JIT and TQM hand in hand (84), Lean guidelines are provided for industry to survive in recession, including cross-trained employees, cut down cost, identification of money drain point, customer communication, flexibility in reacting to changes, vendor support and quality, ISO 2000 and information technology and information library framework, operation cost reduction, overhead cost reduction, pareto principles, reduced obsolescence, reduced scrap and waste, reduction of hold up money, self-directed work teams, total quality management (191), the taxonomy of the core dimensions of Lean can be used by managers as a checklist or aide-memoire to ensure that they are attending to all the necessary facets of their Lean system and as a framework for organisational self-assessment of Lean implementation (including customer focus and co-operation, layout for continuous product and process flow, set up time improvement and SMED, supplier relationships, supplier improvement and development, kanban-based production control, HRM issues, work standardisation, capturing and sharing improvements, operator responsibility and autonomy, performance objectives, measures and KPIs) (200).
Lean benefits and firm performance	The LP, market share and value creation model provides a useful perspective for firms helping them to understand the potential Lean benefits (79), LM practices help in improving the organisational performance of industrial firms (217), LM enables firms to increase their manufacturing strength and competitiveness through the concurrent improvement among the manufacturing objectives (cost, quality, flexibility and environment) (217).
Inter-correlations among Lean practices	Understanding of the inter-relationship between the critical factors of Lean implementation serves as an important tool for taking strategic decisions for improving Lean performance of the organization (89), Lean practices should be holistically implemented because all the practices are interdependent and equally important (146), the multi-faceted nature of Lean highlights the need for managers to focus attention on the interactions and relationships of the core dimensions of Lean which make it work effectively (200).

*(Continued)*

**Table VI (Continued)**

<b>Themes</b>	<b>Practical implications</b>
Lean implementation issues	LM systems should work upstream to smooth demand fluctuation in order for level production operation to be fully successful (64), operations management should not implement a Lean strategy solely on the manufacturing floor, they need to partner with accounting personnel to ensure that Lean management accounting practices such as value stream costing and visual performance measures are implemented in support of the LM processes (81), companies must give Lean initiatives shorter time horizons than they have elsewhere and implement them more swiftly (154).
Lean definition	When embarking on a journey towards Lean, it is important to acknowledge the different perspectives that the concept comprises (160), raising the awareness of the differences of the Lean concept may help make the message clearer and avoid conflicting opinions on which concept the organization is implementing (160).
Countries	The societal benefits gained from adopting a “Lean Lite” programme may ultimately help an SME in a developing nation become much more attractive to a Western organisation looking to improve their own corporate social responsibility policy (51), Lean practices are significant in enhancing operational performance in the Asian context (167), reducing cost is more effective and decreased inventory is less effective on LM implementation in Iranian industries (227).
Manufacturing sub-sectors	Besides organizational factors such as structure, remuneration, and change agent, sector specific factors such as product perishability, behavior of the retailer, traditional production process, and layout play significant roles in Lean implementation in the food sector (70), a hierarchical approach to implementing Lean in textile companies consisting of policy deployment, value stream mapping, visual management, continuous improvement, standardized work, JIT, customer satisfaction (94), the framework consisting of Lean practices in the human resources subsystem, the production planning and control subsystem, and the process technology subsystem has been successfully applied in several real cells and cells from different industries (e.g. auto parts, shoes, electronics) (177).
SMEs - Large companies	A methodology based on factors affecting quality, delivery, flexibility, time, and cost can be used by manufacturing SMEs easily and inexpensively as a decision support system regarding the selection of the most appropriate Lean tool (7), advanced Lean tools (e.g. TPM) and other supporting initiatives (e.g. IT) that require more resources may need to be adopted at later stages of the Lean journey of SMEs (100), it is suggested that SME owners/managers actively seek funding opportunities and support from externals, such as government agencies and consultants on their Lean journey (100).
Customers	Managing and developing strategic relationships with buyers in LM contexts is strongly suggested (55), successful relationships between firms and customers enhance Lean strategies (107), the customer feedback system in the Lean context should be improvised to implement an effective system for handling customer complaints, and proper training should be provided to improve the handling of customer complaints (213).

(Continued)

