



Does Lean Underpin Sustainable Supply Chains?

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Abstract

In the late 20th century, drivers like growing demands, globalization, and competitiveness have forced entire organizations worldwide to minimize cost and to be more responsive to customer demands. Lean Manufacturing Processes have been as an answer to these requirements since it aims at increasing productivity by diminishing waste in human effort, materials movement, manufacturing space, equipment, time, defects, and inventory. Additionally, it has been seen consequently that lean processes yield considerable number of ecological benefits such as pollution prevention, waste reduction, recycling, and remanufacturing capabilities. Concarnitantly, sustainability has emerged as a concept owing to depletion of earth's natural resources and rise of environmental issues, has become an indispensable and vitally important issue for all divisions of society with the inclusion of manufacturing and service industries. Sustainability is a universal methodology that aims at meeting the needs of the present without compromising the ability of future generations to meet their own needs. The primary objective of this philosophy is the accomplishment of beneficial results at three distinct aspects: economy, environment, and society. There is an interaction between lean processes and sustainability philosophies particularly in terms of ecological issues. Synthesis of these two approaches can contribute to improvements in eco-friendly supply chains. This paper investigates the link between the two methods; it explores similarities, differences, and conflicts between them.

Keywords: Lean, Sustainability, Lean&Sustainability Relationship

INTRODUCTION

In recent decades, demand increase and high competitiveness of the global economy have leaded enterprises to improve quality with cutting the cost. At this time, sustainability is becoming a crucial point for manufacturing philosophy and rise of customer oriented markets has been a peripeteia about organizations' methodologies. A visible trend comes out to synthesize this philosophy with respect to ecological and social facets. Consequently, to guarantee sustainable business development, integrating environmental, social and economic aspects is a bounden task for majority of industrial firms. Companies have to cope with rapid changes and satisfy sustainability requirements[1]. The main difficulties arose in front of the company management to accomplish perfection in production strategies are defect free(aimed at high quality goods with less internal failure and less external failure), fast(it is related about manufacturing lead time or order processing time), lean(eliminating waste), flexible(meeting more varied the market requirements when demand arises), environment-friendly (manufacturing operations without pollution, goods designed for protecting the environment and preventing the harmful effects of wastes(recyclable, re-manufacturable), to overcome the complexity emergency situations(fire, occupational accidents, explosion, flood, earthquake)). To handle with these difficulties, industries are canalizing safer approaches, which are reengineering and continuous improvement. Among these strategies, "Lean" is the most important one, since sustainability has become one of the significant points in lean particularly from an environmental

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perspective. The ideas of wasting less materials, workforce and avoiding emissions which stem from gaseous chemicals, solvents fit notably well with lean ideas.

“Lean” is the most important continuous improvement tool, the goal of lean is sustaining improvement in the long run. Lean is thought as an ideal, rather than a system that stresses on continuous improvement. During the recent years, the concept of “Lean Manufacturing” has become popular. Various firms have implemented “Lean” to provide customer satisfaction, save cost and reach the desirable quality and production strategies, management practices of organizations are being amended in a leaner and fitter way to achieve high performance.[1]

Analyzing lean and sustainability concludes that they complement each other in a compatible way.

Lean and sustainability paradigms are not able to survive in isolation within the supply chain, they should exist together. Applying lean to sustainability attempts ensures that a company’s green initiatives will have long-term effective power, since it adds value to company’s business. Besides, this combination facilitates more competitive value chains that are able to prevail in a volatile and cost-conscious conditions. The purpose of environment-friendly attitude of manufacturing industries, which is seeking to do the right thing for the environment can be achieved more effectively by implementing lean systems. Establishing a culture that supports both methodologies can attain significant results.

The goal of this paper is to finding out whether lean reinforces sustainable supply chains or not. Firstly, we will present the literature review of lean, secondly we will introduce literature review of sustainability and thirdly we will compare “Lean” and “Sustainability” by examining the similarities and contradictions between them.

BRIEF LITERATURE REVIEW

LEAN

History of Lean

The lean concept arose out of Toyota Production System which was found by Taiichi Ohno, a Japanese businessman. He is considered to be the father of the Toyota Production System. Toyota Production System was developed to provide products at world class quality levels to meet the expectations of customers, to reduce cost through the elimination of waste and maximize profit, to create flexible production standards based on market demand. Toyota was inspired by Ford’s mass production system and by quality gurus Edwards Deming(American engineer, statistician) and Joseph Juran(known as father of quality)who put importance on quality besides cost reduction. In 1970s the supplier manuals about Toyota’s Production System (TPS) were produced and translated in English. Thereafter, the performance gap between Western and Japanese manufacturing drew attention.

