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Review

Lean manufacturing and sustainable performance: Trends and future challenges

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Highlights

- A systematic literature review of investigations linking lean manufacturing and sustainable performance is presented.
- Presents effects of lean manufacturing on each triple bottom line pillars (operational, environmental and social).
- There is a short of theoretical knowledge and empirical evidence on how LM practices affect sustainable performance.
- Future lines of research from the identified gaps in the literature are proposed.

Abstract

Lean manufacturing has proven its positive effects on operational and economic performance in multiple cases. However, growing consciousness regarding sustainability and the Triple Bottom Line

approach requires an integral performance based on three main goals: economic growth, environmental preservation, and social responsibility. Given the relevance that lean manufacturing has acquired, it is important to understand its effects on sustainability. Thus, this paper presents a literature review, discussing the most relevant findings of research in this sphere, and identifying current trends concerning the effect of lean manufacturing on sustainable performance. A total of 69 papers were reviewed, following a five-step synthesis methodology. Common and contrasting results were categorized according to each pillar of the triple bottom line, which allowed for the identification of not only growing research trends, but also of knowledge gaps. Unlike previous literature reviews, this study approaches lean manufacturing's effect on performance from a multidimensional point of view, accounting for all three triple bottom line pillars. It contributes on the identification of the main current research trends, which favors branches: one which supports complementary interactions between lean manufacturing and all three pillars of the triple bottom line, and the other, which evidences trade-offs among them. According to the results of the review, knowledge gaps on the matter remain, which require further research.

Introduction

Since “The Machine that Changed the World” (Womack et al., 1990) was published, lean manufacturing (LM) has been recognized as a world-class manufacturing and management philosophy. Since then, several well-known authors have studied the different sets of tools comprising LM and their effect on performance, mainly from operational or economic perspectives (i.e. profit, cost, quality, delivery, etc.) (Negrão et al., 2017). Nevertheless, nowadays, there is a need to consider performance from a multidimensional point of view that also accounts for environmental and social impacts (Seuring et al., 2008).

As world population grows to an expected 9 billion people by 2050, and nonrenewable resources are more difficult and expensive to obtain every day, companies, governments and organizations need to embrace sustainability as a top priority. However, this is easier said than done. In spite of the wake-up call generated by 1987's “Brundtland Report” from the UN World Commission for Environment and Development (WCED, 1987), at least until the end of the 20th century, evidence suggests that many companies continued to relegate environmental protection and social responsibility to positions below economic performance (Pagell and Shevchenko, 2014). Although alternatives for the achievement of sustainable development (especially in the manufacturing industry) have emerged in recent years, there are still concerns about their long-term effectiveness and worldwide scalability, according to the World Business Council for Sustainable Development (WBCSD, 2011).

Elkington, 1994, Elkington, 1998 proposed a framework called the “Triple Bottom Line” (TBL), urging companies and organizations to measure their performance using a multidimensional perspective that integrates not only the traditional indexes such as profit, return on investment or share value, but also to include environmental and social aspects. The TBL accounts for three pillars (economic, environmental and social) as the base of successful sustainable development, and thus can be used as

a metric for performance measurement in organizations. However, there is no universal standard for calculation of sustainable (or TBL) performance (Helleno et al., 2017, Slaper and Hall, 2011), making it difficult for companies to evaluate the impact of their policies and strategies, or to compare themselves with others.

In today's globalized market, consumers often set their own standards, and prices are determined by the market. To cope with this situation and increase competitiveness, manufacturing industries need to deploy several strategies. Lean manufacturing emerges as an advanced manufacturing strategy to provide productivity improvement, quality maximization, and waste elimination (Resta et al., 2016). However, there is growing pressure from stakeholders involved in the entire value chain, demanding that this continuous quest for efficiency and competitiveness doesn't come at the expense or detriment of the environment or the social conditions of citizens (Gupta, 2016, Martínez León and Calvo-Amodio, 2017, Sajan et al., 2017).

In spite of growing interest in research related to LM effects on performance, studies linking LM and sustainability remain scarce (Azevedo et al., 2012, Kowang et al., 2016, Resta et al., 2017). Therefore, the objective of this paper is to conduct a systematic literature review, highlighting the relationship between LM and sustainable performance (or TBL performance). The results are analyzed, discussed and categorized according to the identified trends on this topic, allowing for the identification of several knowledge gaps. Findings provide guidance for future lines of research on the subject.

The literature review was performed with data collected from the most highly renowned P&OM publications, and databases which gather them. Previous related literature reviews were used as starting points, when available. Relevant literature was cross-referenced to pinpoint seminal works, and thematic synthesis was used to group the results following the method proposed by Garza-Reyes (2015). Also, My Tree of Science (Robledo et al., 2014), a computational tool based on networks theory, and oriented to create citation chains from search equations, was employed. As shown in Table 1, previous literature reviews have identified different relationships between LM and performance, usually focused either on operational/financial performance or environmental performance alone.

Of the previous literature reviews considered, only three account for all three pillars of TBL sustainability. Martínez-Jurado and Moyano-Fuentes (2014) addressed the supply chain management perspective, linking this concept with LM practices. They conclude that further research is required regarding the interrelationships between LM and the three dimensions of sustainable performance, especially the social pillar, as their study covers mostly environmental sustainability, and the economic dimension from a sustained performance over time perspective (Martínez León and Calvo-Amodio, 2017). A second review carried out by Cherrafi et al. (2016), presents a brief account of benefits derived from LM, six sigma, and sustainability practices integration. Environmental and social benefits are considered in this review, but as the authors noted "*The negative effects of the integration of lean/six sigma and sustainability still have to be explored. By understanding such effects, it will be possible to investigate how they can be ameliorated so that a compromise between business, environmental and social performance can be made*" (Cherrafi et al., 2016). Finally, Hartini and Ciptomulyono (2015) present

a brief account of positive impacts in operational, environmental, and social performance, derived from the interaction between LM and sustainable manufacturing practices. However, their work is limited to listing the results of literature review, without extracting possible explanations for those outcomes.