**Table VI (Continued)**

Themes	Practical implications
Supply chain	Companies need to further exploit Lean practice bundles related to suppliers, along with HRM practice bundles, if not already in place (39), managing suppliers by Lean principles, can contribute to a more stable environment and result in superior indicators (e.g. better quality, faster and more reliable supply) (119), better flow of information, a wider base of suppliers, and more sophisticated evaluation of supplier performance in the Lean context, could make the adaptation to fluctuating conditions easier (119).
Government	The weaknesses of the Kuwaiti manufacturing SMEs can be used by the government to formulate some action points in this direction (12), firms' managers and the Thai government should implement a policy to support Thai manufacturing industries investing in manufacturing technologies, especially among smaller firms, in order to improve their operational performance through the concurrent implementation of Lean practices (111), the correlation among internal, external and policy drivers will enable the policy makers in government and industry to strategically allocate the resources for the successful implementation of Lean in the industry (176).
Factors affecting Lean	Certain organizational culture characteristics are strategic factors that make the difference in Lean implementation (43), environments characterized by technological change can have an impact on the effectiveness of Lean (55), the bundle of three dimensions including the degree of codification, the degree of autonomy, and the prevalent type of ambidexterity can lead plants to achieve the desired performance in the Lean roll-out process (180).
Lean integration with other management approaches	Practitioners and academics can propose new ways of integrating Lean thinking and ISO 9001 (56), a full range of Lean tools and processes (Lean into workplace, Lean into supply chain, and Lean into company strategy) as well as sustainability tools and processes (sustainability in the workplace, sustainability in the supply chain, and sustainability in community) can provide the company with a clear starting point in the improvement across Lean and sustainability agendas (161), LM and environmental management practices are synergistic in terms of their focus on reducing inefficiency (226).

**Table VII:** The future research agenda

<b>Catergories of themes</b>	<b>Themes of future research suggestions</b>	<b>Supporting references</b>
Themes concerning the LM approach itself (pertaining to the internal nature of LM)	Lean literature review	103,119,127,175
	Lean theory	103,105,115,178, 210
	Lean future research agenda	103
	Waste management	17,32,46,103,124,143,204
	Lean barriers	27,32,37,38,77,99,102,106,126,127,133,198,227
	Lean failures - negative side	22,32,92,126,127,192,205
	Lean knowledge, training	5,44,46,62,93,99,127,128,137,151,193,197,200, 207
	Lean benefits	2,22,30,34,44,48,81,83,93,100,126,141,143,155, 159,161,192
	Human factor involved in Lean	2,5,23,42,44,48,49,56,59,71,72,87,91,95, 99,118, 120,125,127,132,141,143,147,148,163,171,180, 185,189,197,200,221,222,223
	Leanness	10,20,26,29,35,73,97,101,108,121,133,134,143, 144,156,186,213,214,216,219,225
	Lean implementation assessment	2,24,33,46,48,53,58,77,93,107,108,126,137,141, 145,152,159,162,175,177,183,188,200,219,225
	Lean effects	6,13,14,15,16,20,22,24,25,30,32,34,39,41,42,43, 46,47,48,49,51,54,56,61,64,65,82,83,91,96,100, 111,114,115,119,123,126,129,130,131,137,143, 145,148,150,152,155,156,161,162,175,182
	Lean Implementation issues and inter-relationships among Lean elements	13,14,16,17,22,25,29,30,32,44,52,62,65,71,84,86, 92,100,101,106,110,112,126,131,135,137,138, 141,143,147,148,149,161,165,170,173,177,178, 183,196,200,201,205,206,218
	Lean implementation guidelines, framework, methodology	4,6,7,11,24,27,33,34,35,44,46,58,60,61,66,70,78, 81,82,99,103,104,105,106,108,110,114,123,155, 157,158,192,200,212
Lean definition	14,22,54,55,87,115,149,160,183,200	
Lean motivation	82,200,209	

*(Continued)*

**Table VII:** (Continued)

Categories of themes	Themes of future research suggestions	Supporting references
Themes concerning factors outside the LM approach (pertaining to the external nature of LM)	Supply Chain	2,55,63,100,107,130,131,141,143,161,170,182
	Lean integration with other management approaches	33,40,48,56,81,85,135,166,169,180,183
	Countries	2,5,32,43,53,68,69,78,79,95,100,103,105,106,114,115,129,130,132,141,142,146,176,188,202
	Manufacturing sub-sectors	30,34,41,44,47,61,62,67,69,70,79,100,103,105,106,129,131,132,137,138,142,155,156,158,177,182,188,197,198,210,218,224
	Factors affecting Lean	2,3,12,25,36,37,38,39,40,42,43,44,45,54,55,58,63,64,65,68,73,76,77,79,83,84,85,93,99,100,110,111,114,126,127,128,129,130,147,149,153,155,162,163,176,178,180,205,212
	Research methodologies	5,7,14,26,30,39,42,43,47,49,54,55,56,66,67,68,72,78,81,96,100,102,103,104,105,111,118,121,123,130,131,132,137,138,147,149,176,177,182,185,188,192,200,207,212,215,219,222,223
Research sample size	39,40,43,45,49,54,55,72,81,96,103,105,111,113,114,118,126,130,145,146,176,177,182,200,207,219,221,222,223	