Through the book entitled, “The Machine That Changed the World”by Womack, Jones and Roos (1990) the world manufacturing community discovered lean manufacturing. The book purposed to guide manufacturers to management of customer relations, production operations, the supply chain. Both the book and Toyota Company have paved the way for lean approach. The “lean thinking” has been interpreted by Womack and Jones and they have given Lean Enterprise importance rather than Lean Production. Today, it is the paradigm for processes, in a wide range of manufacturing and service industry.[2]

Definition of Lean and Production Principles

Lean is one of the terms for Toyota’s way of speeding up the supply chain by concentrating on eliminating wasteful steps in processes. Taiichi Ohno has identified the first seven type of muda (waste), which is any activity that does not change the product or assembly, does not directly affect in



production. The seven wastes are defined as transportation(moving products or materials that are non mandatory to perform the process), inventory, motion(employees or equipment moving more than it required to perform the process), waiting, overproduction(producing more than demand), unnecessary processing(caused by poor product design) and defects. Wastes are also known as non-value added activities. The value is defined as a thing which brings a product in the form desired by the customers who want to pay for it. Lean is a philosophy that aims at reduction and elimination of all waste from the every area which are customer relations, product design, supplier networks and factory management to create valuefor the customer. Its goal is adoption of less human effort, less inventory, less time to develop products, less space to become highly responsive to customer demand, while producing high-quality products in the most productive and economical manner.

The Lean Production has five basic principles: “precisely specify value by product, identify the value stream for each product, make value flow without interruptions, let the customer pull value from the manufacturer and pursue perfection. Firstly, the value should be specified from the point of view of customer. The value can only be determined by thecustomer and it has to be expressed in terms of specific product which meets the customer’s needs at a specific price at a specific time. Lean thinking starts with a clear definition of value. Next is identifying the value stream: This isthe set of all the actions essential to bring a specific product from raw material to final customer. After this, making the value-creating steps for specific products flow continuously should be carried out to avoid or at least reduce batch and queue. Following step is letting customers pull value from the enterprise, which is the capability of scheduling, designing and making exactly what the customer wants just when the customer wants. Finally, pursuing perfection, it is delivering accurately what the customer wants, at a fair price and with minimum waste.[3]

Consequently, lean strategies focus on waste diminishment, contributes to eliminate non-value adding activities about slack time, equipment, space, labor and inventories across the supply chain). A matrix propounds that there might be four possible supply chain strategies according to three-dimensional classification(products, demand, replenishment lead-times): lean (plan and execute), leagile (postponement), lean (continuous replenishment), agile (quick response). Lean is a business model that eliminates waste while delivering quality products at the least cost. The competitiveness of lean production originates from physical savings (fewer parts, shorter production operation, less unproductive needed for set-ups, less material) on the technical side, psychological efficiency(commit, empowerment, communication etc.) is also stressed. Lean production system has been one of the competitive advantages for firms.

SUSTAINABILITY

History and Definition of Sustainability

Sustainability or sustainable development has emerged in the late 1980s by the Norwegian Prime Minister Brundtland as “Meeting the needs of the present without compromising the ability of future generations to meet their own needs. The principle of sustainability concept covers an not only environmental aspect, but also delivers social and economic benefits. The term triple-bottom-line is directly which is planet, people, and profit, is directly related to three dimensions of sustainability: ecological, social and economical [2].

According to these aspects, different performance measures have arosen in the supply chains. In economic aspect, the operational cost, environment cost, inventory cost; in social aspects, supplier screening, corruption risk, local suppliers. Finally, the ecological dimension, which is also referred as “Green Philosophy”, targeting green is improvement of the quality of green compliant products, processes while decreasing cost, the carbon and the environmental footprint of all product design, manufacturing, raw material processing, remanufacturing, recycling, warehousing and logistics activities, considers business wastage, green image and carbondioxide as performance measures[4].



COMPARISON OF LEAN AND SUSTAINABILITY PHILOSOPHIES

There are both conflicts and similarities while comparing the two philosophies. An exploratory study was conducted by collecting data on different cases. The study is summarized by the Table 1.

