Lean Thinking: A Useful Tool to Integrate Sustainability into Project Management

C. Cruz-Villazon, J. R. Otegi-Olaso, M. E. Aguilar-Fernandez and L. Fuentes-Ardeo

Keywords Lean thinking · Sustainability · Project management
Lean project management

1 Introduction

Lean Thinking (LT) was first introduced in the Toyota Production System in 1970 (Hines et al. 2004), and it became popular in 1990 following the publication of Womack's, Jones' and Roos' book "The Machine that Changed the World" (Anholon and Sano 2016). The approach has been shown to be a significant success, resulting in its worldwide implementation across a range of sectors, including products and services (Folinas et al. 2013). Womack and Jones (1996) state that LT philosophy is based on "improvement of continuous flow manufacturing, customer-driven production, waste elimination, zero defects, visual management, safe and orderly working environment, the elimination of non-value adding but cost incurring activities, and customer value" (as cited in Anholon and Sano 2016).

LT is viewed from two standpoints that are closely related. In their study, Bortolotti et al. (2015) link the work of Womack and Jones (1996) to a strategic/philosophical perspective, whilst the work of Shah (2003) , Shah and Ward (2007) is linked to an operational/technical perspective. Hines et al. (2004) explain that the strategic level refers to value creation and understanding of customer value, whilst the operational level is concerned with improved efficiency and cost reductions.

LT has undergone substantial development in recent decades, which, as a result, has led to great changes in its targets, scope, and techniques for implementation (Hines et al. 2004). The success of LT in manufacturing has prompted other sectors to adopt this philosophy (Hines et al. 2004). Additionally, LT methods and

C. Cruz-Villazon (✉) · J. R. Otegi-Olaso · M. E. Aguilar-Fernandez · L. Fuentes-Ardeo
Departamento de Expresión Gráfica y Proyectos de Ingeniería Escuela Técnica Superior de Ingeniería de Bilbao, Universidad del País Vasco (UPV/EHU), Alameda Urquijo, S/N, 48013 Bilbao, Spain
e-mail: ccruz003@ikasle.ehu.eus

J. L. Ayuso Muñoz et al. (eds.), *Project Management and Engineering Research*, Lecture Notes in Management and Industrial Engineering,
https://doi.org/10.1007/978-3-319-92273-7_3

mind-sets are being applied in areas outside shop-floor operations (Hines et al. 2004). Aziz (2012) asserts that this philosophy can be extended to Project Management (PM), yet this is still rarely mentioned in the literature. Reusch and Reusch (2013) states that "lean management is a management of values" and it can be applied to improve project management.

In the 1990s, the first investigations emerged with regard to the link between LT and the three aspects of sustainability, but these were mainly conducted through observational case studies (Chianiri 2014). LT, environmental and social practices, as well as their effects on different aspects of the company's performance have been studied separately (Galeazzo et al. (2014); Wu et al. 2015). Wu et al. (2015), establish that from a sustainability perspective, there is a need to collectively take into account these practices in order to have a more comprehensive framework.

2 Methodology

A literature review was conducted to identify the main ideas underlying the links between LT, PM and sustainability. Papers published in peer-reviewed journals and proceedings from the year 2000 up to 2016 were selected (except for Womack's, Jones' and Roos' book "The machine that changed the world" (1990) and "Lean Thinking" (1996). Relevant books, reports, and theses were included. The survey was made using the following major research databases: Scopus, EBSCO, Web of Science and Google Scholar. A search of the literature was conducted by combining the following keywords: "Lean Thinking", "Lean Thinking Project Management", "Lean Project Management", "Lean Sustainability", "Green Lean", "Lean environmental" and "Lean Project Management Sustainability". Articles containing "Sustainable" where the word refers to "capable of being sustained" were excluded.

Articles were chosen for revision if published in English and Spanish (languages spoken by the authors) and contained the mentioned keywords in the title. After carrying out an initial filtering process by reading the abstracts, 20 articles were selected for research contribution (Table 1). Each of the papers was then completely read to ensure that they were relevant to the aims of the current research.