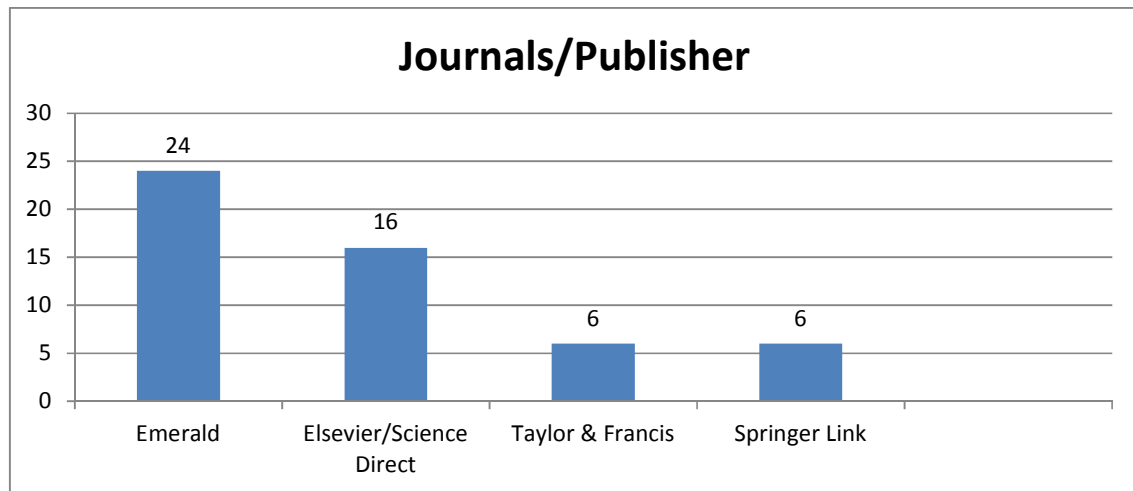
**Table VIII:** Examples of grouping the future research suggestions into themes

<b>Themes</b>	<b>Future research suggestions</b>
Lean literature review	Thorough review of empirical Lean literature (103), strategic management literature in the context of Lean (119), writings on Lean (175).
Lean theory	Build and verify Lean theory (103,105), analyse Lean theory from the perspective of other theories on systems functioning (e.g. system dynamics, systems engineering and soft systems methodology) (178), study Lean new product development theory (210).
Lean future research agenda	Propose future research directions (103).
Waste management	Determine a systematic methodology and stepwise process to remove all kinds of wastes in a sustainable manner (103), the potential wastes and their root causes (124), metrics of the individual seven wastes and total amount of wastes (143).
Lean barriers	Identify the interactions among Lean barriers using modeling techniques (102), the mechanisms for monitoring the changes of Lean barriers (128), the Lean barriers (133).
Lean failures - negative side	Examine the reasons for failures of Lean in different contexts (32), the possible negative sides of Lean (91), the cases of failed Lean transformations (192).
Lean knowledge, training	Study the training methods for all hierarchical levels involved in Lean (127), the design of serious games for teaching Lean (128), the Lean knowledge transfer measurement in the whole organization (193).
Lean benefits	Determine the operational benefits beyond efficiency improvement from Lean (100), the benefits of Lean across a full range of sustainability issues (161), how to maintain the gains made through Lean (192).
Human factor involved in Lean	Examine social performance measures such as employee and other stakeholders' satisfaction and well-being in the context of Lean (49), the leadership attributes in Lean production (87), whether the dedicated teams are more effective at the early stages of Lean than they are at later stages (148).
Leanness	Determine the criteria and key factors of Leanness (20), extend the measure of the overall Leanness to measure the improvement in any specific area of an organization or measure departmental effectiveness (26), examine aspects of Leanness other than inventory Leanness (73).
Lean implementation assessment	Develop standard/critical metrics for Lean evaluation before its implementation, during implementation, and after implementation (33), understand how Lean manufacturing can be measured (Chauhan 53), develop means to investigate the level of maturity of Lean (177).
Lean effects	Examine the impact of selected Lean tools on performance metrics (16), how internal Lean practices affect operational, environmental and social performance (55), the contribution of Lean to performance measures related to different business dimensions, such as human and financial (126).

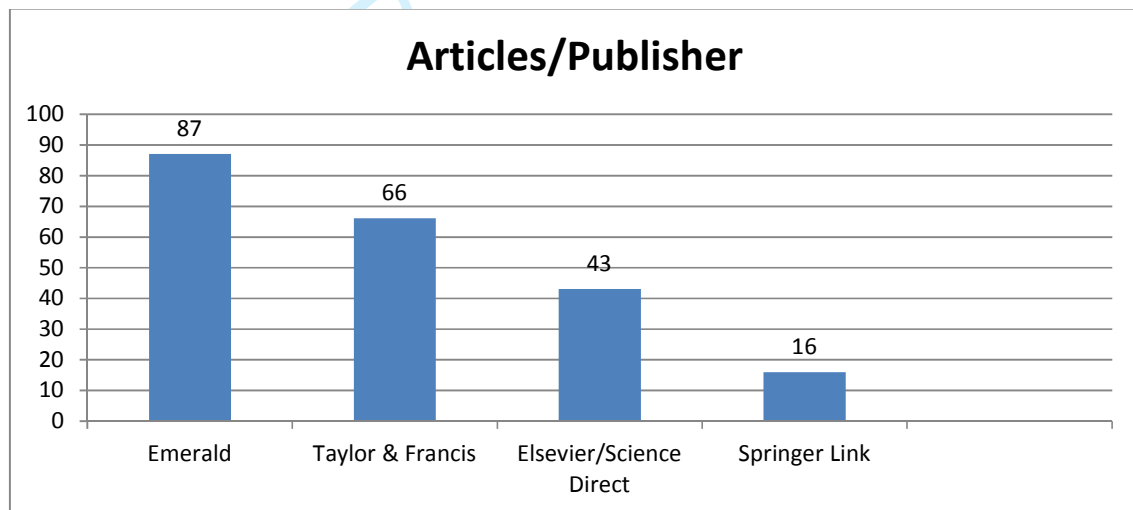
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**Table VIII:** (Continued)