The current review presents a novel contribution to the literature by approaching LM effects on performance (both positive and negative) from a multidimensional point of view, using the TBL perspective. It accounts for LM's operational (OP), environmental (EP) and social performance (SP) outcomes, as noted in the literature. Previous reviews have listed both the positive and negative effects of LM in operational performance. This literature review goes further, so as to extract possible explanations from published articles for said contrasting results, and also considers both the positive and negative effects of LM on EP and SP (these topics are scarcely addressed in existing reviews). Finally, it analyzes the interactions of all three performance dimensions from a comprehensive "sustainable performance" perspective, which has not yet been thoroughly discussed in previous reviews. Therefore, in contrast to the other reviews presented in Table 1, special emphasis was placed on the identification of those contrasting sustainability effects which resulted from the implementation of LM practices, as well as the explanations provided for said outcomes.

This study presents the current state of research of LM impact on performance from a multidimensional point of view, covering operational/economic, environmental and social perspectives, where they have been previously studied in the literature. Although there are investigations, including some LM and sustainability relationships (Bergenwall et al., 2012, Chiarini, 2014, Martínez-Jurado and Moyano-Fuentes, 2014, Piercy and Rich, 2015, Vinodh et al., 2016), we have concluded that current LM research still falls short of proper identification, proof, and more importantly, management of the issues regarding its impact on long-term sustainability.

It can be concluded that most of the empirical evidence available from past research points to a positive LM – OP interaction (in most cases), while results relating to the effect of LM on EP show less consensus. Regarding the impact of LM on SP, contributions are still scarce, as are those embracing its holistic effect on the three pillars of TBL. One important contribution of this investigation relies on the identification of two major conceptual trends, regarding the effect of LM on sustainable performance. The first trend presents a win-win interaction between all three TBL pillars, with LM positively affecting each of them, and prompting cumulative performance gains. The second trend points to trade-offs between all TBL pillars, or at least between two of them, when LM demands resources. Therefore, in order to increase performance in one dimension, at least one of the others is negatively affected. Although partial evidence is presented to support each trend, a comprehensive explanation is not yet conclusive in the most recent literature. Consequently, this paper contributes to lay the groundwork for future lines of research relating to LM and sustainability, which allow for the clearing of yet unsettled conceptual and theoretical dilemmas in the field.

This paper is structured as follows: research questions and the methodology are presented in Section 2. In Section 3 the main findings and discussion are addressed. Section 4 provides insights for

potential future research on the topic, and finally, relevant conclusions are presented in Section 5.

Section snippets

Research questions

There is a great deal of empirical evidence linking the effect of LM to operational and economic performance (Chavez et al., 2015, Shah and Ward, 2003, Singh and Sharma, 2009), as well as evidence supporting the idea that "Lean is Green" (Bergmiller and Mccright, 2009, Yang et al., 2010). However, several authors claim that such evidence is only partially true (Belekoukias et al., 2014, Zhu and Sarkis, 2004), as most studies present only a "picture" of the current relationship between the …

Results data

A total of 679 papers resulted from the search strings, 137 of which were present both in Scopus and Web of Science. For sorting purposes, both papers published in peer reviewed journals and conference proceedings were considered. Papers were reviewed in English, Spanish, Italian, French and Portuguese. Papers written in other languages were not considered in this review.

As not all of the resulting papers were directly related to the research topic, or contributed to answers for the specific …

Further paths for research

Further research paths identified in the LM – SSTP literature review are presented in Table7 in the form of research questions consequent from knowledge gaps yet unaddressed on the subject. The first three questions are derived from results presented and discussed in Section 3.2.5, and they should either provide a better understanding of how LM allows for continuous, simultaneous improvement in all three TBL pillars, or force companies to choose to allocate their resources for profitable …

Conclusions

This paper contributes to the LM and sustainability literature by being the first systematic literature review linking LM to sustainable performance, using the TBL approach, which accounts for

economic/operational, environmental, and social performance outcomes. It shows the extent to which the current state of research has addressed the effects of LM in sustainable performance, and provides paths to further extend academic and scientific knowledge on the matter.

As a result of the information …

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References (112)

I. Alhuraish *et al.*
Acomparative exploration of lean manufacturing and six sigma in terms of their critical success factors
J. Clean. Prod. (2017)

A.L. Bergenwall *et al.*
TPSs process design in American automotive plants and its effects on the triple bottom line and sustainability
Int. J. Prod. Econ. (2012)

T. Bortolotti *et al.*
Leveraging fitness and lean bundles to build the cumulative performance sand cone model
Int. J. Prod. Econ. (2015)

G. Büyüközkan *et al.*
Assessment of lean manufacturing effect on business performance using Bayesian belief networks
Expert Syst. Appl. (2015)

K. Ceulemans *et al.*
Sustainability reporting in higher education: a comprehensive review of the recent literature and paths for further research
J. Clean. Prod. (2015)

R. Chavez *et al.*
Internal lean practices and performance: the role of technological turbulence
Int. J. Prod. Econ. (2015)

A. Cherrafi *et al.*
The integration of lean manufacturing, Six Sigma and sustainability: a literature review and future research directions for developing a specific model

J. Clean. Prod. (2016)

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

K. Ferdows *et al.*
Lasting improvements in manufacturing performance: in search of a new theory
J. Oper. Manag. (1990)

F. Figge *et al.*
Is green and profitable sustainable? Assessing the trade-off between economic and environmental aspects
Int. J. Prod. Econ. (2012)

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