In the majority of the articles, the content was concerned with LT, PM, and sustainability in isolation, whilst only a few explicitly combined two of the concepts. The only document found that alluded to the relationship between the three topics is the paper by Galeazzo et al. (2014) (Fig. 1).

The systematic literature review (SLR) for this paper was based on the model developed by Garza-Reyes (2005). It consists of the following five consecutive phases: (1) question formulation, (2) locating studies, (3) study selection and evaluations, (4) analysis and synthesis, and (5) reporting and using the results. Each of these phases explains its objective, method, and tool along with the section of the paper where the information is located (Fig. 2).

Table 1 Articles selected for research contribution

No.	Authors	Paper name	Year	Journal	Times cited (G. Scholar/ Scopus)
1	Anholon R. Sano A. T.	Analysis of critical processes in the implementation of lean manufacturing projects using project management guidelines	2015	International Journal of Advanced Manufacturing Technology	0/0
2	Aziz, B.	Improving Project Management with Lean Thinking?	2012	Master thesis. Institute of Technology, Linköping University, Sweden	1/No info
3	Ballard, G. Howell, G.	Lean project management	2003	Building Research & Information	159/69
4	Bortolotti, T. Boscari, S. Danese, P.	Successful lean implementation: Organizational culture and soft lean practices	2015	International Journal of Production Economics	18/5
5	Chiarini, A.	Sustainable manufacturing-greening processes using specific Lean Production tools: an empirical observation from European motorcycle component manufacturers	2014	Journal of Cleaner Production	26/13
6	Dhingra, R. Kress, R. Upreti, G.	Does lean mean green?	2014	Journal of Cleaner Production,	14/3
7	Faulkner, W. Badurdeen, F.	Sustainable Value Stream Mapping (Sus-VSM): methodology to visualize and assess manufacturing sustainability performance	2014	Journal of Cleaner Production	29/10
8	Fliedner, G.	Sustainability: a new lean principle	2008	In Proceedings of the 39th annual meeting of the decision sciences institute	16/No info
9	Folinas, D. Aidonis, D. Triantafillou, D. Malindretos, G.	Exploring the greening of the food supply chain with lean thinking techniques	2013	Procedia Technology	3/0
10	Galeazzo, A. Furlan, A. Vinelli, A.	Lean and green in action: interdependencies and performance of pollution prevention projects	2014	Journal of Cleaner Production	19/11

(continued)

Table 1 (continued)

No.	Authors	Paper name	Year	Journal	Times cited (G. Scholar/ Scopus)
11	Hines, P. Holweg, M. Rich, N	Learning to evolve: a review of contemporary lean thinking	2004	International Journal of Operations & Production Management	1027/420
12	Höök, M. Stehn, L.	Lean principles in industrialized housing production: the need for a cultural change	2008	Lean Construction Journal	53/No info
13	Longoni, A. Cagliano, R.	Cross-functional executive involvement and worker involvement in lean manufacturing and sustainability alignment	2015	International Journal of Operations & Production Management	0/0
14	Martínez-Jurado, P. J. Moyano-Fuentes, J.	Lean management, supply chain management and sustainability: a literature review	2014	Journal of Cleaner Production	47/15
15	Reusch, P. J. Reusch, P.	How to develop lean project management?	2013	(IDAACS), 2013 IEEE 7th International Conference	3/1
16	Sousa, R. Voss, C. A.	Quality management: universal or context dependent?	2001	Production and Operations Management	179/No info
17	Staats, B. R. Brunner, D. J. Upton, D. M.	Lean principles, learning, and knowledge work: Evidence from a software services provider	2011	Journal of Operations Management	157/63
18	Womack, J. P. Jones, D. T.	Lean thinking	1996	Book	7084/No info
19	Womack, J. P. Jones, D. T. Roos, D.	Machine that changed the world	1990	Book	13575/No info
20	Yusup, M. Z. Mahmood, W. H. W. Salleh, M. R. Yusof, A. S. M.	Review the influence of lean tools and its performance against the index of manufacturing sustainability	2015	International Journal of Agile Systems and Management	1/0