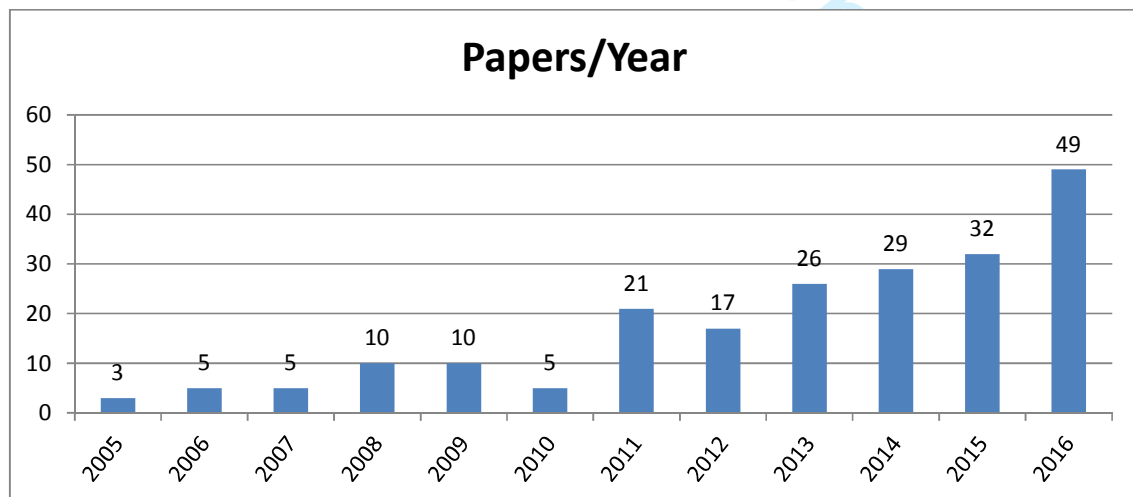
Themes	Future research suggestions
Lean implementation issues and inter-relationships among Lean elements	Study the process time of Lean (62), the interaction between Lean practices and principles (126), the balance in the implementation of Lean practices with a technical emphasis and practices that have an impact on human and organisational aspects (126), the relationships between the human and organisational dimensions of Lean (200).
Lean implementation guidelines, framework, methodology	Consider elements in order to have the optimum route of implementing Lean such as cost, benefits, time of completion, technological capabilities, administrative constraints, and the degree of risk involved (11), find out the “best fit” solution for Lean implementation (27), develop a stepwise guideline/process, a standard framework for Lean transformation (33), develop frameworks with Lean enterprise approach instead of particular activity of the organisation (105).
Lean definition	Explore different interpretations of the Lean concept and understand why it is important to name process improvements Lean (22), define the characteristics and the specific objectives of Lean (88), define the theoretical and rhetorical foundation of Lean (115).
Lean motivation	Determine why firms implement Lean (82), the motivational potential of the Lean system (200), the Lean production intrinsic motivation (209).
Supply Chain	Study Lean across the supply chain of manufacturers who are successful in Lean (2), the impact of the supply chain relationships on internal Lean practices (55), Lean from manufacturing to other stages of the supply chain, retail and service businesses (161).
Lean integration with other management approaches	Determine the common and different elements of Lean, agile manufacturing, six sigma, and green manufacturing (33), how Lean interrelates with other management practices (48), new ways of integrating Lean thinking and ISO 9001, ISO 14001, ISO 18001 (56,169).
Countries	Understand how to adjust Lean to succeed in developed countries other than Japan (68), study Lean using samples from developing (like India and China) and undeveloped countries (103), study the relationships between Lean and contextual factors in emergent economies such as China and India, and also in developed countries, such as the USA and Europe (129).
Manufacturing sub-sectors	Study Lean application in several manufacturing sectors (106), the pharmaceutical industry (155), the steel and textile industry (155), food processing SMEs (218).
Factors affecting Lean	Examine factors such as industry type, ownership, and type of management, which could affect Lean (12), the role of technological turbulence and environmental dynamism in Lean implementation (55), how facility culture interacts with national culture to influence Lean effectiveness (114).
Research methodologies	Study Lean using quantitative and qualitative data-sets tested through rigorous statistical methods (30) case studies (103); surveys (130), multiple levels of analysis, such as in plant, departmental and individual level (207).
Research sample size	Research Lean using a variety of samples (45), large cross-sectional random samples (81,113), a large set of experts (177), large samples of companies (200).



