Literature Review: Lean Manufacturing Assessment During the Time Period (2008-2017)

Malek Khalaf Albzeirat¹, *, Muhammad Iqbal Hussain¹, Rosmaini Ahmad¹, Alaa Salahuddin¹, Falah Mustafa Al-Saraireh², Nazih Bin-Abdun³

¹School of Manufacturing Engineering, Universiti Malaysia Perlis, Pauh Putra Campus, Arau, Malaysia
²Department of Mechanical Engineering, Mutah University, Mutah, Alkarak, Jordan
³School of Mechatronic Engineering, Universiti Malaysia Perlis, Pauh Putra Campus, Arau, Malaysia

Email address: eng.malekunimap@gmail.com (M. K. Albzeirat)

*Corresponding author

To cite this article:
Malek Khalaf Albzeirat, Muhammad Iqbal Hussain, Rosmaini Ahmad, Alaa Salahuddin, Falah Mustafa Al-Saraireh, Nazih Bin-Abdun. Literature Review: Lean Manufacturing Assessment During the Time Period (2008-2017). International Journal of Engineering Management. Vol. 2, No. 2, 2018, pp. 29-46. doi: 10.11648/j.ijem.20180202.12

Abstract: The aim of this paper is to explore and evaluate previous work focusing on the relationship and links between Lean manufacturing and industrial work. This study reviews the literature on Lean Manufacturing Assessment (LMA) during the last decade; 2008–2017 and analyses the literature from different perspectives. This paper highlights various key words, scopes, objectives, case study, definitions, methodologies, tools and main results. A total of 126 research papers have been reviewed in this study to help the researchers in the evaluation of lean manufacturing practices to identify and benefit from these studies. This paper provides a quantitative descriptive analysis and qualitative thematic analysis to provide an analysis of impact of lean on performance. Consequently, this paper can be considered as a guide for researchers in LMA. It is expected to be a brief reference for future researchers that reduces effort and time consuming during their studies.

Keywords: Industrial, Lean Manufacturing, Assessment

1. Introduction

This century is characterized by the rapid growth in all areas related to human life, such as education, health, industry and services. In line with this rapid growth is the lean applications, which include many applications that contribute to improving the performance in the field of services and industry, and this momentum produced many researches in the field of lean and its applications. In the past decade, several studies were conducted on lean manufacturing assessment LMA in general, given the wide range of lean application processes. These studies have assessed what has been achieved in the field of lean philosophy study, thus resulting in developing studies based on previous literature. Table 1 shows the previous studies on subjects directly related to the lean concept in general.

Based on Table 1, the number of papers reviewed, and the number of citation for each study, it seems that many studies have been conducted in the field of lean and these studies included a difference in the type of firms, processes, size of firms, different tools, differences in methodology. Nevertheless, these studies emphasize the importance of lean application and its role in improving performance. Regarding the subject of this paper, previous studies indicate that there is momentum in studies that include different assessments in terms of objectives, key words, definitions, objectives, firms, methodologies and results. Therefore, this paper summarizes a review of the research papers published in the time period from 2008 to 2017 that are directly related to the evaluation process and applications of lean practices. The structure of this study is as follows. The first section contains studies on the evaluation processes in general, followed by the second section, which includes the methodology of the study. The third section involves studies in addition to the analysis of the content of these studies. The fourth section includes the repetitive analysis of previous studies and the conclusions are discussed in the last section.


Table 1. Literature Review in Previous Studies.

| Main Themes                                      | Reference | Time Period       | No. of Papers | 1/6/2018 Cited by |
|-------------------------------------------------|-----------|------------------|---------------|------------------|
| State of Lean Implementation in Health care      | [1]       | 1977-2009        | 57            | 254              |
| Lean thinking in healthcare                     | [2]       | 1990-2009        | 64            | 404              |
| Six Sigma                                        | [3]       | 1981-2010        | 87            | 124              |
| Value stream mapping                             | [4]       | 1993-2010        | 49            | 117              |
| Lean                                            | [5]       | 1970-2009        | 148           | 217              |
| Lean Six Sigma                                   | [6]       | 2000-2011        | 116           | 61               |
| Lean                                            |           | 200-2006         | 11            | 51               |
| Sustainable Supply Chains                        | [8]       | 2000-2010        | 85            | 159              |
| Lean Service                                     | [9]       | 1980-2008        | 86            | 22               |
| Learning on Lean                                 | [10]      | 1980-2009        | 86            | 22               |
| Lean Manufacturing                               | [11]      | 2000-2011        | 48            | 52               |
| Sustainability through Lean Construction Approach| [12]      | 1992-2012        | 18            | 29               |
| The lean gap                                     | [13]      | 1985-2012        | 38            | 47               |
| Lean Manufacturing                               | [14]      | 1988-2013        | 249           | 424              |
| Lean Management                                  | [15]      | 1990-2013        | 66            | 185              |
| lean manufacturing implementation                | [16]      | 1983-2013        | 43            | 102              |
| lean manufacturing                               | [17]      | 1990-2009        | 178           | 58               |
| Lean Production                                  | [18]      | 1988-2011        | 546           | 151              |
| Lean implementation                              | [19]      | 1983-2014        | 148           | 47               |
| Lean and green                                   | [20]      | 1998-2014        | 59            | 113              |
| Lean and Sustainable Manufacturing               | [21]      | 2000-2014        | 58            | 21               |
| Lean in healthcare                               | [22]      | 2003-2013        | 243           | 135              |
| Lean management                                  | [23]      | 2004-2014        | 49            | 20               |
| Lean Assessment                                  | [24]      | 1970-2015        | 98            | 20               |
| lean manufacturing, Six Sigma and Sustainability | [25]      | 1990-2015        | 118           | 55               |
| Lean Healthcare                                  | [26]      | 1983-2015        | 107           | 28               |
| Lean and Six Sigma                               | [27]      | 1999-2015        | 149           | 22               |
| Lean Practices                                   | [28]      | 1974-2015        | 83            | 20               |
| Six Sigma and Lean                              | [29]      | 2000-2015        | 70            | 10               |
| sustainability in supply chain management        | [30]      | 2000-2015        | 190           | 36               |

2. Methodology of the Study

The methodology of this study is based on the fundamentals of content analysis referred to in many studies such as [14, 29, 31] which included the following research steps: collection of materials, evaluating the appropriateness of subjects with each other and classification of what is selected in the classification lists (key words, scopes, objectives, and methodologies). Table 2 shows a brief explanation of the research methodology.

Table 2. Summary of Research Methodology.

| Unit of Analysis                  | The sources include high ranked peer-reviewed papers in the LMA. |
|-----------------------------------|------------------------------------------------------------------|
| Type of Analysis                  | Qualitative.                                                     |
| Papers Selected                   | Scientific journals and conferences accessible through Google Scholar. |
| Time Period of Articles           | 2008-2017                                                        |
| Totals Numbers of Articles Before Exclusion | 225                                                               |
| Totals Numbers of Articles After Exclusion   | 126                                                              |

3. Collection of Materials

The general framework of this study is based on LMA studies, as LMA is considered a key basis for improving the performance of organizations in general, as indicated by many previous studies in the past decade the collection of data on the concept of lean in general. There are many studies that have been carried out in LMA in the previous decade, and these studies included the subject of LMA as a general subject and then dispersed in different parts. Tables 3-12 represent a wide range of these studies in LMA in general, and also include the number of citations for studies related to this research field.

3.1. Time Period 2008

The study found that there were 28 studies that included lean assessment methodology in general. Within the methodology of this study, the number was limited to research that includes the word lean as a keyword in the title. Therefore, the number was reduced to 12 papers.

3.1.1. Keywords Classification

Previous studies [32-34] included keywords (Lean Manufacturing and Manufacturing System [32], Lean manufacturing, Change agents and Regional development...
agency [33], Leanness measure, Data envelopment analysis and Slacks-based measure [34]; Lean production, Decision making and Strategic choices [35], Lean Manufacturing and Workplace [36], Lean production, Performance measurement and Balanced scorecard [37], Lean, Leanness, Fuzzy-logic leanness, Systematic measures and Benchmarking [38], Lean Manufacturing Systems and Performance Measurement [39], Lean strategy, Automotive supplier industry, Relationship building and Path analysis [40], Lean Thinking [41], Lean accounting, Contingency Theory, Performance measures, Management Control, Lean Manufacturing; Control and Interdependencies [42], Lean Bundles and Operational Performance [43]). It is noted that these studies included key words referring to practices in general, and some indicate performance, types of institutions and type of data.

3.1.2. Objective and Firm Classification
The objectives of previous studies [32-43] are to indicate to different objectives, thus including (Current state of lean practice, Investigating the correlation, Decision-making strategies, Development of evaluation processes). Previous studies in Table 3. include several types of institutions firms, whereby the size of companies included small- and medium-sized enterprises.