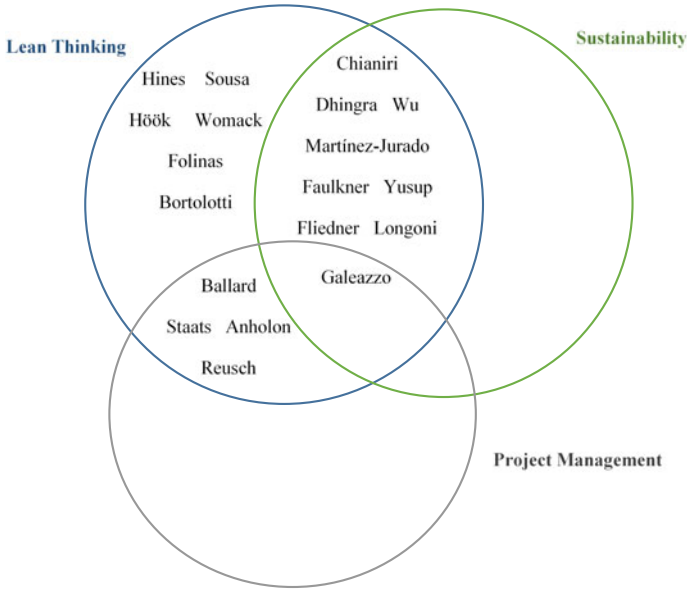

Fig. 1 Authors related by research topic

The following research questions have been addressed based on a SLR of the existing literature on the three topics. The aim of this paper is to answer these using the analysis of the research.

- Question 1: What concepts of LT are relevant for PM and sustainability?
- Question 2: What are the connections between LT and sustainability?
- Question 3: What are the connections between LT and PM?
- Question 4: How can sustainability be integrated in PM practices with LT?

3 Results

3.1 Lean Thinking Principles, Wastes, Tools and Techniques

3.1.1 Lean Thinking Principles

LT has five principles defined in Womack's and Jones' book "Lean Thinking", which focus on value and elimination of waste. These principles could be applied across a wide range of industrial settings (Sousa and Voss 2001; Hook and Stehn (2008). The LT principles are:

