

LEAN EXPERIENCE ANALYSIS AT A LEADING AUTOMOTIVE MANUFACTURER IN VIETNAM

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Abstract:

Over the last decades, thanks to the increased pressure to reduce cost and to be more responsive to customer demands as well as improving continuously to the value provided to them, the business has been motivated for managing their operation responsibly in regards to the economical, environmental and social aspects as well. In order to fulfill this mission, encouraged companies and researchers have been finding ways to meet customer demands and sustainable requirements. Lean is one of the systematic approaches to achieving higher value for organizations by eliminating non-value-added activities. Through a case study, the research aims is to present the effectiveness of sustainable improvement on economic, social, and environmental improvement from the perspective of Lean practices. The analysis of the day-to-day Lean practices experience in a case study a good experience for enterprises in desiring applies Lean for sustainable development, can be extremely effective at developing management techniques to achieving sustainable improvement.

Key words: *Lean experience, Lean techniques, Lean principles, Lean practice, Sustainable improvement*

INTRODUCTION

In the last decades, the whole world has been facing severe global environmental issues such as climate change, natural resource depletion, and environmental pollution. Those issues are expected to be solved mainly by enterprises considered as main contributors. If they can handle the above ones while operating their business, they actually can achieve sustainable development which has obtained significant attention of the society and most enterprises in various fields. However, it is clear that there is a pressure existing and growing in most enterprises which are striving towards sustainability. Particularly, they have figured out how to operate their business in a circumstance which is reshaped day by day by customers' requirements and global competition and how to achieve that goal without compromising the ability of future generations at the same time. Thus, it is necessary for enterprises to prepare a flexible and appropriate method for their own business culture so that they develop towards higher productivity, quality, efficiency, and competitiveness while ensuring social equity and environmental protection as well. In which, Lean is determined as a method which can help enterprises to achieve the concept of sustainability integrated with process efficiency [1].

Lean is a production philosophy that was derived from an engineer named Taiichi Ohno working at Toyota Motor Company to eliminate inefficiency and defective products and also the wasteful practices in the area of production. This concept was originally developed for Toyota, and then becoming well known as the Toyota Production System (TPS) that set the foundation of today's lean production. The term "Lean" was firstly introduced by Womack and Jones in 1990 in their book "The Machine That Changed the World", which captures the fundamental essence of TPS that reduces non-value-adding waste such as motion, inventory, waiting, transport, overproduction, and defects in comparison with other mass production systems [2]. The result of Lean application is recognized by customer satisfaction in terms of cost, quality, and delivery time. Thanks to that, the competitiveness of enterprises is also improved [3].

In reality, Lean is now being applied widely in various areas to optimize cost, reduce waste and irrationalities in business operation so that the enterprise can achieve lower production costs and improve competitiveness for enterprises [4].

Lean has played an important role in enterprises in terms of improving the processes and increasing customers' satisfaction and organizational performance [5]. Besides,

Lean techniques are believed to contribute to sustainable achievement in its economic dimension by reducing resources and cost within enterprises' operation, social dimension through enhancing working environment conditions for employees, and finally environmental dimension by reducing eliminating wastes and pollution [6]. Many researchers are searching for the application of Lean techniques, and practices which can effectively impact sustainability improvement of enterprises. Lean techniques are capable of improving the sustainability of an enterprise by focusing on reducing waste, resulting in capital gain, and ensuring social and environmental quality [7]. Obviously, wastefulness reduction is a top priority of the Lean principle, which can improve sustainability in preventing enterprises from injuring current and future generation's potentials [8].

In developing countries, the term "sustainable" has been increasingly widespread in recent decades to promote the business community for the implementation of sustainable development. From an academic perspective, sustainability is a concerned topic in some studies, however, there is still limited academic research considering the linkage between management systems practice and sustainable improvement such as Lean. Thus, the purpose of this paper is to analysis the Lean technique that are integrated into the sustainable improvement goals of enterprises through the experience at a leading manufacturer in Vietnam. Additionally, Lean practices result of the previous research will be shown as pieces of evidence to indicate the positive influences of Lean application on the sustainable improvement of enterprises.

LITERATURE REVIEW

Lean production practices

Lean practices have been presenting in the industry for over 40 years as a route for improving business performance [9]. Over this period, Lean principles and practices have been refined. According to Shah and Ward (2007), their main purpose is to achieve zero waste in production, the highest quality, and resource optimization [10].