3.1.3. Definitions, Methodology and Tools Classification
The studies [32-43] included a variety of methodologies: quantitative studies, qualitative studies, observations, and historical data, also the existence of fuzzy logic on a limited scale. One of the most important definitions in this time domain is that the definition of the Fuzzy logic for lean measurement: level of lean may include undetermined and uncertain degrees.

| No. | Lean Tools | Main Results | References |
|-----|------------|--------------|------------|
| 1   | Cell/flow-line/product, Flow of Material/Work in Processes, Delivery of Row Materials, Kanban setup, Rate, On Time Delivery. | The results of assessments show that the petroleum industry is in lead among | [32] |
| 2   | Total productive maintenance, statistical process control, Lean Management, Kaizen, cellular manufacturing, synchronous manufacturing, Poka-Yoke, standardized working and work place organization | The results obtained from 15 companies show that the savings are eight times greater than total costs. It has been found that the commitment of management and the ability of the change agents are the key determinants of success. | [33] |
| 3   | Value stream, flow, pull, Kanban system, quick changeover, just-in-time Total quality management (TQM), Six-sigma (SS), | The decision-making process can be improved through historical data | [34] |
| 4   | Total productive maintenance (TPM), value stream mapping, Work-in-process, | An extensive analysis of PROMETHEE model revealed that LMS was the best for the given circumstances of the case. | [35] |
| 5   | Lean tools in general. | The model has proved effectiveness in improving the training process. | [36] |
| 6   | Lower WIP, higher quality, greater production flexibility. | The DMP model presented in this paper has generic appeal and can be applied to quite disparate organisations. | [37] |
| 7   | Just-in-time, Kaizen, and quality, Controls. Total Quality Management | The results show that Ford's more than leaner GM's. | [38] |
| 8   | | The results show that building the external relationship is an important stage in making improvement. | [39] |
| 9   | Just-in-time, Standardization, Value analysis. | Effectiveness of redesigning care programs for hospitals. | [40] |
| 10  | Pull, Value Stream Mapping. Just-in-Time, Total Quality Management, Total Preventative Maintenance. | Suggestion insights from evidence on lean accounting. | [41] |
| 11  | Just-in-Time, Total Quality Management, Human Resource Management. | Results show that JIT and TQM have a direct and positive effect on the operational performance while HRM has a mediated effect on it. | [42] |
| 12  | | | [43] |

3.2. Time Period 2009
The study found that there were 25 studies that included lean assessment methodology in general, and within the methodology of this study, the number was limited to research that includes the word ‘lean’ as a keyword in the title. Therefore, the number was reduced to 8 papers.

3.2.1. Keywords Classification
Previous studies [44-51] included keywords (Non-financial performance measures, Lean manufacturing, Structural equation modeling [44], Manufacturing systems, Benchmarking, Best practice, Lean production, Just in time [45], Lean production, Agile production, Operations management. [46]; Flexible manufacturing systems, Lean production, Best practice. [47]; Lean Management, Multiple Case Study, Lean Service [48], Lean manufacturing, key practice areas [49], Lean manufacturing, just in time [50], Worker assignment; lean manufacturing; cross-training; multi-skilling; skill chaining [51]. It is noted that these studies referred to specific practices as Just-In Time.
3.2.2. Objective and Firm Classification

The previous studies [44-51] indicate different objectives, including (Current state of lean practice, Identifying the practices that managers use to improve the overall manufacturing flexibility and including several types of institutions firms, such as electronic companies and financial services, whereas the companies included small- and medium-sized enterprises.

3.2.3. Definitions, Methodology and Tools Classification

The studies [44-51] included a variety of methodologies: quantitative studies, qualitative studies, observations and historical data, also the existence of fuzzy logic on a limited scale. One of the most important definitions in this time domain is that the definition of the Structural equation model (SEM) is estimated using data provided by companies.

Table 4. Exploration and Analysis, Lean Tools and Main Results in Publications 2009.

| Lean Tools | Main Results | References |
|------------|--------------|------------|
| Just-in-Time, Total Quality Management | Results provide substantial evidence that utilization of non-financial manufacturing performance measures mediates the relationship between lean manufacturing and financial performance. | [44] |
| Counties Improvement, Just-in-Time, Total Quality Management, Value Stream Mapping | Review of studies in benchmarking field. | [45] |
| Just-in-Time, Flexibility Techniques, and major groups involved in improving Flexibility | Identify practices that contribute to improving work through agility and softness. | [46] |
| General Practices | The results identified the practices as the best practices that managers can use to improve processes. | [47] |
| General Practices | Lean first, then Automate. | [48] |
| General Practices | Select 14 key area: work processes, scheduling, inventory, equipment, layout, material handling, employees, quality, product design, suppliers, tools and techniques, customers, ergonomics and safety, and management and culture. | [49] |
| General Practices | Determined 65 lean practices. | [50] |
| General Practices | Developing a model that contributes to improving training to use and apply lean skills. | [51] |

3.3. Time Period 2010

The study found that there were 33 studies that included lean assessment methodology in general, and within the methodology of this study, the number was limited to research that includes the word ‘lean’ as a keyword in the title. Therefore, the number was reduced to 16 papers.

3.3.1. Keywords Classification

Previous studies [52-67] included keywords (Material handling, Lean manufacturing, Case study, Value stream mapping; Diamond drill bit components [52], Lean manufacturing, Lean maturity, manufacturing companies, methodology [53], Supply chain management, Lean production, Integration [54], assessment, authentic problems, facilitator; games, problem-based learning, problem soft skills, realism, review, simulations, skills, soft lean manufacturing, solving skills, Toyota Production System [55], Lean, Value Stream Mapping, Small Medium Enterprises, Future State [56], Lean manufacturing, green manufacturing, case-study, discrete event simulation, optimization [57], Lean manufacturing, Medium Size Manufacturing Enterprises, Kaizen [58], Lean manufacturing, Value Stream Mapping, Tak time and capacity [59], Lean production, Manufacturing systems, Fuzzy control, Quality management [60], United Kingdom, Public sector organizations, Business process re-engineering [61], Lean implementation, Lean manufacturing, simulation, Toyota Production System [62],

Lean Kitting assembly, Fuzzy Based Simulation (FBS), work in process inventory, floor space required, operator walking distance [63], Lean paradigm, green paradigm; performance measurement, supply chain management; SCM [64], Lean model Second generation wavelet packet, transforms, Fisher criterion [65], Emergence department administration, Lean principles, length of stay, time to physician, wait time [66], Lean manufacturing, organizational change, automotive industry [67].

3.3.2. Objective and Firm Classification

The previous studies [52-67] refer to different objectives, including (Current state of lean practice, Identifying the practices that managers use to improve the overall manufacturing flexibility and including several types of institutions firms, such as electronic companies petroleum drill bit manufacturing, hospitals and services sectors, whereas the companies included small- and medium-sized enterprises.

3.3.3. Definitions, Methodology and Tools Classification

The studies [52-67] included a variety of methodologies: quantitative studies, qualitative studies, observations, historical data and a mathematical model. One of the most important definitions in this time domain is the definition of the Lean Kitting assembly as: “a specific collection of components and/or sub-assemblies together and combine with other kits to support one or more assembly operations for a given product”.

Table 5. Exploration and Analysis, Lean Tools and Main Results in Publications 2010.

| Lean Tools | Main Results | References |
|------------|--------------|------------|
| Value stream mapping | The process of lean application contributes to the disposal of waste in drills factories by reducing assembly and disposal of distances. | [52] |
| Just in Time, Perfect quality, Continuous improvement, | Lean is considered an integrated system to improve the performance. | [53] |
3.4. Time Period 2011

The study found that there were 24 studies that included lean assessment methodology in general, and within the methodology of this study, the number was limited to research that includes the word ‘lean’ as a keyword in the title. Therefore, the number is limited to 14 papers.

3.4.1. Keywords Classification

Previous studies [68-81] included keywords: Lean Performance, Fuzzy Logic and continuous improvement [68], International study Lean manufacturing Environmental management practices Environmental performance Empirical study [69], Lean manufacturing; leanness assessment, fuzzy methods, leanness index [70], lean manufacturing, leanness assessment, fuzzy logic, decision support system [71], Lean, manufacturing, practices, small, medium, enterprises [72], Cycle time, Inventory management, 5-whys, SS, Value stream mapping, Cellular manufacturing [73], Material handling and Lean [74], Lean Manufacturing, Lean Thinking, Total Quality Management [75], Lean manufacturing, implementation, case studies, electrical and electronics, Malaysia [76], Cellular manufacturing, Lean production, Performance measurement [77], Lean tools, Waste, Mass production, Tak time, Lead time. Value chain, Value-added activity, Non-value-added activity [78], Lean, Simulation [79], Manufacturing systems, Analytic hierarchy process, Lean manufacturing, Concept selection, Multi-criterion decision making 80], Lean Manufacturing, Value Stream Mapping, Unified Modelling Language, Analytic Hierarchy Process. [81]. It is noted that there is an increase in the number of practices in the keywords.

3.4.2. Objective and Firm Classification

The objectives of previous studies [68-81] included Studying the effect of lean on the performance, Assessing the lean using a fuzzy approach including several types of institutions firms, such as electronic companies petroleum drill bit manufacturing, hospitals, pharmaceutical industries and services sectors, whereas the size of companies included small- and medium-sized enterprises.