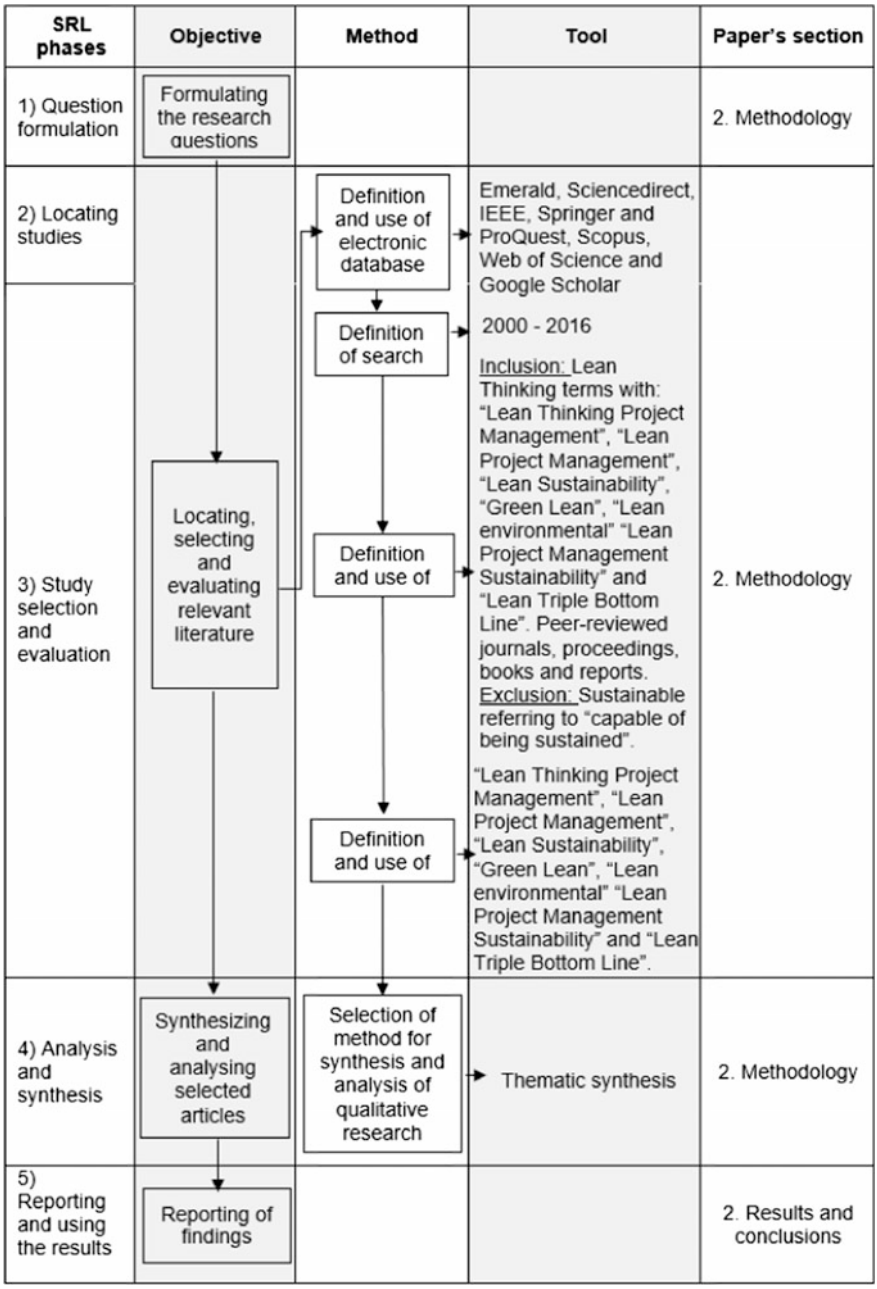

Fig. 2 SLR phases, methods, tools and location within the article (Garza-Reyes 2015)

1. Value specification: to define value from the customer's perspective.
2. Value stream identification: to identify all the steps in the processes that deliver the customer's values and remove everything that do not add value to the customer.
3. Flow: to take actions that ensure continuous flow in the value stream.
4. Pull: to produce only what the customer wants just in time
5. Perfection: to strive for perfection by delivering what the customer wants and expects through a continuous removal of waste.

3.1.2 Lean Thinking Wastes

Every operation involves a mixture of processes that could be regarded as value adding and non-value adding. Non-value adding processes are characterized by wastes of different forms (Folinas et al. 2013). LT classifies these into seven types of waste (Toyota's seven wastes) in a business process, including the following (Womack and Jones 1996) (Table 2).

3.1.3 Lean Thinking Tools and Techniques

The majority of the tools and techniques used in LT aim to bring about changes in a company that enable it to adapt to the needs of the customer (Folinas et al. 2013). The US Environmental Protection Agency (EPA) mentioned eight core methods and tools that organizations use to implement LT systems (EPA 2013). Yusup et al. (2015) investigates how the implementation performance of LT selected tools contributes to establishing sustainable practices (mainly in manufacturing). Table 3 shows the most common tools that are referred to in the reviewed literature.

From the other hand, Hines et al. (2004) go farther and suggest a classification of the LT methods and tools shown in Table 4.

3.2 Relationship Between Lean Thinking and Project Management

Currently, PM exists as a universal methodological framework to define the application of knowledge, skills, and tools to manage the projects to meet their requirements. There are several published PM guidelines, and whilst they differ in

Table 2 Lean thinking types of wastes Womack and Jones (1996)

1. Transport	2. Inventory	3. Motion	4. Waiting
5. Over-processing	6. Overproduction	7. Defects	

Table 3 LT tools found in the literature reviewed

Authors	LT tool
EPA (2013)	Kaizen, 5S, Total Productive Maintenance (TPM), Cellular Manufacturing/ One-piece Flow Production Systems, Just-in-time (JIT)/Kanban, Six Sigma, Pre-Production Planning (3P) and Lean Enterprise Supplier Networks
Folinas et al. (2013)	Takt Time, Kaizen, Statistical Process Control, Poka-Yoke, 5S, Value Stream Mapping (VSM), Total Quality Management, Kanban, Jidoka
Hines et al. (2004)	TQM, Agile, Drum-buffer-rope, Level scheduling, 6 Sigma, TPM, MRP, TQC, Postponement, TOC, KANBAN, SPC, ERP, Takt Time, APS
PMBok	Cause and effect-diagram, control chart, run charts, scatter diagram and FMEA
Yusup et al. (2015)	5'S, JIT, Root cause analysis, SMED, Takt time, Bottleneck analysis, Standardised work, Jidoka, Poka-yoke, Heijunka, CFA, Kanban and Andon, Visual factory