18  
19 **Figure 1:** Journals per publisher



37  
38 **Figure 2:** Articles per publisher



56 **Figure 3:** Articles per publication year



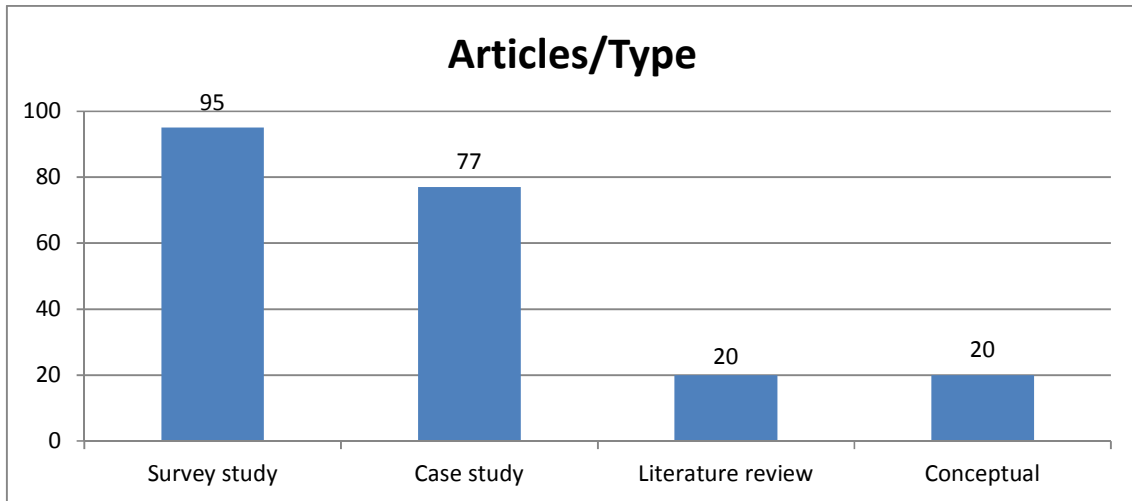


Figure 4: Article type

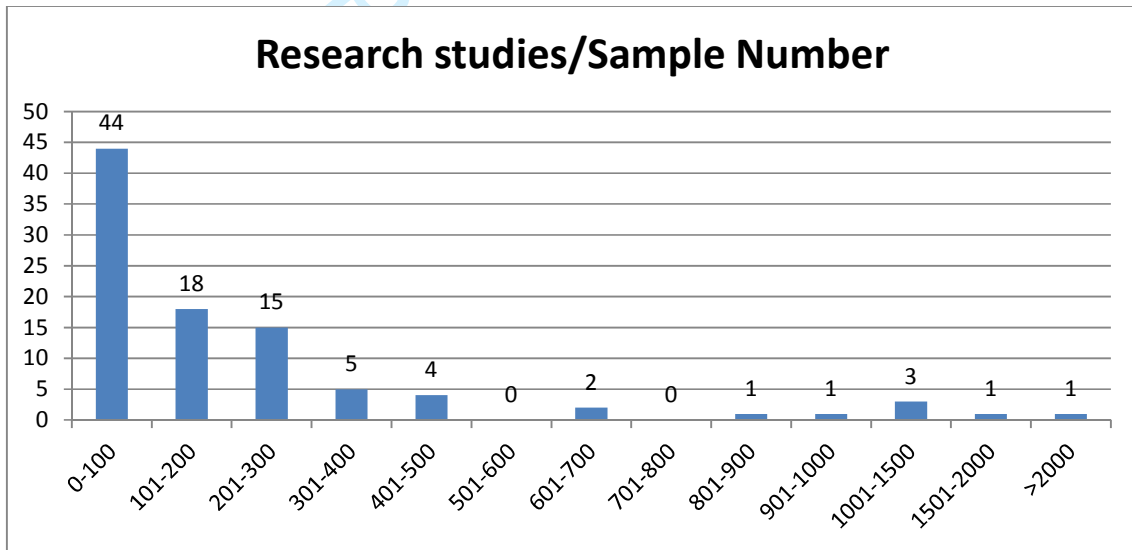