3.4.3. Definitions, Methodology and Tools Classification

The studies [68-81] included a variety of methodologies: quantitative studies, qualitative studies, observations, historical data and a mathematical model. One of the most important definitions in this time domain is that the definition of the Manufacturing Cells is characterized by the creation of a workflow in which the tasks are required and workers are closely connected in terms of time, space, and information.

| Lean Tools | Main Results | References |
|------------|--------------|------------|
| Visual management | The study showed the positive effect of adopting a lean methodology on the performance in companies. | [54] |
| Just in Time | Simulations contribute to the strengthening of learning and training on lean assessment but do not give actual results to the lean level in companies in fact. | [55] |
| SS | The results indicate that there is a positive effect of lean in reducing time-related wastes and the number of operators according to the case study. | [56] |
| Value stream mapping | The lean can have a significant impact on improving the operational processes. | [57] |
| Value stream mapping | The results indicate that SMEs have a high potential to employ lean practices to improve the performance, raise production values, and eliminate waste. | [58] |
| Just in Time | The results showed a high potential for improving the performance. | [59] |
| Total productive Maintenance, Total Quality Management, Value Stream Mapping and Visual Control. Visual management, Value stream mapping, SS and Line balancing Value stream mapping Operator walking distance and WIP Lean practices Lean Just in Time, Value stream Mapping, Workplace Organization | The model includes uncertainty in the presence of waste. | [60] |
| | The results indicate the effectiveness of lean practices in improving the service sector. | [61] |
| | Use simulations in training, education, and fact analysis. | [62] |
| | Employing fuzzy logic in the decision-making process in improving the performance. | [63] |
| | Study the relation between lean and green supply chain. | [64] |
| | Lean model can reduce the time consumption. | [65] |
| | Lean practices have contributed to improving the flow of patients in the emergency department and increasing their level of satisfaction. | [66] |
| | The study showed that there is an impact of the organizational change in the process of transition to lean. | [67] |

**Table 6.** Exploration and analysis, Lean Tools and Main Results in Publications 2011.
3.5. Time Period 2012

The study found that there were 27 studies that included lean assessment methodology in general. Within the methodology of this study, the number was limited to research that includes the word ‘lean’ as a keyword in the title. Therefore, the number was decreased to 16 papers.

3.5.1. Keywords Classification

Previous studies [82-97] included keywords: India, Manufacturing industries, Lean production, Lean manufacturing, Manufacturing, Manufacturing performance, Manufacturing operations [82], lean manufacturing; manufacturing systems; structural equation modeling; organizational performance [83], Lean manufacturing Leanness, Fuzzy logic [84], Lean manufacturing, Parameters, Manufacturing industry, Survey, Lean production, Process efficiency [85], Lean production Analytical hierarchy process, Artificial neural network, Adaptive analytical hierarchy process approach [86], lean manufacturing; India; operational and quality improvement; survey [87], Lean Product development, Lean implementation measurement, New Product Development process [88], Malaysia, Manufacturing industries, Supply chain management, Lean production, Product quality management, performance, Structural equation modeling [89], Fuzzy logic; Impact assessment; Lean manufacturing; SMEs [90], Variability; Lean Manufacturing; Assessment [91], Lean /Ideology/Culture Tools/Journey [92], Lean manufacturing, Leanness, IF–THEN Rules, Leanness enablers, Gap analysis [93], India, Manufacturing industries, Lean production, Decision support systems, Lean manufacturing, Leanness assessment, Fuzzy method [94], Lean management, Lean production, Continuous improvement, Off-site manufacturing, Manufacturing industries [95], Performance improvements; Waste; Lean Manufacturing; Mathematical model [96], Lean production, Inventory management, Financial performance [97]. It is noted that studies have become limited to specific areas, such as the focus on the process of production, inventory, and performance.

3.5.2. Objective and Firm Classification

The objectives of previous studies [82-97] included Improving the decision-making process by determining the lean level within the application of hierarchical analysis, an exploratory study of the lean state of India's industries, developing a valuation model enables companies to understand the basic practices, rapid and accurate assessment of lean level, a broader understanding of how lean application in malaysia depends on supply chain management, developing a system of consulting companies towards the use and application of lean, developing a new methodology for lean assessment through variability source mapping, exploring lean in large companies, developing the assessment process within the ambiguous logic, the development of the decision-making system in lean applications. Several types of institutions firms were included, such as electronic companies petroleum drill bit manufacturing, hospitals, pharmaceutical industries and services sectors, and the size of companies included small- and medium-sized enterprises.

3.5.3. Definitions, Methodology and Tools Classification

The studies [82-97] included a variety of methodologies: quantitative studies, qualitative studies, observations, historical data and a mathematical model. One of the most important definitions in this time domain is that the definition of the Value stream mapping (VSM) is a lean manufacturing technical methodology that helps interpret the flow of materials and information currently needed to transfer goods or services to the end consumer.
Table 7. Exploration and Analysis, Lean Tools and Main Results in Publications 2012.

| Lean Tools | Main Results | References |
|------------|--------------|------------|
| Total productive maintenance, Employee’s productivity and Total Productivity Management | The study indicates to lean dimensions on operational performance. | [82] |
| Lean Manufacturing | The results indicated that the proposed model improves the objectives of the manufacturing process (cost, quality, flexibility) | [83] |
| Lean Practices | The results suggest that the evaluation and fuzzy logic analysis give more comprehensive results. | [84] |
| Just in time, Zero Defect, Pull, Continuous improvement | Develop a proposed model to improve the effectiveness of lean application. | [85] |
| Continuous improvement, Zero Defect, Pull, Standardized Workplace, Lean Practices | Improving the level of operational performance does not depend only on lean. | [86] |
| Lean Manufacturing | Develop a road map that contributes to the lean tracking of each stage of the production process and identify the difficulties faced by the lean application. | [87] |
| Continuous improvement, Setup time reduction, Product reliability and Product performance | Results show a strong correlation between lean and quality management. | [88] |
| Lean Manufacturing | Research study has provided a novel system for assessing the impact of lean manufacturing within SMEs. | [90] |
| Main Value Stream | The results showed that the proposed model contributed to the identification of objects that have no value in production processes. | [91] |
| Kanban systems, Cellular manufacturing, Total productive maintenance, Process mapping, continuous improvement and 5S | The study points to be deemed to be embracing Lean as an ideology. | [92] |
| Lean Manufacturing | Effectiveness of the proposed model | [93] |
| Just in Time | The proposed model contributes to the determination of lean areas accurately. | [94] |
| Continuous improvement Total Quality Management | The study shows important aspects of management where improvement can be applied. | [95] |
| Standard Processes, Visual management, Continuous Improvement, Pull Systems. | Develop a methodology to support the identification of lean strategies. | [96] |
| Total Quality Management, Just in Time | Development of lean production theory | [97] |

3.6. Time Period 2013

The study found that there were 29 studies that included lean assessment methodology in general. Within the methodology of this study, the number was limited to research that includes the word ‘lean’ as a keyword in the title. Therefore, the number of paper was reduced to 11.

3.6.1. Keywords Classification

Previous studies [98-109] included keywords: Production planning, Simulation, Sustainable development [98], lean manufacturing, lean production, leaness, lean indicators, lean assessment, lean model [99], Just-in-time; lean manufacturing; kanban system; inventory management; operations strategies [100], Environmental management, Lean manufacturing, Human resource management, Operational performance, Automotive sector [101], Leaness, Lean implementation methodology, Continuous performance measurement, Lean strategies, Lean production, Performance management [102], Accounting Management, Lean [103], Lean Manufacturing, Performance [104], Performance measurement, Lean production, Assessment instrument, Lean service [105], Lean manufacturing, Lean enterprise, Lean Transformation, Lean principles and practices, Lean Assessment, Lean stakeholder value, Analytic network process [106], Lean manufacturing, Interpretive structural modeling, Leanness index, Tire manufacturing, [107], Product development, New products, Lean production, New product development, Lean manufacturing, Concurrent engineering [108], lean manufacturing, competitive skills, business performance [109]. It is noted that studies have become limited to specific areas more than other years, such as the focus on the process of production, inventory and performance, human resource, and accounting management.

3.6.2. Objective and Firm Classification

The objectives of previous studies [98-109] included integration of lean and green strategies into the industrial system, describing a preliminary study in developing a conceptual model to measure leanness in manufacturing industry and purposing the relationship between competitive skills and lean manufacturing. It included several types of institutions firms.

3.6.3. Definitions, Methodology and Tools Classification

The studies [98-109] included a variety of methodologies: quantitative studies, qualitative studies, observations, historical data. One of the most important definitions in this time domain is that the definition of the Lean and Green is: the ability of operations to support the environmental management.
3.7. Time Period 2014

The study found that there were 23 studies that included lean assessment methodology in general. In the methodology of this study, the number was limited to research that includes the word ‘lean’ as a keyword in the title. Therefore, the number was reduced to 14 papers.

3.7.1. Keywords Classification

Previous studies [110-123] included the following keywords: leanness; lean implementation; lean operations; lean manufacturing; performance measures; performance analysis; quality management; Toyota production system [110], Lean manufacturing Lean accounting Operations and financial performance Survey analysis Structural equation modeling [111], Manufacturing strategy, SME, Small-to-medium-sized enterprises, Lean production, Lean implementation, Lean process [112], Brazil, Degree of leanness (DOL), Lean implementation [113], Lean Assessment, Take Time, System Dynamic [114], Lean manufacturing; National culture; Behavioral operations [115], Waste reduction, Empirical research, Lean manufacturing, Industry competitiveness [116], Lean, Kaizen, Total Productivity Maintenance, Just In Time, Standardization, 5S, Effectiveness [117], Automonation, JIT, kaizen, lean methods, measures of operational performance [118], Lean, Road Map, AHP, Lean Assessment [119], Leanness; Product-Service System (PSS); Conceptual model [120], Manufacturing technologies Lean practices Complementary effects Performance [121], Lean Manufacturing, Lean Implementation, Survey Research, Reliability, validity, New Variable Design [122], Lean manufacturing practice; LMP; quality initiative; continuous improvement; environmental performance [123]. It is noted that the studies have become limited to specific areas more than other years, such as the focus on the process of production, inventory and performance, human resource, and accounting management.

3.7.2. Objective and Firm Classification

The objectives of previous studies [110-123] were based on the development of evaluations and the improvement of the evaluation process.