Table 1. Lean and Sustainability

Attribution	Lean Philosophy	Sustainability Philosophy
FOCUS	Elimination of waste in every area, including customer relations, product design, supplier networks and factory management [1].	Minimizing environmental impact of manufacturing processes and products is ever more important to our sustainable future [5].
MAIN PURPOSE	Cost minimization and waste elimination[6].	Reduction of the ecological impact of the industrial activity without sacrificing quality, cost, reliability, performance or energy utilization efficiency; meeting environmental regulations, minimize ecological damage and leading to overall economic profit [7].
	Incorporate less human effort, less inventory, less time to develop products and less space to become highly responsive to customer demand, while producing top-quality products in the most efficient and economical manner possible [1].	To find out the sources of pollutants and eliminate them [7].
	Maximize profits through cost reduction[5].	Reducing environmental risks and impacts while improving ecological efficiency of organizations and their partners [5].
TOOLS, METHODS AND PRACTICES	Kaizen Rapid Improvement Process, 5S, Total Productive Maintenance (TPM), Cellular Manufacturing (One-piece Flow Production Systems), Just-in-time Production, Kanban, Six Sigma ,Pre-Production Planning (3P) [8].	Ensuring materials that are not in inventory past shelf life, modification of layout, equipment, separation of hazardous and non hazardous waste, improvement of maintainance Schedule, substitution of raw materials, Life-Cycle Assessment:Analyzingthe potential environmental aspects and potential aspects associated with a product (or service), Sustainable VSM, waste minimization(energy, water, non product output), reduction of lead time for transportation and replenishment(reordering) frequency [8][9].
KPI	Leadership, cost, time, quality, people and organization[10].	Emission(Air emission,water emission, land emission), Resource utilization(Energy utilization,Water utilization,Fuel consumption, Land used), Waste(Solid waste, Hazardous waste,Waste water)[11].
EMPLOYEE EMPOWERMENT	The ability to participate in decision-making and Problem-solving(Kaizen), job satisfaction [12]	Employee training, development and job satisfaction [10].



MANUFACTURING IMPLEMENTATION	JIT, controlling the flow resources by replacing only consumed ones in production process, using customer order-driven production schedules based on actual demand and consumption [13].	Resource efficiency and waste elimination for environmental benefits lead to a development of remanufacturing capabilities to integrate recyclable/reusable parts [14].
WASTES	Overproduction Waiting Inventory Motion Defects Transportation Overprocessing [8].	Water: leaks, waste streams from processes. Air: evaporation of chemicals, dust, particulate. Solid Waste: filters, excess material scrap. Toxic & Hazardous Waste: solvents, process residuals. Energy: machinery on when not in use, heat loss, oversized motors [14].
TRANSPORTATION	To reduce motion, it aims at minimize material handling during manufacturing [5].	To reduce fuel consumption and carbondioxide emissions, it aims at reduction of replenishment frequency [5].
CUSTOMER SATISFACTION	Satisfying customers by diminishing costs and lead times [5].	Satisfying customers by helping them for environmental sustainability, producing products or providing services in green principles [14].
END OF LIFE	Lean does not consider end of life scenerios [14].	Environmental sustainability aims at less scrap through considering different scenarios by product life cycle planning procedure from the product design phase [14].
ENVIRONMENT	Lean considers environment as a valuable source [14].	Sustainability considers environment as limitation for product and services design and Production [14].
ISO STANDARDS	Implementation of ISO14001 standard is the continuation of Lean Manufacturing techniques improvement [14].	Implementation of ISO14001 is strong beginning for Environmental Sustainability Integration [14].
COST	Costs can be classified as operational cost, inventory cost and environmental cost. Supply chain management practices in lean like just in sequence, single sourcing, deliveries directly to the point of utilization reduce all these three types of costs [4].	Costs can be classified as operational cost, inventory cost and environmental cost. Supply chain management practices in environmental sustainability like using reusable packaging to deliver materials, using green purchasing guidelines and sourcing from environmentally responsible resources only reduce environmental cost, they have no influence on operational cost and inventory cost [4].

In the view of this information, it can be deducted that lean and sustainability have strong connections in waste management, they target waste elimination and this factor integrates them. Their main purpose and focus are similar. When ISO Standards are considered, both methodologies are parallel. Cost minimization is another common attribution, by reducing cost they both improve efficiency. The benefits of these two are energy savings, productivity increase, and advantages from improved utilization of materials, they can also lead to innovations that involve creation of new products out of waste materials.



CONCLUSION

The research findings shows that a Lean environment supports sustainable supply chains. The integration of Lean and Sustainability practices will bring benefits to companies and introducing Sustainability as the new Lean is no longer a strong and unsupported statement. It is rather obvious that the ultimate Lean will be Sustainable.

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