Figure 5: Research studies (surveys) per sample number

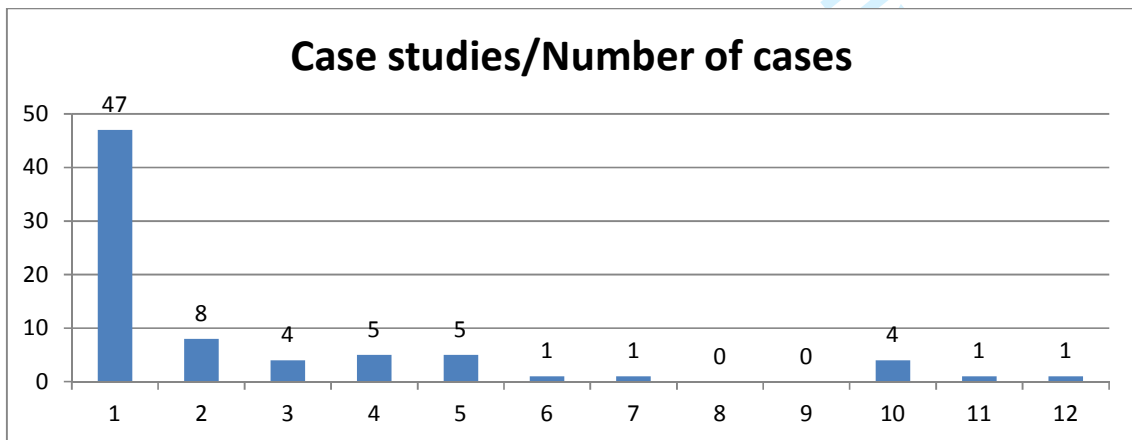


Figure 6: "Case study" articles per number of cases

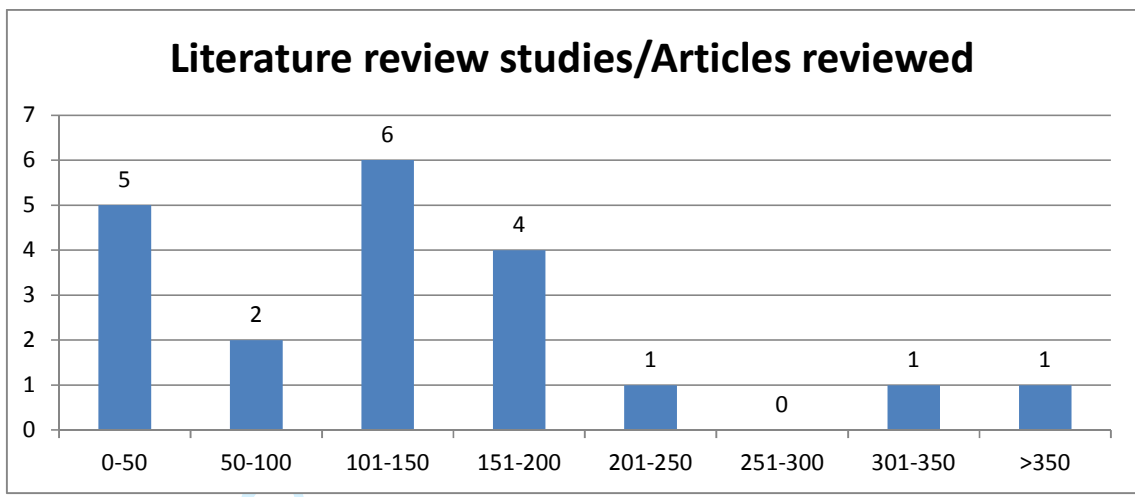


Figure 7: "Literature review" studies per articles reviewed