The term Lean was first introduced in 1990 in the book of "The Machine That Changed the World" published by Womack & Jones. Lean is a comprehensive philosophy for structuring, operating, controlling, managing and continuously improving industrial production systems [11]. The ultimate goal of Lean is the reduction of wastes in human effort, inventory, time to market and manufacturing space in order to become highly responsive to customer demand while producing world-class quality products in the most efficient and economical manner [12]. There are eight types of wastes in Lean systems: Transportation, Inventory, Motion, Waiting, Over-production, Over-processing, Defect, and Knowledge Disconnection [13].

Lean is a combination of principles, tools, and techniques designed to deal with the root problems of ineffective activities in manufacturing [14]. Lean aims to optimize the values of Productivity, Quality, Cost, and Ability to meet customer's requirements (Delivery) while still ensuring the safety conditions of production. As to meet these

goals, Lean tries to get rid of three main sources leading to damages from the production management system: waste, volatility, and inflexibility [15].

One of the other goals of Lean is to use fewer resources to generate the same results. This is obviously environmentally friendly: since using fewer materials in production leads to reduced environmental impact. Besides, quality improvement reduces reusing, reconditioning, or remanufacturing, then waste is reduced and pollution costs are diminished, so the environmental benefits are obvious [16]. Lean practices represent the Lean principles in an implementation form. There are many tools and techniques of Lean that vary from one study to another.

The strength of Lean is to reduce manufacturing costs through eliminate all types of waste and guide a company to become a world-class organization [17]. This approach has made a substantial impact on manufacturing companies resulting in higher performance enhancements and significant improvement in productivity, quality, cost, and delivery [18].

In conclusion, Lean is a combination of multiple tools, techniques, and principles related together to deal with the problems of the manufacturing process. Each technique used always solves one or many problems. Depending on conditions and manufacturing characteristics, the business can choose and apply certain ones. In the next section, the authors will show the impacts of Lean practices on sustainable improvement through its techniques.

Sustainable improvement

Sustainable development is an accelerating trend that is important to all humankind. People are not only enjoying higher living conditions with rapid economic growth but also coping with serious environmental degradation (pollution, global warming, and so on) and social problems (diseases or inequity) [19]. Sustainable improvement in the corporate perspective is defined as the right combination of economic, environmental, and social aspects [20]. Organizations achieve sustainability through economic outcomes and operational outcomes. Economic outcomes are financial benefits via return on investment and cost reduction through the supply chain. Business growth is another measure of economic outcomes. Operational outcomes (productivity) have a direct relationship with sustainability performance, which leads to economic performance [10]. Environmental performance is highly dependent on energy usage, resource optimization, and waste reduction [21]. Social sustainable improvement refers to enhancing the quality of life of all the concerned stakeholders. This is measured through CSR project investments, employee wellbeing initiatives, enhanced green image, and so on. Social sustainability not only ensures that the industry makes profits but also ensures that industrial activities do not cause social degradation [21, 22, 23]. In this research, sustainable improvement is defined as a balance among three aspects: economics, environmental, and social improvement. The measures of sus-

tainable improvement are based on three aspects: economic improvement, environmental improvement, and social improvement.

Economically sustainable improvement: Economic improvement is one of the most important pillars of sustainability performance and equivalent to business performance, which is measured through several indices including productivity, quality, cost, and delivery. Clear determination of criteria expresses that businesses have been successfully the Lean manufacturing method into the production process, which helps the research to have an exact evaluation for the process and performing results of research businesses. Denis Pascal (2007) showed that the results of economic improvement are explained via four main criteria (1) Production Capacity increase (2) Quality improvement (3) Cost reduction (4) Capacity of Delivery

on time. These criteria are considered as the most important outcomes to determine economic improvement result [13, 24].

Environment sustainable improvement: The environmental aspect of sustainable improvement is measured by Minimizing the emission of hazardous substances or waste, the consumption of energy, the consumption of direct or indirect usage of material, the consumption of water [25].

Social sustainable improvement: Social aspect of sustainable improvement which is measured by Improving the overall customer retention and loyalty, its green image, the living conditions for human (safety, health, working environment, noise level, light intensity), working skills and training ratio [25].

In conclusion, the indicators of sustainable improvement are summarized in Table 1 below.

