



# Lean and Green strategy: the Lean and Green House and maturity deployment model



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## ABSTRACT

Industrial firms are facing increasing environmental and societal challenges in order to sustain their processes. The association of Lean manufacturing to Green concerns has therefore grown in both the industrial and academic fields over the last decade. Following on from the “Lean and Green Project”, this paper intends to enhance previous studies by giving an implementation structure to a Lean and Green methodology based on the seeking and eradication of wastes in production processes. A state of the art featuring main scientific contributions and industrial best practices of Toyota is presented, followed by an in-depth analysis of the synergies between Lean and Green wastes, and the tools that may eliminate them. The results are gathered and highlighted in an original Lean and Green house. The last section presents a detailed CMMI-based Lean and Green maturity model.

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## 1. Introduction

Since the 1990s, the concept of sustainable development has been of interest to industry. Defined by the World Commission on Environment and Development (better known as the “Brundtland Commission”) in 1987, as “a development that meets the needs of the present without compromising the ability of future generations to meet their own needs”, the term is more and more widespread, and quoted in the majority of firms’ strategic public communications (Moldan et al., 2012).

Corporate social responsibility (CSR), along with the Triple Bottom Line (TBL) (Elkington, 1998), is a business strategy commonly adapted from the three pillars of sustainable development (i.e. Economic, Social, Environmental). While firms have obviously always taken economic concerns into account in their performance management, the current economic and ecological crisis has acted as an impetus to link them to more exhaustive sustainability goals.

Our present research has been conducted along the “Lean and Green Project” (Verrier et al., 2014), initiated by the Alsace Region of France and coordinated by the Economic Development Agency of the Bas-Rhin (ADIRA) (Adira, 2015) in 2010. Built with stakeholders from various scientific and industrial fields, including the Icube

research laboratory, consultancy companies, SMEs and major firms that are representative of the industrial network of the region, the project aims to highlighting industrial best practices by the association of lean manufacturing and sustainable development.

A main aim of our research is to find an appropriate way to combine and implement L&G tools and methodologies within firms and especially SMEs that have different corporate cultures and process specificities. Another important question is how to cope with the difficulties of dealing with customers and regulatory requirements while fostering the economic, environmental and social pillars of sustainability.

Linking industrial performance to sustainability pressures leads industry to promote eco-efficiency strategies and the association of Lean manufacturing and environmental concerns appears to be a tangible way to answer these constraints and is therefore of growing interest to both academics and industrialists.

Lean methodology has already proved to be important to manufacturing firms as an enhancer of competitiveness since its spread worldwide through the Toyota Production System (TPS). One of the main objectives of lean manufacturing is the identification and elimination of non-value added activities, known as “wastes” or by the Japanese term “muda”, in production processes.

Our research project lies in the association of Lean and Green themes and particularly the joint elimination of manufacturing and environmental wastes. The seven Lean wastes defined by Taiichi Ohno for the TPS are commonly known as overproduction, defects, unnecessary motion, unnecessary inventory, inappropriate

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processing, transportation and waiting. The importance of employees and good human behavior at every hierarchical stage has been defined in the original TPS as the center of success in manufacturing strategies. We therefore also consider in our study the notion of “lost people potential”, nowadays commonly recognized as the 8th lean waste in order to reaffirm and foster this statement. These wastes all lead to potential disorganizations as well as loss of profits and motivation. In the same way, environmental impacts can be considered as a result of green wastes.

Peter Hines was the first to propose a categorization of eight green manufacturing wastes inspired from the Lean methodology (Hines, 2009) and we chose to use his model as it closely fit our study towards a global seeking and eradication of manufacturing wastes. Thus, the green muda are defined as: greenhouse gases, eutrophication, excessive resource usage, excessive power usage, pollution, rubbish, excessive water usage, and poor health and safety.

After the presentation of a synthesized state of the art on Lean and Green topics from both a scientific and industrial point of view, this paper emphasizes the correlations between Lean and Green mudas and the corresponding tools that can help to eliminate them. We then highlight, enhance and optimize the findings, thanks to the knowledge and industrial observations coming from the “Lean and Green project”, through the development of originals Lean and Green house and Lean and Green maturity model.