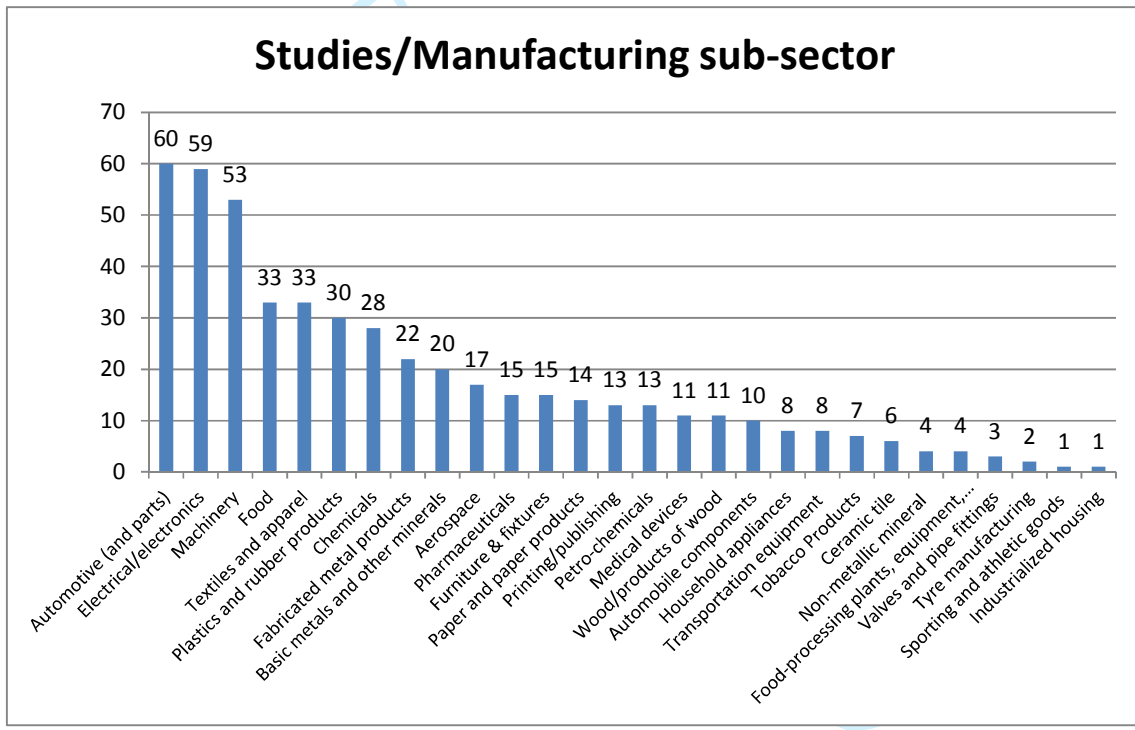


Figure 8: Studies (surveys and case studies) per manufacturing sub-sector

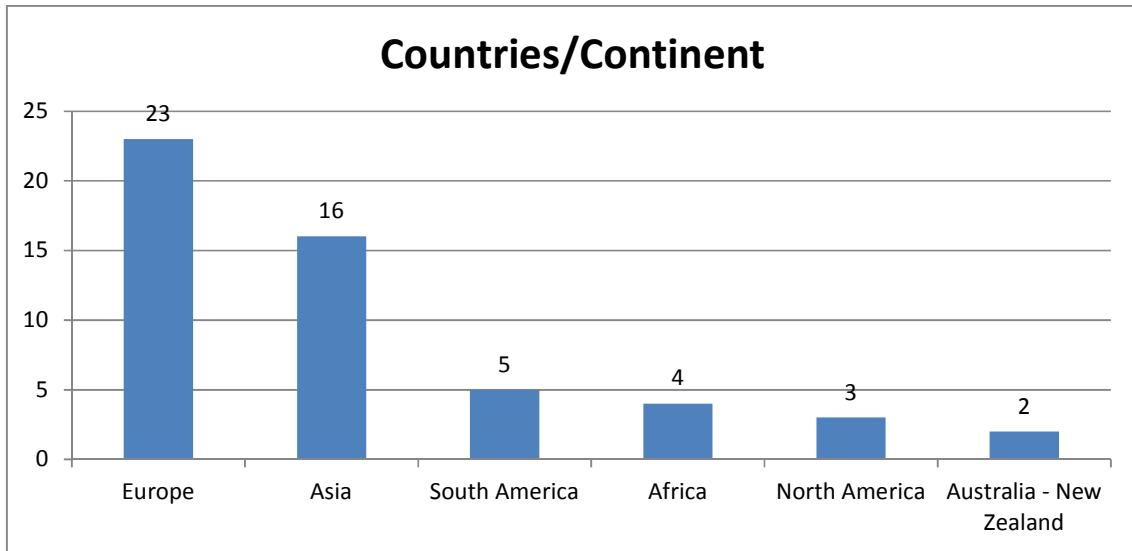


Figure 9: Countries per continent where the studied companies operate