Table 4 LT methods and tools classification (Hines et al. 2004)

Quality	Responsiveness	Capacity	Production	Variability	Availability	Control
TQM	Agile	Drum-Buffer-Rope	Level scheduling	6 Sigma	TPM	MRP
TQC	Postponement	TOC	KANBAN	SPC		ERP
			Takt Time			APS

terms of structure, they all cover the same broad principles of PM. Anholon and Sano (2016) mention some relevant publications such as the International Organization for Standardization (ISO), the Project Management Institute (PMI, through the 5th edition of the Project Management Body of Knowledge—PMBoK), and the Office of Government Commerce (OGC) in the UK (Prince2 guidelines).

For the aims of the research in this paper, the 5th edition of the PMBok Guide was used. This guideline describes 47 project management processes within five project management process groups, dividing these processes into ten knowledge areas (PMI 2016) (Tables 5 and 6).

Table 5 PM processes (PMI 2016)

1. Initiating	2. Planning	3. Executing	4. Monitoring & Controlling	5. Closing

Table 6 PM areas (PMI 2016)

1. Integration	2. Scope	3. Time	4. Cost	5. Quality
6. Procurement	7. Human Resources	8. Communications	9. Risk Management	10. Stakeholder Management

PMBok refer to the use of several LT tools, including the cause and effect diagram (also known as the fishbone or Ishikawa diagram), control chart, run charts, scatter diagram and FMEA. LT activities are recommended in the Project Quality Management knowledge area. This guide states that "quality improvement initiatives such as Total Quality Management (TQM), Six Sigma, and Lean Six Sigma could improve the quality of the projects" (PMBok 2013).

Reusch and Reusch (2013) stated that "lean management is a management of values" and it can be applied in order to improve project management. In their paper, they cite Stephan Wood, who claims "Quality Management means Lean Management". Quality Management principles (ISO 9000) such as costumer focus, continual improvement, and process approaches, are, among others the bases of lean management (Reusch and Reusch 2013). This is important for linking LT to PM since, as mentioned in the paragraph above, Quality Project Management is one of the ten knowledge areas of PM.

On the other hand, Aziz (2012) relates aspects of LT to PM activities through the following concepts:

- LT is to specify the value of project activities.
- Value is defined by the costumer and focuses on long-term strategy benefits.
- Project scope consists of value adding (activities essential for the costumer) or non-value adding (waste) activities.
- The elimination of non-value adding activities reduces the project scope.
- Value-adding activities save resources whilst improving the efficiency and effectiveness of projects.

According to this author, "each concept is applicable to all project's activities including product related activities and administrative activities (project office)".

3.3 Lean Project Management

Lean Project Management (LPM), as a concept, was found in some of the documents analysed for this paper. Aziz (2012) proposes the following definition: "LPM is the application of LT in PM, it tends to focus PM toward creating value and preventing waste, LPM improves project productivity". Reusch and Reusch (2013) based on the definitions of LPM from Leach (2005). Karim and Nekoufar (2011), establish the following LPM principles:

- Specify what creates value from the customer´s perspective.
- Identify all the steps along the process chain.
- Make those processes flow.
- Identify waste—based upon needs and expectations of customers.
- Eliminate waste—based upon needs and expectations of customers.
- Make only what is pulled by the customer.
- Strive for perfection by continually removing wastes.

- Amplify learning.
- Make decisions at the right time.
- Empower the team, build integrity.
- See the whole.

On the other hand, Aziz (2012) analysed the work of Ballard and Howell (2003) who developed a model called the Lean Project Delivery System (LPDS) for construction projects. They state that this model "has emerged from theoretical insights from other industries (lean production). The LPDS focuses on several aspects of project delivery, such as improving dialogue among stakeholders, deferring decisions, process design, eliminating waste, flow and pull" (as cited in Aziz 2012).