We conducted along the global Lean and Green project several manufacturing studies based on evaluation, classification and improvement of performances. Our research is therefore based both on descriptive and instrumental tools objectives and the chosen methodology is fitting a crossed path of case study (Yin 2008) and grounded theory (Charmaz, 2003). Thus, we consider observations and data coming from real manufacturing environment while our research is highlighted by a thorough scientific literature review. Our objective in this paper is aimed at the construction of theories that can be used in other studies. As our observations are also completed by qualitative data coming from industrial surveys that contributed to the construction of the Lean and Green models and flexible methodologic strategies, we are also in line with the grounded theory as detailed by Engward (2013).

## 2. Synthesized state of the art

We will present in this section a synthesized state of the art on Lean and Green topics. While taking into account the more important contributions that have influenced these research fields, the scientific literature review is especially focused on recent contributions (2008–2015).

### 2.1. From the association of environmental and financial performance to Lean and Green considerations

Some contributions from the beginning of the last decade were at the forefront in the association of environmental and operational performances and had a real impact on subsequent investigations (Maxwell and van der Vorst, 2003; Pimenova and van der Vorst, 2004; Zhu and Sarkis, 2004; Schaltegger and Synnestvedt, 2002). Nowadays, the relevance of the subject is confirmed by the number of related interesting contributions (Gunasekaran and Spalanzani, 2012; Rusinko, 2007; Schoenherr, 2011), which have almost doubled since the beginning of the decade. Most papers still discuss the overall consideration of environmental practices in traditional manufacturing processes although interesting recent publications have added case studies and frameworks to the topic (Ahemad et al., 2013; Asif et al., 2013; Thoumy and Vachon, 2012).

The association of Lean Manufacturing, derived from the Ohno's Toyota Production System, with environmental paradigms, also came to light at the beginning of the last decade. King and Lenox and Simons and Mason were among the pioneers in associating Lean and Green performances, respectively focusing on the interactions between quality and environmental management (King and Lenox, 2001) and the elimination of wasteful activities in the supply chain (Simons and Mason, 2003). Some authors, such as Bergmiller, also specifically addressed Lean and Green principles in the following years (Bergmiller and McCright, 2009), and suggested that they could lead to waste and cost reduction, with more chance of being successful if they were implemented in parallel.

These contributions have proved the existing interest of the association of Lean and Green paradigms for industrial companies, especially when many firms still consider environmental issues as a constraint instead of seeing them as opportunities for progress (May et al., 2011).

Environmental paradigms are still often being treated with a macroscopic point of view and notably at the supply chain level. In recent contributions, Dubey et al. presented a green supply chain management model (Dubey et al., 2015) and Faulkner and Badurdeen developed a value stream mapping-oriented methodology called Sus-VSM (Faulkner and Badurdeen, 2014). As for Duarte and Cruz-Machado, they specifically handled Lean and Green themes along a supply chain assessment framework (Duarte and Cruz-Machado, 2015).

Several recent papers have however addressed Lean and Green themes associated to manufacturing processes (Pampanelli et al., 2014; Kurdve et al., 2014). Jabbour et al. find evidence that Lean management has a positive impact on environmental management, which itself has a positive impact on operational performance (Jabbour et al., 2013) and Chiarini underlines interesting links between specific basic Lean tools and their consequences on environmental performance (Chiarini, 2014). Most of these contributions were published in a dedicated issue of the Journal of Cleaner Production, Volume 85 (Dhingra et al., 2014). Only few studies proposed Lean and Green models but most confirmed the ability of a joint Lean and Green philosophy to reduce the usage of resources and increase cost benefits.

Dües et al. published an interesting contribution that explores the bonds between Lean and Green practices and argues that Lean is a catalyst for the implementation of Green in manufacturing companies, and that Green may help in return to maintain best practices in Lean (Dües et al., 2013).

These results prove positive links between Lean and Green paradigms. However, there is still a lack of contributions in highlighting Lean and Green best practices and in the investigations about L&G causal relationships. The aim of our research is therefore to foster the development of L&G methodologies by exploring and highlighting L&G synergies. The originality of our research notably lies in the parallel seeking for Lean and Green mudas as a catalyst for total waste reduction alongside the implementation of Lean and Green thinking in operational procedures.

Another point of interest has to be taken under consideration in our research in order to complete an existing gap in the literature between social, economic and environmental practices. The social aspects of sustainability have indeed been the least considered until now although they are attracting increasing interest. Some authors explored very recently how social concerns can be included in sustainable manufacturing exploration and quality management in order to foster competitiveness (Brown et al., 2014; Frolova and Lapina, 2014; Golini et al., 2014). In accordance with these considerations, the importance of the “human factor” will be considered in our research as a pillar for a true and exhaustive L&G sustainability.

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