3.7.3. Definitions, Methodology and Tools Classification

The studies [110-123] included a variety of methodologies: quantitative studies, qualitative studies, observations, historical data. One of the most important definitions in this time domain is that the definition of Resource-Based View (RBV) is used as a theoretical lens to examine the relationship between resources and lean practices and the operational performance.

| Table 8. Exploration and Analysis, Lean Tools and Main Results in Publications 2013. |
|---------------------------------|-------------------------------------------------|-------------------|
| Lean Tools | Main Results | Reference |
| Lean, Green, Quality rate improvement | The integration of lean and green strategies reduces production costs. | [98] |
| Total Quality Management, Just in Time, Pull, SS, Continues Improvement and Visual Management System. | The study identified seven basic dimensions to measure leanness. | [99] |
| Lean Manufacturing | The study suggests that top management commitment, vendor participation, inventory management and quality improvement are important for Kanban deployment and towards lean manufacturing. | [100] |
| Lean Manufacturing | There is a positive relationship between environmental management, operational performance, lean manufacturing, and human resources. | [101] |
| Value Stream, Pull, Just in Time, Six Sigma, Total Quality Management | The basic results included the development of a simple tool to measure lean. | [102] |
| Lean Manufacturing | Accounting and control practices management form the basis for a lean environment. | [103] |
| Lean Manufacturing | Improve the effectiveness of measuring instruments | [104] |
| Lean Manufacturing | Comprehensive tool to evaluate services. | [105] |
| Lean Manufacturing | The modeling and weighting of all the determinants in the lean tools is discussed in this paper. | [106] |
| Lean Manufacturing | Proposed model for lean assessment | [107] |
| Lean Manufacturing | The results indicate that companies that implement the lean system are able to develop quickly and at a lower cost. | [108] |
| Lean Manufacturing | There is a positive correlation between competitive performance and lean system. | [109] |

| Table 9. Exploration and Analysis, Lean Tools and Main Results in Publications 2014. |
|---------------------------------|-------------------------------------------------|-------------------|
| Lean Tools | Main Results | References |
| Just in Time, Takt time, Defect rate. | Proposing a comprehensive evaluation system that contributes to increasing the efficiency of the evaluation of firms. | [110] |
| Just in Time, Toyota Production System | Cooperation between accounting and processes is needed to ensure a better application of lean. | [111] |
| Visual Management, Workplace Organization, SS, Just in Time and Continuous Improvement, Total Quality Management and Total Productive Maintenance | Early assessment to identify weaknesses contributes to higher efficiency for lean implementation. | [112] |
| Just in Time | Results showed a difference in lean application levels in companies. | [113] |
| Just in Time, Total Productive Maintenance and Work in Processes | Results indicate that the model contributes to decision making. | [114] |
3.8. Time Period 2015

The study found that there were 26 studies that included lean assessment methodology in general. The methodology of this study was limited to research that includes the word ‘lean’ as a keyword in the title. Therefore, the number is restricted to 10 papers.

3.8.1. Keywords Classification

Previous studies [124-134] included the following keywords: Lean Manufacturing, Bayesian Belief Networks, Scenario Analysis, Business Performance [124], Lean Management; Services; Organizational culture; Lean Culture; Lean maturity; Management tool [125], lean manufacturing; production management; cultural transformation; sustainability [126], Lean production Leanness assessment, Fuzzy cognitive map (FCM), Data envelopment analysis (DEA), Fuzzy data envelopment analysis (FDEA), Decision Making Trial and Evaluation [127], lean; lean service; waste; customer value; lean methodologies applied to services [128], Lean production; human resource management; high performance work practices [129], Lean manufacturing, productivity improvement, continuous improvement [130], Case studies, Lean production, Assessments, Learning, Adult education, Experiential learning [131], Lean metrics; lean performance; lean index; qualitative analysis; quantitative analysis [132], India, Lean manufacturing, Performance improvement, Process industry [133]. It is noted that studies have become limited to specific areas more than other years, such as the focus on the process of production, inventory and performance, human resource, and accounting management.

3.8.2. Objective and Firm Classification

The main objectives of previous studies [123-134] were based on exploring the financial and non-financial consequences of lean implementation, the improvement of the evaluation process and exploring the impact of employee’s participation in the implementation of lean.

3.8.3. Definitions, Methodology and Tools Classification

The studies [124-134] included a variety of methodologies: quantitative studies, qualitative studies, observations, historical data. One of the most important definitions in this time domain is that the definition Lean is a process of removal of unnecessary processes.

| Lean Tools | Main Results                                                                 | References |
|------------|-----------------------------------------------------------------------------|------------|
| Just-in-Time Total Quality Management | This study gives a new vision in applying Bayesian network for business performance. | [124]      |
| Lean Manufacturing | The study shows that production process measures are most related to lean. | [125]      |
| Lean Management | Organizational culture is essential for lean implementation. | [126]      |
| Lean | Workforce development is important for lean implementation. | [127]      |
| Value Stream Mapping, 5S, Pull and Six Sigma | There is a strong relationship between empowerment and training. | [128]      |
| Lean Manufacturing | Identifying success factors is a key to success and improvement of companies. | [130]      |
| SS, Kaizen, Standardized work, Just in Time, Total Productive Maintenance and Value Stream Mapping | Design training courses or assess existing experiential learning courses. | [131]      |
| Just in Time, Value Stream Mapping | It was established that the qualitative-based lean index is subjective quantitative types that lack scope. | [132]      |
| Lean Practices | Research contributes to identifying lean implementation strategies in India. | [133]      |

Table 10. Exploration and Analysis, Lean Tools and Main Results in Publications 2015.
3.9. Time Period 2016

The study found that there were 22 studies that included lean assessment methodology in general. In this study, the methodology was limited to the number of research that includes the word ‘lean’ as a keyword in the title. Therefore, the number is restricted to 14 papers.

3.9.1. Keywords Classification

Previous studies [124-134] included the following keywords: (Multi Criteria Decision, Analytic Hierarchy Process, Lean manufacturing, Six Sigma [134], Lean manufacturing; performance measurement; variability analysis [135], Lean manufacturing, Lean tools, Supply chain [136], Lean thinking, Waste, Lean manufacturing, Manufacturing industry [137], Lean manufacturing Green manufacturing [138], Lean Manufacturing [139], Lean Product Development (Lean PPD), Lean Transformation, Lean Readiness, Lean Assessment, LeanThinking, Set-Based Concurrent Engineering [140], Lean manufacturing, Leanness, Fuzzy logic, Performance measurement [141], Lean manufacturing; lean assessment tool; system dynamics [142], Lean manufacturing implementation; lean manufacturing attributes; operational performance parameters; lean manufacturing impact [143], Healthcare, lean management, productivity; maturity, complexity, value [144], Lean manufacturing, lean practices, India, Indian industries [145], Lean Manufacturing system, Lean manufacturing attributes, Graph theory, Graph Theory and Matrix, Approach Permanent function [146], Lean manufacturing; Toyota Production System; small and medium enterprises; survey; performance [147]. It is noted that studies have become limited to specific areas more than other years, such as the focus on the process of production, inventory and performance, human resource, and accounting management.

3.9.2. Objective and Firm Classification

The main objectives of previous studies [123-134] were based on the improve assessments, identifying lean practice levels and lean relationships impact of lean on the production factors.

3.9.3. Definitions, Methodology and Tools Classification

The studies [134-147] included a variety of methodologies: quantitative studies, qualitative studies, observations, historical data, mathematical model and fuzzy logic. One of the most important definitions in this time domain is that the definition Lean Manufacturing: is the set of practices intended to attain perfection in the identification and elimination of waste through continuous improvement flowing the product at the pull of the customer.

| Lean Tools | Main Results | References |
|------------|--------------|------------|
| Lean, Six Sigma | Results showed that the combination of lean and six sigma give results that are more effective than using lean only. | [134] |
| Lean Manufacturing | Provide a lean assessment model that is more flexible. | [135] |
| Just-in-Time, Six Sigma, Pull, Kankan Process Mapping, Value Stream Mapping, Continues Improvement, Visual Management, Benchmarking, Work Standardization | The results indicate the positive effect of lean on performance, and the results indicate that the most important obstacles are the limited knowledge of lean. | [136] |
| Just-in-Time, Kaizen, 5S, 5S, Value Stream Mapping, Continues Improvement, Teamwork, Visual control. | The results indicate that the most important practices are: operations, planning, human resources, customer relationship. | [137] |
| Lean Manufacturing | Total productive maintenance is identified as the most important lean practice. | [138] |
| Lean Manufacturing | The results indicated that the lack of awareness and knowledge of staff is the most important obstacles to the implementation of lean. | [139] |
| Value Stream Mapping, Just in Time | A five-level scale was designed, showing the results of the effectiveness of the model. | [140] |
| Total Productive Maintenance, Just in Time | The measurement model is designed according to the fuzzy logic. | [141] |
| Just in Time, Total Productivity Management | Improving lean uses in the packaging industry. | [142] |
| Kaizen | The study showed the impact of lean practices on performance, quality, and cost. | [143] |
| Just in Time, Value Stream Mapping, Total Productivity Management, Visual Management, Benchmarking, Total Productive Maintenance, Continuous Improvement Program Just in Time, Value Stream Mapping, Continuous improvements, 5S, Kanban | There is a positive effect of the lean on the performance of hospitals, and it is necessary to expand attention to aspects related to patients. | [144] |
| Lean Manufacturing | The study notes that lack of experience and education are the main reasons for the lean application process in India. | [145] |
| | A model was designed to compare the relative importance of lean practices. | [146] |
| Lean Manufacturing | The results show that the companies used practices in a fragmented manner without a holistic view of Lean Manufacturing. | [147] |

3.10. Time Period 2017

The study found 28 studies that included lean assessment methodology in general. Hence, the methodology of this study was limited to research that includes the word ‘lean’ as a keyword in the title. Therefore, only 10 papers were included.