Some studies have explored the link between LT and PM in various types of projects. When LT is connected to PM, the construction industry is primarily used as an example (Ballard and Howell 2003). According to Aziz (2012), Staats et al. (2011) explore the possibility to implement LT in software projects, and in doing so, they affirm that organizations learn "through hypothesis-driven problem solving, streamlined communications, simplified processes, and to a lesser degree, specified tasks".

3.4 Relationship Between Lean Thinking and the Three Sustainability Aspects

Yusup et al. (2015) links the performance of LT practices with increased levels of sustainability in manufacturing. The author groups them into three aspects of sustainability performance: the competency accomplishment performance (CAP) (related to the social aspect), economic achievement performance (EAP) and environmental responsiveness performance (related to the social aspect) (ERP).

The only document found that mentions the three topics of this research was the paper from Galeazzo et al. (2014). However, the study just focuses on the relation with LT and the environmental aspect of sustainability. Additionally, it uses projects as case studies and not really a relationship with PM practices.

According to Wu et al. (2015), LT is "directly related to a firm's profitability and indirectly addresses concerns related to environmental and social dimensions". Fliedner (2008) highlights that "many organizations have found that a by-product of the LT principles is related to environmental performance, even when lean activities were not initiated for environmental reasons".

Fliender (2008) identifies eight methods and tools that are associated with the environmental benefits (Table 7). The author states that while LT improves processes and saves money through waste reduction and elimination, these methods and tools have also been demonstrated to produce environmental benefits.

Faulkner and Badurdeen (2014) suggest the use of LT tool Value Stream Map (VSM) to identify value added activities or wastes. According to the authors, this

Table 7 Lean methods and tools associated with environmental benefits (Fliender 2008)

Lean method/Tool	Environmental benefits
Kaizen Events	• Uncovering and eliminating hidden wastes and waste generating activities.
Value Stream Mapping	• Magnification of environmental benefits of lean production (e.g., reduced waste through fewer defects, less scrap, less energy usage, etc.) across the network.
5S	• Clean windows reduce lighting requirements. • Spills and leaks noticed more quickly.
Cellular Manufacturing	• Smaller set-up times reduce energy and resource needs. • Fewer product changeovers reduce energy and resource needs.
Pull Approach	• Lower in-process and post-process inventory avoids potential waste from damaged, spoiled, or deteriorated products.
Total Preventive Maintenance	• Increased longevity of equipment decreases need for replacement equipment and associated environmental impacts.
Six Sigma	• Fewer defects which reduce energy and resource needs avoid waste. • Focuses attention on reducing the conditions that result in accidents, spills, and malfunctions, thereby reducing solid and hazardous wastes.
Pre-production Planning	• Reduces waste at the product and process design stage, similar to "Design for Environment" methods • Use of right-sized equipment lowers material and energy requirements. • Reducing the complexity of the production process ("design for manufacturability") can eliminate or streamline process steps; environmentally sensitive processes can be targeted for elimination, since they are often time-, resource-, and capital-intensive.
Lean Supplier Networks	• Magnification of environmental benefits of lean production (e.g., reduced waste through fewer defects, less scrap, less energy usage, etc.) across the network.

practice can include metrics for evaluating environmental and societal sustainability performance. A new methodology known as 'sustainable' Value Stream Mapping or Sus-VSM was developed and was tested in three case studies (Dhingra et al. 2014).

In a document published online, titled "*Lean Manufacturing and Environment*", the EPA presented findings from a research study conducted in four American companies by means of observations (EPA 2013). The research underlined how Lean Thinking can be taken into account to improve environmental performance (Chiarini 2014). According to Chiarini (2014) the most relevant outcomes are:

- LT produces an operational and cultural environment that is highly conducive to the minimization of waste and the prevention of pollution.
- LT can be leveraged to produce more environmental improvement, filling key 'blind spots' that can arise during Lean implementation.
- LT experiences regulatory 'friction' around environmentally sensitive processes.