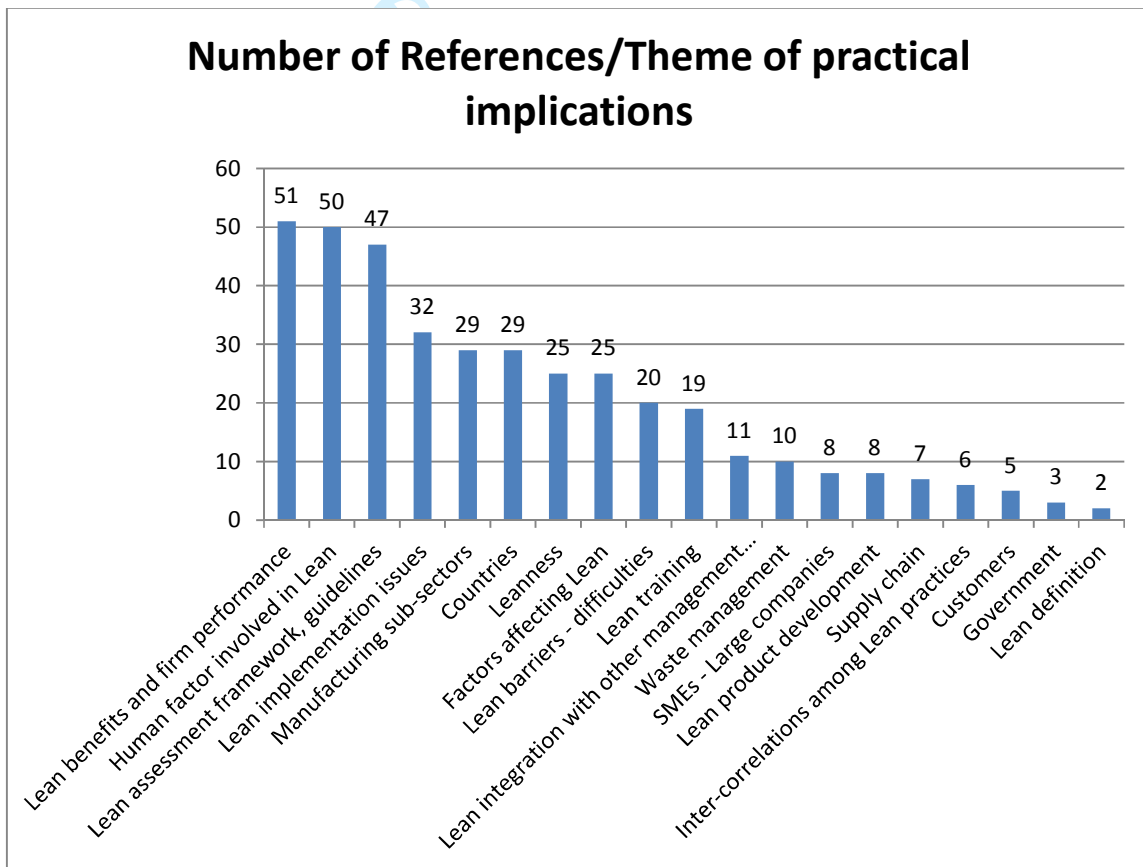


Figure 10: The number of the literature references per theme of the practical implications

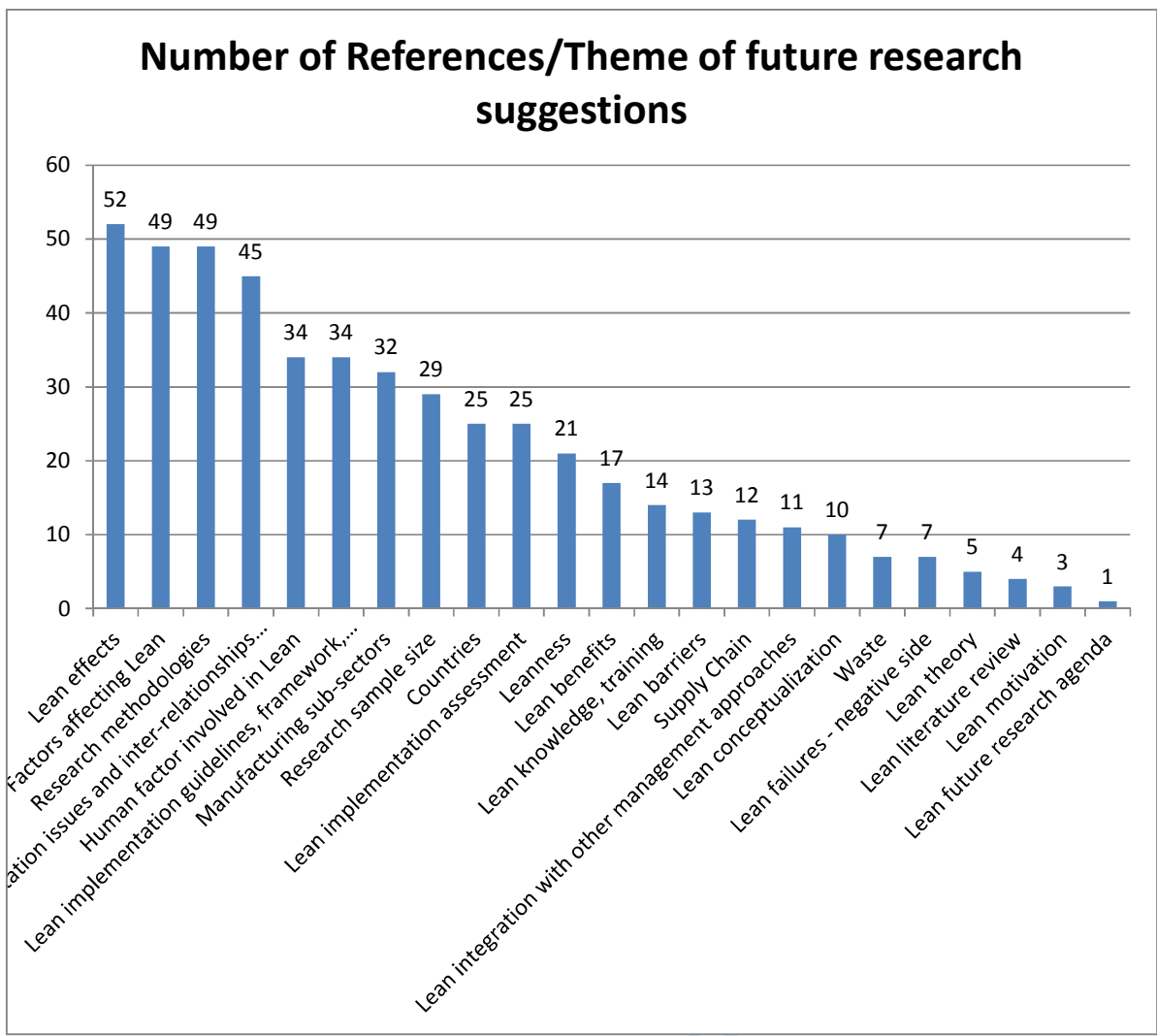


Figure 11: The number of the literature references per theme of future research suggestions