3.10.1. Keywords Classification

Previous studies [148-157] included the following keywords: Lean manufacturing practices, Socio-technical and ergonomics practices, Maturity analysis [148], Sustainability indicators, Lean Manufacturing,
Manufacturing process, Value stream mapping, Sustainable operations [149], Lean, Green [150], Lean Manufacturing, Lean Principles, Relative Efficiency, Retail Stores, Takt Time, Value Added Services [151], Quality management system; QMS; integration; conceptual model; impact; structural equation modeling [152], Lean Manufacturing, Auto Parts industry, ANOVA, Post Hoc test [153], Lean production, workforce development and operational performance [154], lean manufacturing; cement production; waste minimization [155], Lean Performance [156], lean production, operational performance, SMEs [157]. It is noted that studies have become limited to specific areas more than other years, thus focusing on the process of production, quality management, operational performance, human resource, and accounting management.

### 3.10.2. Objective and Firm Classification

The main objectives of previous studies [148-157] were based on the studying the expected impact of soft practices on performance, improving the process of lean implementation and the improvement of the evaluation process.

### 3.10.3. Definitions, Methodology and Tools Classification

The studies [124-134] included a variety of methodologies: quantitative studies, qualitative studies, observations, historical data. One of the most important definitions in this time domain is that the definition of Lean is a manufacturing philosophy that shortens the time between the customer's order and the product build/shipment by eliminating the sources of wastes.

| Lean Tools | Main Results | References |
|------------|--------------|------------|
| Flexible manpower, Pull system, Takt time, Continuous flow, Material supply, Zero defects, Quality assurance, Product / process quality planning, Standardized work, Production leveling, Maintenance system, Workplace organization, Goal oriented teams, Cross functional work, Problem solving methods, Improvement organization, Prioritization, Improvement approach | The integration between lean and socio-technical and ergonomics contributes to the effectiveness of the organizational environment. | [148] |
| Value Stream Mapping | This method has identified three levels of sustainability. | [149] |
| Green paradigm is intended to reduce environmental risks and negative environmental impacts while improving the ecological efficiency and eliminating environmental waste in organizations chain initiatives. | Develop proposals to improve the supply chain | [150] |
| Takt time | The results obtained in the three retailers are good enough to implement lean tools and enhance day to day efficiency at the outlets. | [151] |
| Lean Tools | Results indicate the integration of Lean and quality management. | [152] |
| Just in Time, Load Leveling, Andon, Single, minute exchange die, Value Stream Mapping (VSM), Total Productive Maintenance, 5s, Six sigma, Kaizen, Root Cause Analyses, Group Technology, Plan Do Check Analysis, Smart goals, Key Performance Indicator, Single Piece Flow, Overall equipment efficiency, Visual factory, Standardized Work, Six Big losses, Policy development, Mudas, Mistake Proofing, Takt Time, Bottle Neck Analyses and Gemba | Major barriers founded in micro, small and medium industries were lack of communication, attitude of shop floor management and degree of investment respectively. | [143] |
| Just-in-time production, Total productive maintenance, Cellular manufacturing, Total quality management | The results of this study reinforce the assumption that during the implementation of lean production workforce development plays a key role due to its nature that advancement in the implementation translates to improving the performance. | [154] |
| Lean Manufacturing | Proposals have been made to reduce waste in the cement industry. | [155] |
| Total quality control, Standardized operating procedures, Total production maintenance, Total quality control, Pull production / Kanban, Standardized operating procedures Process Improvement, | This study suggests that companies should implement more lean practices that affect some operational characteristics. | [156] |
| | The study indicates the importance of the lean and its active role in raising the level of performance. | [157] |

### 4. Digital Analysis of Previous Studies

This part of the study includes the digital analysis of previous studies and presents illustrations of the rules of metadata for the values of repetition.

Through the descriptive analysis of the methodology used in previous studies, the results are demonstrated as in Figure 1.
The descriptive analysis of the methodology (Mathematical Model, Don't Use a Mathematical Model) used in previous studies is showed in Figure 2.

Through the descriptive analysis of studies that included references to performance in key words, objectives and results (Indicate For Performance, Not Indicate For Performance), the results are presented in Figure 3.

Through the descriptive analysis of studies that included references to Just-in Time as a tool, the results are illustrated by Figure 4.

The descriptive analysis of studies that included references to Value Stream Mapping is demonstrated by Figure 5.

The descriptive analysis of studies that included references to (Fuzzy Logic) is showed by Figure 6.

The descriptive analysis of studies that included references to Analytic Hierarchy Processes illustrate the results as in Figure 7.
5. Conclusion

Previous studies indicate several key points:

a. There is a large amount of evaluation studies on lean practices.
b. Extend areas of application of lean practices in various industry fields and services.
c. Most of the objectives of the studies are to measure the level of enterprises and companies.
d. Studies indicate the depth of the relationship as a power sector between performance and the level of lean.
e. Studies indicate that there is no established methodology for measuring the level of lean practices.
f. Some studies attempt to expand the fuzzy concept in the measurement of lean levels.
g. Most studies are based on quantitative and qualitative methodologies.
h. There are also studies based on qualitative data, and there are studies that combined the two methods in addition to multiple methods of arithmetic. There are many industries and sectors that need new and in-depth studies on lean studies, such as energy, tourism, hotel services, communications, and education.
i. Studies that attempted to link the evaluation process to the practical decision-making process of the lean are often more related to mathematical logic and mathematical methods.
j. In the past five years, there has been a clear change in evaluation methodology by combining quantitative and descriptive data with mathematical models that include calculations that help in decision making, and it was clear that the Analytic Hierarchy Process was the most commonly used.

References

[1] Poksinska, B. (2010). The current state of Lean implementation in health care: literature review. Quality Management in Healthcare, 19(4), 319-329.
[2] Mazzocato, P., Savage, C., Brommels, M., Aronsson, H., & Thor, J. (2010). Lean thinking in healthcare: a realist review of the literature. BMJ Quality & Safety, 19(5), 376-382.
[3] Tjahjono, B., Ball, P., Vitanov, V. I., Scorzafave, C., Nogueira, J., Calleja, J., ... & Srivastava, S. (2010). Six Sigma: a literature review. International Journal of Lean Six Sigma, 1(3), 216-233.
[4] Singh, B., Garg, S. K., & Sharma, S. K. (2011). Value stream mapping: literature review and implications for Indian industry. The International Journal of Advanced Manufacturing Technology, 53(5-8), 799-809.
[5] Stone, K. B. (2012). Four decades of lean: a systematic literature review. International Journal of Lean Six Sigma, 3(2), 112-132.
[6] Zhang, Q., Irfan, M., Khattak, M. A. O., Zhu, X., & Hassan, M. (2012). Lean Six Sigma: a literature review. Interdisciplinary Journal of Contemporary research in business, 3(10), 599-605.
[7] Hasle, P., Bojesen, A., Langaa Jensen, P., & Bramming, P. (2012). Lean and the working environment: a review of the literature. International Journal of Operations & Production Management, 32(7), 829-849.
[8] Hassini, E., Surti, C., & Searcy, C. (2012). A literature review and a case study of sustainable supply chains with a focus on metrics. International Journal of Production Economics, 140(1), 69-82.
[9] Suárez-Barraza, M. F., Smith, T., & Dahlgaard-Park, S. M. (2012). Lean Service: A literature analysis and classification. Total Quality Management & Business Excellence, 23(3-4), 359-380.
[10] Moyano-Fuentes, J., & Sacristán-Díaz, M. (2012). Learning on lean: a review of thinking and research. International Journal of Operations & Production Management, 32(5), 551-582.
[11] Gupta, S., & Jain, S. K. (2013). A literature review of lean manufacturing. International Journal of Management Science and Engineering Management, 8(4), 241-249.
[12] Marhani, M. A., Jaapar, A., Bari, N. A. A., & Zawawi, M. (2013). Sustainability through lean construction approach: A literature review. Procedia-Social and Behavioral Sciences, 101, 90-99.
[13] Pernstål, J., Feldt, R., & Gorschek, T. (2013). The lean gap: A review of lean approaches to large-scale software systems development. Journal of Systems and Software, 86(11), 2797-2821.
[14] Bhamu, J., & Singh Sangwan, K. (2014). Lean manufacturing: literature review and research issues. International Journal of Operations & Production Management, 34(7), 876-940.
[15] Martínez-Jurado, P. J., & Moyano-Fuentes, J. (2014). Lean management, supply chain management and sustainability: a literature review. Journal of Cleaner Production, 85, 134-150.
[16] Sundar, R., Balaji, A. N., & Kumar, R. S. (2014). A review on lean manufacturing implementation techniques. Procedia Engineering, 97, 1875-1885.
[17] Vamsi Krishna Jasti, N., & Kodali, R. (2014). A literature review of empirical research methodology in lean manufacturing. International Journal of Operations & Production Management, 34(8), 1080-1122.
[18] Jasti, N. V. K., & Kodali, R. (2015). Lean production: literature review and trends. International Journal of Production Research, 53(3), 867-885.
[19] Hu, Q., Mason, R., Williams, S. J., & Found, P. (2015). Lean implementation within SMEs: a literature review. Journal of Manufacturing Technology Management, 26(7), 980-1012.
[20] Garza-Reyes, J. A. (2015). Lean and green—a systematic review of the state of the art literature. *Journal of Cleaner Production, 102*, 18-29.

[21] Hartini, S., & Ciptomulyono, U. (2015). The relationship between lean and sustainable manufacturing on performance: literature review. *Procedia Manufacturing, 4*, 38-45.