The US Environmental Protection Agency (EPA) suggests a table of correlation between the LT wastes and their associated environmental effects (EPA 2013). An extract from this table is shown in Table 8.

The relationship between LT implementation and social practices has also emerged in academic research in recent years (Wu et al. 2015). According to Wu et al. (2015), De Treville and Antonakis (2006) establish that LT practices have an impact on social performance, the most important of which is on the internal human resources of the firms. This can be achieved by empowering, educating, motivating, and designing jobs for employees, (Wu et al. 2015).

Wu et al. (2015) make two interesting statements. First, they affirm that "Total Production Maintenance (TPM) activities largely prevent workplace injuries and deaths, contributing to better employee health and safety". Second, they state that LT practices impact customers primarily through Total Quality Management (TQM) programs. In addition, Wu et al. (2015) remark that researchers such as Jasti and Kodali (2015) recommend covering "a wide range of stakeholders along the supply chain such as suppliers, shareholders, employees, customers, as well as the society as a whole".

Table 8 Environmental impacts linked with manufacturing waste taken from EPA (2013) (cited in Chiarini 2014)

Waste type	Environmental impact
Defects	Raw materials consumed in making defective products. Defective components require recycling or disposal. More space required for rework and repair, increasing energy use for heating, cooling, and lighting.
Waiting	Potential material spoilage or component damage causing waste. Wasted energy from heating, cooling, and lighting during production downtime.
Overproduction	More raw materials consumed in making the unneeded products. Extra products may spoil or become obsolete requiring disposal.
Movement and transportation	More energy use for transport. Emissions from transport. More space required for work-in-process (WIP) movement, increasing lighting, heating, and cooling demand and energy consumption. More packaging required to protect components during movement.
Inventory	More packaging to store WIP. Waste from deterioration or damage to stored WIP. More materials needed to replace damaged WIP. More energy used to heat, cool, and light inventory space.
Complexity and Over processing	More parts and raw materials consumed per unit of production. Unnecessary processing increases wastes, energy use, and emissions.
Unused creativity	Fewer suggestions of pollution and waste minimization opportunities.

4 Conclusions

In the Results section of this study, the main concepts of the three topics of the literature review were described. It was possible to find theoretical information regarding some links between LT and PM as well as LT and the three concepts of sustainability.

- PMBok guide include the use of LT tools for PM practices.
- This guide states improvement of the project's quality by using LT methodology.
- The LT core elements such as costumer focus, continual improvement, process approaches affect positively the PM practices.
- Detection of LT tools and methods associated with environment benefits.
- Relation with firm's profit and LT through waste elimination and costs reduction.
- Impact on social aspect mostly at internal human resources of the organizations and costumer.

Gaps found in the research which should lead to future research

The social aspect was not widely developed in the researched articles, just in some cases considered the employee and customer integration but not all the project's stakeholders.

Likewise, there is a lack of information on how LT concepts can contribute to PM to integrate sustainability. A solution could be developed based on a specific model or framework.

References

Aziz B (2012) Improving project management with lean thinking? Master thesis. Master of management of innovation and product development. Institute of Technology, Linköping University, Sweden http://www.diva-portal.org/smash/get/diva2:504715/FULLTEXT01.pdf. Accessed 10 April 2016

Anholon R, Sano A (2016) Analysis of critical processes in the implementation of lean manufacturing projects using project management guidelines. Int J Adv Manufact Technol 84:2247–2256

Ballard G, Howell G (2003) Lean project management. Build Res Inf: Int J Res, Dev Demonstration 31(2):119–133

Berggren C, Järkvik J, Söderlund J (2008) 'agomizing, organic integration, and systems emergency wards: innovative practices in managing complex systems development projects. Proj Manag J 39(Supplement 1):S111–S122

Bortolotti T, Boscari S, Danese P (2015) Successful lean implementation: Organizational culture and soft lean practices. Int J Prod Econ 160(1):182–201

Carvalho H, Duarte S, Cruz Machado V (2011) Lean, agile, resilient and green divergencies and synergies. Int J Lean Six Sigma 2(2):151–179