[22] D’Andreamatteo, A., Ianni, L., Lega, F., & Sargiacomo, M. (2015). Lean in healthcare: A comprehensive review. *Health policy, 119(9)*, 1197-1209.

[23] Kobus, J., & Westner, M. (2015). Lean management of IT organizations: a literature review.

[24] Narayananurthy, G., & Gurumurthy, A. (2016). Leanness assessment: A literature review. *International Journal of Operations & Production Management, 36(10)*, 1115-1160.

[25] Cherrafi, A., Elfetiaz, S., Chiariini, A., Mokhlis, A., & Benhida, K. (2016). The integration of lean manufacturing, Six Sigma and sustainability: A literature review and future research directions for developing a specific model. *Journal of Cleaner Production, 139*, 828-846.

[26] Costa, L. B. M., & Godinho Filho, M. (2016). Lean healthcare: review, classification and analysis of literature. *Production Planning & Control, 27(10)*, 823-836.

[27] Deblois, S., & Lepanto, L. (2016). Lean and Six Sigma in acute care: a systematic review of reviews. *International Journal of health care quality assurance, 29(2)*, 192-208.

[28] Negrão, Léony Luís Lopes, Moacir Godinho Filho, and Giuliano Marodin. "Lean practices and their effect on performance: a literature review." *Production Planning & Control* 28.1 (2017): 33-56.

[29] Chugani, N., Kumar, V., Garza-Reyes, J. A., Rocha-Lona, L., & Upadhyay, A. (2017). Investigating the green impact of Lean, Six Sigma and Lean Six Sigma: A systematic literature review. *International Journal of Lean Six Sigma, 8(1)*, 7-32.

[30] Rajeev, A., Pati, R. K., Padhi, S. S., & Govindan, K. (2017). Evolution of sustainability in supply chain management: A literature review. *Journal of Cleaner Production, 162*, 299-314.

[31] Shukla, M., & Jharkaria, S. (2013). Agri-fresh produce supply chain management: a state-of-the-art literature review. *International Journal of Operations & Production Management, 33(2)*, 114-158.

[32] Taj, S. (2008). Lean manufacturing performance in China: assessment of 65 manufacturing plants. *Journal of Manufacturing Technology Management, 19(2)*, 217-234.

[33] Herron, C., & Hicks, C. (2008). The transfer of selected lean manufacturing techniques from Japanese automotive manufacturing into general manufacturing (UK) through change agents. *Robotics and Computer-Integrated Manufacturing, 24(4)*, 524-531.

[34] Wan, H. D., & Frank Chen, F. (2008). A leanness measure of manufacturing systems for quantifying impacts of lean initiatives. *International Journal of Production Research, 46(23)*, 6567-6584.

[35] Anand, G., & Kodali, R. (2008). Selection of lean manufacturing systems using the PROMETHEE. *Journal of modelling in management, 3(1)*, 40-70.

[36] Ichimura, M., Arunachalam, S., & Page, T. (2008). An Emerging Training Model for Successful Lean Manufacturing—An Empirical Study. *i-Manager’s Journal on Management, 2(4)*, 29.

[37] Bhasin, S. (2008). Lean and performance measurement. *Journal of Manufacturing Technology Management, 19(5)*, 670-684.

[38] Bayou, M. E., & De Korvin, A. (2008). Measuring the leanness of manufacturing systems—a case study of Ford Motor Company and General Motors. *Journal of Engineering and Technology Management, 25(4)*, 287-304.

[39] Anand, G., & Kodali, R. (2008). Performance measurement system for lean manufacturing: a perspective from SMEs. *International Journal of Globalisation and Small Business, 2(4)*, 371-410.

[40] Jayaram, J., Vickery, S., & Droge, C. (2008). Relationship building, lean strategy and firm performance: an exploratory study in the automotive supplier industry. *International Journal of Production Research, 46(20)*, 5633-5649.

[41] Ben-Tovim, D. I., Bassham, J. E., Bennett, D. M., Dougherty, M. L., Martin, M. A., O'Neill, S. J., ... & Szwarzcords, M. G. (2008). Redesigning care at the Flinders Medical Centre: clinical process redesign using“ lean thinking”*. *Medical Journal of Australia, 188(6)*, 927.

[42] Kennedy, F. A., & Widener, S. K. (2008). A control framework: Insights from evidence on lean accounting. *Management Accounting Research, 19(4)*, 301-323.

[43] Dal Pont, G., Furlan, A., & Vinelli, A. (2008). Interrelationships among lean bundles and their effects on operational performance. *Operations Research Management, 1(2)*, 150-158.

[44] Fullerton, R. R., & Wempe, W. F. (2009). Lean manufacturing, non-financial performance measures, and financial performance. *International Journal of Operations & Production Management, 29(3)*, 214-240.

[45] Gurumurthy, A., & Kodali, R. (2009). Application of benchmarking for assessing the lean manufacturing implementation. *Benchmarking: An International Journal, 16(2)*, 274-308.

[46] Hallgren, M., & Olehner, J. (2009). Lean and agile manufacturing: external and internal drivers and performance outcomes. *International Journal of Operations & Production Management, 29(10)*, 976-999.

[47] Boyle, T. A., & Scherrer-Rathje, M. (2009). An empirical examination of the best practices to ensure manufacturing flexibility: Lean alignment. *Journal of Manufacturing Technology Management, 20(3)*, 348-366.

[48] Bortolotti, T., Romano, P., & Nicoletti, B. (2009, September). Lean first, then automate: an integrated model for process improvement in pure service-providing companies. In IFIP International Conference on Advances in Production Management Systems (pp. 579-586). Springer, Berlin, Heidelberg.

[49] Wong, Y. C., Wong, K. Y., & Ali, A. (2009, April). Key practice areas of lean manufacturing. In Computer Science and Information Technology-Spring Conference, 2009. IACSITSC’09. International Association of (pp. 267-271). IEEE.
[50] Anand, G., & Kodali, R. (2009). Development of a framework for lean manufacturing systems. International Journal of Services and Operations Management, 5(5), 687-716.

[51] McDonald, T., Ellis, K. P., Van Aken, E. M., & Patrick Koelling, C. (2009). Development and application of a worker assignment model to evaluate a lean manufacturing cell. International Journal of Production Research, 47(9), 2427-2447.

[52] Green, J. C., Lee, J., & Kozman, T. A. (2010). Managing lean manufacturing in material handling operations. International Journal of Production Research, 48(10), 2975-2993. Q

[53] Lyonnct, B., Pillot, M., & Pralus, M. (2010). Lean manufacturing in the screw cutting sector: assessment of maturity level. International Journal of Rapid Manufacturing, 1(3), 256-277.

[54] So, S., & Sun, H. (2010). Supplier integration strategy for lean manufacturing adoption in electronic-enabled supply chains. Supply Chain Management: An International Journal, 15(6), 474-487.

[55] Badurdeen, F., Marksberry, P., Hall, A., & Gregory, B. (2010). Teaching lean manufacturing with simulations and games: A survey and future directions. Simulation & Gaming, 41(4), 465-486.

[56] Rashid, A., Hani, A., Shaari, M. F., Basri, H., & Fazliana, N. (2010). Lean manufacturing assessment in Malaysia small medium enterprise: a case study.

[57] Miller, G., Pawloski, J., & Standrigde, C. R. (2010). A case study of lean, sustainable manufacturing. Journal of industrial engineering and management, 3(1), 11-32.

[58] Upadhye, N., Deshmukh, S. G., & Garg, S. (2010). Lean manufacturing system for medium size manufacturing enterprises: an Indian case. International Journal of Management Science and Engineering Management, 5(3), 362-375.

[59] Erfan, O. M. (2010). Application of lean manufacturing to improve the performance of health care sector in Libya. International Journal of Engineering & Technology, 10(6), 117-128.

[60] Singh, B., Garg, S. K., & Sharma, S. K. (2010). Development of index for measuring leanness: study of an Indian auto component industry. Measuring Business Excellence, 14(2), 46-53.

[61] Radnor, Z. (2010). Transferring lean into government. Journal of Manufacturing Technology Management, 21(3), 411-428.

[62] Shannon, P. W., Krumwiede, K. R., & Street, J. N. (2010). Using simulation to explore lean manufacturing implementation strategies. Journal of Management Education, 34(2), 280-302.

[63] Rahman, S., Laosirihongthong, T., & Sohal, A. S. (2010). Impact of lean strategy on operational performance: a study of Thai manufacturing companies. Journal of manufacturing technology management, 21(7), 839-852.

[64] Carvalho, H., Azevedo, S. G., & Cruz-Machado, V. (2010). Supply chain performance management: lean and green paradigms. International Journal of Business Performance and Supply Chain Modelling, 2(3-4), 304-333.

[65] Huang, Y., Liu, C., Zha, X. F., & Li, Y. (2010). A lean model for performance assessment of machinery using second generation wavelet packet transform and Fisher criterion. Expert Systems with Applications, 37(5), 3815-3822.

[66] Ng, D., Vail, G., Thomas, S., & Schmidt, N. (2010). Applying the Lean principles of the Toyota Production System to reduce wait times in the emergency department. Canadian Journal of Emergency Medicine, 12(1), 50-57.

[67] Nordin, N., Deross, B. M., & Wahab, D. A. (2010, December). Relationship between organizational change and lean manufacturing implementation in Malaysian automotive industry. In The 14th Asia Pacific Regional Meeting of International Foundation for Production Research (pp. 7-10).

[68] Behrouzi, F., & Wong, K. Y. (2011). Lean performance evaluation of manufacturing systems: A dynamic and innovative approach. Procedia Computer Science, 3, 388-395.

[69] Yang, M. G. M., Hong, P., & Modi, S. B. (2011). Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms. International Journal of Production Economics, 129(2), 251-261.

[70] Vinodh, S., & Chinthra, S. K. (2011). Leanness assessment using multi-grade fuzzy approach. International Journal of Production Research, 49(2), 431-445.

[71] Vinodh, S., & Balaji, S. R. (2011). Fuzzy logic based leanness assessment and its decision support system. International Journal of Production Research, 49(13), 4027-4041.

[72] Rose, A. M. N., Deross, B. M., Rahman, M. A., & Nordin, N. (2011, January). Lean manufacturing best practices in SMEs. In Proceedings of the 2011 International Conference on Industrial Engineering and Operations Management (Vol. 2, No. 5, pp. 872-877).

[73] Chowdary, B. V., & George, D. (2011). Improvement of manufacturing operations at a pharmaceutical company: a lean manufacturing approach. Journal of Manufacturing Technology Management, 23(1), 56-75.

[74] Acharyaa, T. K. (2011). Material Handling and Process Improvement Using Lean Manufacturing Practices Principles. International Journal of Industrial Engineering, 18(7).

[75] Anvari, A., Ismail, Y., & Hoijati, S. M. H. (2011). A study on total quality management and lean manufacturing: through lean thinking approach. World applied sciences journal, 12(9), 1383-1596.

[76] Wong, Y. C., & Wong, K. Y. (2011). Approaches and practices of lean manufacturing: The case of electrical and electronics companies. African Journal of Business Management, 5(6), 2164.

[77] Saurin, T. A., Marodon, G. A., & Ribeiro, J. L. D. (2011). A framework for assessing the use of lean production practices in manufacturing cells. International Journal of Production Research, 49(11), 3211-3230.

[78] Eswaramoorthi, M., Kathiresan, G. R., Prasad, P. S. S., & Mohanram, P. V. (2011). The International Journal of Advanced Manufacturing Technology, 52(9-12), 1091-1101.

[79] Mahfouz, A., Shea, J., & Arisha, A. (2011, December). Simulation based optimisation model for the lean assessment in SME: a case study. In Proceedings of the Winter Simulation Conference (pp. 2408-2418). Winter Simulation Conference.
[80] Vinodh, S., Shivraman, K. R., & Viswesh, S. (2011). AHP-based lean concept selection in a manufacturing organization. Journal of Manufacturing Technology Management, 23(1), 124-136.

[81] Dotoli, M., Fanti, M. P., Rotunno, G., & Ukovich, W. (2011, October). A lean manufacturing procedure using Value Stream Mapping and the Analytic Hierarchy Process. In Systems, Man, and Cybernetics (SMC), 2011 IEEE International Conference on (pp. 1193-1198). IEEE.

[82] Ghosh, M. (2012). Lean manufacturing performance in Indian manufacturing plants. Journal of Manufacturing Technology Management, 24(1), 113-122.

[83] Vinodh, S., & Joy, D. (2012). Structural equation modelling of lean manufacturing practices. International Journal of Production Research, 50(6), 1598-1607.

[84] Vinodh, S., & Vimal, K. E. K. (2012). Thirty criteria based leaness assessment using fuzzy logic approach. The International Journal of Advanced Manufacturing Technology, 60(9-12), 1185-1195.

[85] Chauhan, G., & Singh, T. P. (2012). Measuring parameters of lean manufacturing realization. Measuring Business Excellence, 16(3), 57-71.

[86] Nasab, H. H., & Zare, H. K. (2012). Finding a probabilistic approach to analyze lean manufacturing. Journal of Cleaner Production, 29, 73-81.

[87] Garza-Reyes, J. A., Parkar, H. S., Oraifige, I., Soriano-Meier, H., & Harmanto, D. (2012). An empirical-exploratory study of the status of lean manufacturing in India. International Journal of Business Excellence, 5(4), 395-412.

[88] Sopelana, A., Flores, M., Martinez, L., Flores, K., & Sortli, M. (2012, June). The application of an assessment tool for lean product development: an exploratory study in Spanish Companies. In Engineering, Technology and Innovation (ICE), 2012 18th International ICE Conference on (pp. 1-10). IEEE.

[89] Agus, A., & Shukri Hajinooor, M. (2012). Lean production supply chain management as driver towards enhancing product quality and business performance: Case study of manufacturing companies in Malaysia. International Journal of Quality & Reliability Management, 29(1), 92-121.

[90] Achangha, P., Shehab, E., Roy, R., & Nelder, G. (2012). A fuzzy-logic advisory system for lean manufacturing within SMEs. International Journal of Computer Integrated Manufacturing, 25(9), 839-852.

[91] Deif, A. (2012). Assessing lean systems using variability mapping. Procedia CIRP, 3, 2-7.

[92] Bhasin, S. (2012). Performance of Lean in large organisations. Journal of Manufacturing Systems, 31(3), 349-357.

[93] Vimal, K. E. K., & Vinodh, S. (2012). Leaness evaluation using IF–THEN rules. The International Journal of Advanced Manufacturing Technology, 63(1-4), 407-413.

[94] Vinodh, S., & Dinesh Kumar, C. (2012). Development of computerized decision support system for leanness assessment using multi grade fuzzy approach. Journal of Manufacturing Technology Management, 23(4), 503-516.

[95] Meiling, J., Backlund, F., & Johnsson, H. (2012). Managing for continuous improvement in off-site construction: Evaluation of lean management principles. Engineering, Construction and Architectural Management, 19(2), 141-158Q.

[96] Amin, M. A., & Karim, M. A. (2012). A systematic approach to evaluate the process improvement in lean manufacturing organizations. In Sustainable manufacturing (pp. 65-70). Springer, Berlin, Heidelberg.

[97] Hofer, C., Ergolgu, C., & Hofer, A. R. (2012). The effect of lean production on financial performance: The mediating role of inventory leaness. International Journal of Production Economics, 138(2), 242-253.

[98] Diaz-Elsayed, N., Jondral, A., Greinacher, S., Dornfeld, D., & Lanza, G. (2013). Assessment of lean and green strategies by simulation of manufacturing systems in discrete production environments. CIRP Annals-Manufacturing Technology, 62(1), 475-478.

[99] Wahab, A. N. A., Mukhtar, M., & Sulaiman, R. (2013). A conceptual model of lean manufacturing dimensions. Procedia Technology, 11, 1292-1298.

[100] Rahman, N. A. A., Sharif, S. M., & Esa, M. M. (2013). Lean manufacturing case study with Kanban system implementation. Procedia Economics and Finance, 7, 174-180.

[101] Jabbour, C. J. C., de Sousa Jabbour, A. B. L., Govindan, K., Teixeira, A. A., & de Souza Freitas, W. R. (2013). Environmental management and operational performance in automotive companies in Brazil: the role of human resource management and lean manufacturing. Journal of Cleaner Production, 47, 129-140.

[102] Karim, A., & Arif-Uz-Zaman, K. (2013). A methodology for effective implementation of lean strategies and its performance evaluation in manufacturing organizations. Business Process Management Journal, 19(1), 169-196.

[103] Fullerton, R. R., Kennedy, F. A., & Widener, S. K. (2013). Management accounting and control practices in a lean manufacturing environment. Accounting, Organizations and Society, 38(1), 50-71.

[104] Susilawati, A., Tan, J., Bell, D., & Sarwar, M. (2013). Develop a framework of performance measurement and improvement system for lean manufacturing activity. International Journal of Lean Thinking, 4(1), 51-64.

[105] Malmbrandt, M., & Åhlström, P. (2013). An instrument for assessing lean service adoption. International Journal of Operations & Production Management, 33(9), 1131-1165.

[106] Cil, I., & Turkan, Y. S. (2013). An ANP-based assessment model for lean enterprise transformation. The International Journal of Advanced Manufacturing Technology, 64(5-8), 1113-1130.

[107] Gupta, V., Acharya, P., & Patwardhan, M. (2013). A strategic and operational approach to assess the lean performance in radial tyre manufacturing in India: a case based study. International Journal of Productivity and Performance Management, 62(6), 634-651.

[108] Meybodi, M. Z. (2013). The links between lean manufacturing practices and concurrent engineering method of new product development: an empirical study. Benchmarking: An International Journal, 20(3), 362-376.
[109] Moori, R. G., Pescarmona, A., & Kimura, H. (2013). Lean manufacturing and business performance in Brazilian firms. *JOSCM: Journal of Operations and Supply Chain Management*, 6(1), 91.

[110] Pakdil, F., & Leonard, K. M. (2014). Criteria for a lean organisation: development of a lean assessment tool. *International Journal of Production Research*, 52(15), 4587-4607.

[111] Fullerton, R. R., Kennedy, F. A., & Widener, S. K. (2014). Lean manufacturing and firm performance: The incremental contribution of lean management accounting practices. *Journal of Operations Management*, 32(7-8), 414-428.

[112] Aqlan, F., & Ali, E. M. (2014). Integrating lean principles and fuzzy bow-tie analysis for risk assessment in chemical industry. *Journal of Loss Prevention in the process Industries*, 29, 39-48.

[113] Faulkner, W., & Badurdeen, F. (2014). Sustainable Value Stream Mapping (Sus-VSM): methodology to visualize and assess manufacturing sustainability performance. *Journal of Cleaner Production*, 85, 8-18.

[114] Ali, R. M., & Deif, A. M. (2014). Dynamic lean assessment for takt time implementation. *Procedia CIRP*, 17, 577-581.