Chiarini A (2014) Sustainable manufacturing-greening processes using specific Lean Production tools: an empirical observation from European motorcycle component manufacturers. J Clean Prod 85(1):226–233

Chen L, Feldmann A, Tang O (2015) The relationship between disclosures of corporate social performance and financial performance: evidences from GRI reports in manufacturing industry. Int J Prod Econ 170(1):445–456
Dhingra R, Kress R, Upreti G (2014) Does lean mean green? J Clean Prod 85(1):1–7
EPA (2013) Lean manufacturing and environment. US Environmental Protection Agency (EPA)
Faulkner W, Badurdeen F (2014) Sustainable value stream mapping (Sus-VSM): methodology to visualize and assess manufacturing sustainability performance. J Clean Prod 85(1):8–18
Fliedner G (2008) Sustainability: a new lean principle. In: Proceedings of the 39th annual meeting of the decision sciences institute, Baltimore, Maryland, pp 3321–3326
Folinas D, Aidonis D, Triantafillou D, Malindretos G (2013) Exploring the greening of the food supply chain with lean thinking techniques. Procedia Technol 8(1):416–424
Galeazzo A, Furlan A, Vinelli A (2014) Lean and green in action: interdependencies and performance of pollution prevention projects. J Clean Prod 85(1):191–200
Garza-Reyes JA (2015) Lean and green – a systematic review of the state of the art literature. J Clean Prod 102(1):18–29
Goerke M, Schmidt M, Busch J, Nyhuis P (2015) Holistic approach of lean thinking in learning factories. Procedia CIRP 32(1):138–143
Hines P, Holweg M, Rich N (2004) Learning to evolve: a review of contemporary lean thinking. Int J Oper Prod Manag 24(10):994–1011
Hook M, Stehn L (2008) Applicability of lean principles and practices in industrialized housing production. Constr Manag Econ 26(10):1091–1100
Hozak K, Olsen E (2015) Lean psychology and the theories of "Thinking, Fast and Slow". Int J Lean Six Sigma 6(3):206–225
Khanzode A, Fischer M, Reed D (2005) Case study of the implementation of the lean project delivery system (LPDS) using virtual building technologies on a large healthcare project. In: 13th international group for lean construction conference: proceedings, p. 153, International Group on Lean Construction
Levy Y, Ellis TJ (2006) A systems approach to conduct an effective literature review in support of information systems research. Informing Sci: Int J Emerg Transdiscipline 9(1):181–212
Longoni A, Cagliano R (2015) Cross-functional executive involvement and worker involvement in lean manufacturing and sustainability alignment. Int J Oper Prod Manag 35(9):1332–1358
Pons D (2008) Project management for new product development. Project Manag J 39(2):82–97
Project Management Institute (PMI) http://www.pmi.org/en.aspx. Accessed 15 May 2016
Reusch PJ, Reusch P (2013) How to develop lean project management? In: 2013 IEEE 7th international conference on intelligent data acquisition and advanced computing systems (IDAACS), vol 2, pp 547–550. IEEE
Shah R (2003) Lean manufacturing: context, practice bundles, and performance. J Oper Manage 21(2):129–149
Shah R, Ward PT (2007) Defining and developing measures of lean production. J Oper Manage 25 (4):785–805
Sousa R, Voss C (2001) Quality management: universal or context dependent? Prod Oper Manag 10(4):383–404
Staats B, Brunner D, Upton D (2011) Lean principles, learning, and knowledge work: evidence from a software services provider. J Oper Manag 29(5):376–390
Womack, J P, Jones, D T, & Roos, D 1990, 'Machine that changed the world', Simon and Schuster
Womack JP, Jones DT (1996) Lean thinking. Simon and Shuster, New York
Wu L, Subramanian N, Abdulrahman MD, Liu C, Lai KH, Pawar KS (2015) The impact of integrated practices of lean, green, and social management systems on firm sustainability performance—evidence from Chinese fashion auto-parts suppliers. Sustainability 7(4):3838–3858
Yusup M, Mahmood W, Salleh M, Yusof A (2015) Review the influence of lean tools and its performance against the index of manufacturing sustainability. Int J Agile Syst Manag 8:2