[115] Kull, T. J., Yan, T., Liu, Z., & Wacker, J. G. (2014). The moderation of lean manufacturing effectiveness by dimensions of national culture: testing practice-culture congruence hypotheses. *International Journal of Production Economics*, 153, 1-12.

[116] Thanki, S. J., & Thakkar, J. (2014). Status of lean manufacturing practices in Indian industries and government initiatives: A pilot study. *Journal of Manufacturing Technology Management*, 25(5), 655-675.

[117] Khlat, M., Harb, A. H., & Kassem, A. (2014). Lean manufacturing: implementation and assessment in the Lebanese pharmaceutical industry. *International Journal of Computing and Optimization*, 1(2), 47-62.

[118] Belekoukias, I., Garza-Reyes, J. A., & Kumar, V. (2014). The impact of lean methods and tools on the operational performance of manufacturing organisations. *International Journal of Production Research*, 52(18), 5346-5366.

[119] Almomani, M. A., Abdelhadi, A., Mumani, A., Momani, A., & Aladeemy, M. (2014). A proposed integrated model of lean assessment and analytical hierarchy process for a dynamic road map of lean implementation. *The International Journal of Advanced Manufacturing Technology*, 72(1-4), 161-172.

[120] Elnadi, M., & Shehab, E. (2014). A conceptual model for evaluating product-service systems leaness in UK manufacturing companies. *Procedia CIRP*, 22, 281-286.

[121] Khanchanapong, T., Prajogo, D., Sohal, A. S., Cooper, B. K., Yeung, A. C., & Cheng, T. C. E. (2014). The unique and complementary effects of manufacturing technologies and lean practices on manufacturing operational performance. *International Journal of Production Economics*, 153, 191-203.

[122] Herzog, N. V., & Tonchia, S. (2014). An instrument for measuring the degree of lean implementation in manufacturing. *Strojniški vestnik-Journal of Mechanical Engineering*, 60(12), 797-803.

[123] Hibadullah, S. N., Habidin, N. F., Zamri, F. I. M., Fuzi, N. M., & Desa, A. F. N. C. (2014). Critical success factors of lean manufacturing practices for the Malaysian automotive manufacturers. *International Journal of Quality and Innovation*, 2(3-4), 256-271.

[124] Büyükozkan, G., Kayakutlu, G., & Karakadilar, İ. S. (2015). Assessment of lean manufacturing effect on business performance using Bayesian Belief Networks. *Expert Systems with Applications*, 42(19), 6539-6551.

[125] Urban, W. (2015). The lean management maturity self-assessment tool based on organizational culture diagnosis. *Procedia-Social and Behavioral Sciences*, 213, 728-733.

[126] Alves, J. R. X., & Alves, J. M. (2015). Production management model integrating the principles of lean manufacturing and sustainability supported by the cultural transformation of a company. *International Journal of Production Research*, 53(17), 5320-5333.

[127] Azadeh, A., Zarrin, M., Abdollahi, M., Noury, S., & Farahmand, S. (2015). Leanness assessment and optimization by fuzzy cognitive map and multivariate analysis. *Expert Systems with Applications*, 42(15), 6050-6064.

[128] Andrés-López, E., González-Requena, I., & Sanz-Lobera, A. (2015). Lean service: reassessment of lean manufacturing for service activities. *Procedia Engineering*, 132, 23-30.

[129] Marin-Garcia, J. A., & Bonavia, T. (2015). Relationship between employee involvement and lean manufacturing and its effect on performance in a rigid continuous process industry. *International Journal of Production Research*, 53(11), 3260-3275.

[130] Bon, A. T., & Kee, T. S. (2015, March). Implementation of Lean manufacturing for productivity improvement in Malaysia. In *Industrial Engineering and Operations Management (IEOM)*, 2015 International Conference on (pp. 1-6). IEEE.

[131] De Zan, G., De Toni, A. F., Fornasier, A., & Battistella, C. (2015). A methodology for the assessment of experiential learning lean: The Lean Experience Factory case study. *European Journal of Training and Development*, 39(4), 332-354.

[132] Oleghe, O., & Salonitis, K. (2015). Improving the efficacy of the lean index through the quantification of qualitative lean metrics. *Procedia CIRP*, 37, 42-47.

[133] Panwar, A., Jain, R., & Rathore, A. P. S. (2015). Lean implementation in Indian process industries–some empirical evidence. *Journal of Manufacturing Technology Management*, 26(1), 131-160.

[134] Al-Ashaab, A., Golob, M., Urrutia, U. A., Gourdin, M., Petritsch, C., Summers, M., & El-Nounu, A. (2016). Development and application of lean product development performance measurement tool. *International Journal of Computer Integrated Manufacturing*, 29(3), 342-354.

[135] Oleghe, O., & Salonitis, K. (2016). Variation modeling of lean manufacturing performance using fuzzy logic based quantitative lean index. *Procedia CIRP*, 41, 608-613.

[136] Zhou, B. (2016). Lean principles, practices, and impacts: a study on small and medium-sized enterprises (SMES). *Annals of Operations Research*, 241(1-2), 457-474.

[137] Zahraee, S. M. (2016). A survey on lean manufacturing implementation in a selected manufacturing industry in Iran. *International Journal of Lean Six Sigma*, 7(2), 136-148.
[138] Thanki, S., Govindan, K., & Thakkar, J. (2016). An investigation on lean-green implementation practices in Indian SMEs using analytical hierarchy process (AHP) approach. *Journal of Cleaner Production*, 135, 284-298.

[139] Jasti, N. V. K., & Kodali, R. (2016). An empirical study for implementation of lean principles in Indian manufacturing industry. *Benchmarking: An International Journal*, 23(1), 183-207.

[140] Alhuraish, I., Robledo, C., & Kobi, A. (2016). Assessment of lean manufacturing and Six Sigma operation with decision making based on the analytic hierarchy process. *IFAC-PapersOnLine*, 49(12), 59-64.

[141] Vidyadhar, R., Sudeep Kumar, R., Vinodh, S., & Antony, J. (2016). Application of fuzzy logic for leaness assessment in SMEs: a case study. *Journal of Engineering, Design and Technology*, 14(1), 78-103.

[142] Omogbai, O., & Salonitis, K. (2016). A lean assessment tool based on systems dynamics. *Procedia CIRP*, 50, 106-111.

[143] Kumar, R., & Kumar, V. (2016). Effect of lean manufacturing on organisational performance of Indian industry: a survey. *International Journal of Productivity and Quality Management*, 17(3), 380-393.

[144] Hasle, P., Nielsen, A. P., & Edwards, K. (2016). Application of lean manufacturing in hospitals—The need to consider maturity, complexity, and the value concept. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 26(4), 430-442.

[145] Singh, M. P., Meena, R., & Panwar, A. (2016). A Survey on the Adoption of Lean Practices in Indian Manufacturing Sector. *International Journal of Industrial Engineering*, 7(2), 52-62.

[146] Kumar, R., & Kumar, V. (2016). Evaluation and benchmarking of lean manufacturing system environment: A graph theoretic approach. *Uncertain Supply Chain Management*, 4(2), 147-160.

[147] Godinho Filho, M., Ganga, G. M. D., & Gunasekaran, A. (2016). Lean manufacturing in Brazilian small and medium enterprises: implementation and effect on performance. *International Journal of Production Research*, 54(24), 7523-7545.

[148] Tortorella, G. L., Vergara, L. G. L., & Ferreira, E. P. (2017). Lean manufacturing implementation: an assessment method with regards to socio-technical and ergonomics practices adoption. *The International Journal of Advanced Manufacturing Technology*, 89(9-12), 3407-3418.

[149] Helleno, A. L., de Moraes, A. J. L., & Simon, A. T. (2017). Integrating sustainability indicators and Lean Manufacturing to assess manufacturing processes: Application case studies in Brazilian industry. *Journal of Cleaner Production*, 153, 405-416.

[150] Duarte, S., & Cruz Machado, V. (2017). Green and lean implementation: an assessment in the automotive industry. *International Journal of Lean Six Sigma*, 8(1), 65-88.

[151] Shakoor, M., Qureshi, M. R., Jadayil, W. A., & Jaber, N. (2017). Assessment of Retail Practices for Providing Enhanced Value Added Services and Improved Customer Satisfaction Using Lean Manufacturing Approach. *International Review of Management and Marketing*, 7(2), 360-366.

[152] Khalili, A., Ismail, M. Y., & Karim, A. N. M. (2017). Integration of lean manufacturing and quality management system through structural equation modelling. *International Journal of Productivity and Quality Management*, 20(4), 534-556.

[153] SINGH, J., & UBHI, M. S. (2017). Assessment of lean tools implementations in Auto Parts Industries of Ludhiana. *International Journal of Advanced Multidisciplinary Research*, 9(1), 53-59.

[154] Uhrin, Á., Brucq-Cámara, S., & Moyano-Fuentes, J. (2017). Lean production, workforce development and operational performance. *Management Decision*, 55(1), 103-118.

[155] Amrina, E., & Lubis, A. A. A. (2017, April). Minimizing waste using lean manufacturing: A case in cement production. In *Industrial Engineering and Applications (ICIEA), 2017 4th International Conference* on (pp. 71-75). IEEE.

[156] Bevilacqua, M., Ciarapica, F. E., & De Sanctis, I. (2017). Lean practices implementation and their relationships with operational responsiveness and company performance: an Italian study. *International Journal of Production Research*, 55(3), 769-794.

[157] Sahoo, S., & Yadav, S. (2017, December). Analyzing the effectiveness of lean manufacturing practices in Indian small and medium sized businesses. In *Industrial Engineering and Engineering Management (IEEM), 2017 IEEE International Conference* on (pp. 6-10). IEEE.