Table 1

Summary of sustainable improvement metrics in production operation

Authors	Economic metrics	Environment metrics	Social metrics
[26]	Production and operational costs	Energy use, resource use, operation footprint, waste reduction, pollution reduction, emissions reduction, hazardous/harmful/toxic materials use, environmental accidents.	Equitable opportunities, diversity encouraging, community connection, quality of life, democratic processes, accountable governance structures
[27]	Not considered	Biodiversity, air and water pollution, energy, recycling	Working conditions: health and safety, training, human rights: child labor, discrimination
[28]	Operation cost, effective cost, stock cost	Power consumption, water consumption, harmful gases release, waste segregation, waste with traceable treatment, green production rate, environmental management system	Absenteeism, turnover, accident rate, noise level, national production, benefits and commissions
[29]	Cost, delivery, flexibility, quality	Pollution, resource consumption, emissions generation, ecosystem degradation	External (community): social reputation, life quality Internal (workforce): employee satisfaction, creation of skills, health
[30]	Cost, service, quality, waste reduction, productivity	Pollution, emissions, materials used, energy use, emissions from transportation, use of recycled materials, recycling	Workforce: safe working environment, good working conditions, fair wages and payment, non-discrimination, union relations Community: charitable donations, community support
[31]	Cost, quality, return on investment (ROI)	Use of resources: coal, oil, water, energy Environmental impact: pollution, toxicity, climate change	Poverty, gender equality, nutrition, child mortality, sanitation, health, education, housing, crime, employment
[22]	Generated economic value, distributed economic value, retained economic value	Resource use, Emission to air, Emission to water, Emission to land	Employment, labor/management relations, health & safety, training, diversity and equal opportunity, remuneration, grievance mechanisms.
[32]	Cost, manufacturing time, material consumption	Energy consumption	Work environment, employee satisfaction
[33]	Operational cost, market value, profit	Environmental business wastage, emission/unit production, material usage/output, energy/fuel usage	Safety and health, labor relationship, training and education, consumer complaints
[7]	Value-added time, value-added cost, raw material consumption, power consumption	Carbon footprint, water eutrophication, air acidification, water consumption	Physical load, work environment risks, noise level

Source: the author summarized from [34].

Table 1 presents a summary of metrics, indexes, and dimensions proposed in the reviewed literature. It is important to note how they account for environment sustainable improvement and social sustainable improvement independently. Besides, there is no widespread methodology found that could integrate all three pillars of sustainable improvement into an overall measure of Lean contribution.

Lean production practices and sustainable improvements

Three pillars of sustainable improvement

Sustainable development divides into three columns: environmental, social, and economic sustainability [35, 36]. Lean contributes toward sustainability from many perspectives [37]. Many researchers have confirmed that the implementation of Lean in manufacturing could positively impact sustainable packages as mentioned [25, 36, 38, 39]. Besides, Lean production affects sustainable improvement as Figure 1.

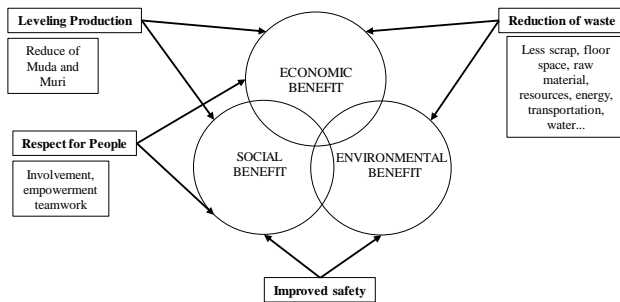


Fig. 1 Lean Production and Sustainable improvement
Source: recreated from [37].

There is a time-consuming discussion in the literature about how lean manufacturing contributes to environmental protection. SMED was applied to reduce the setup times. The setup operations were consistent while the process has been converting faster for manufacturing [40]. These improvements allowed to save energy and materials consumption, which leads to a decrease in the greenhouse gases' emissions – the environmental benefits. Melton emphasized the key techniques in the Lean system like Kanban lead to improve the performance [41]. Some others like Pull system, Andon, Value stream mapping can become efficient to reduce lead-time of production, and cut down on waste of time [42, 43]. All of that contributes to the economic benefits. Waste reduction is the most familiar in the Lean concept, which focused on decreasing all types of redundancy [4] and minimizing the environmental impact of production [44].

The previous literature also discussed the relationship between Lean and financial advantages as an aspect of sustainability. According to Ohno, Lean reduces non-value-adding waste such as motion, inventory, transport, waiting, over-processing, overproduction, and defects [2]. Several studies have shown the positive effect of Lean on waste management [45]. Thanks to that, the company could benefit financially immensely from those activities. Additionally, the contribution in the environment helps the company attract the attention from customers as well

as improve the competitiveness in the market, which all leads to financial returns [46]. In summary, the positive relationship between Lean appliance and financial advantage has been verified in the literature [47, 48].

Social sustainability is another aspect of research that has received less consideration, and in fact, it is the least studied outcome in all operations management literature [49]. With high customer requirements, social responsibility becomes more important in creating company images as well as environmental and financial concerns. And Lean tries to fulfill this mission to raise the competitiveness of the company in the market. However, the relationship between Lean practices and social performance is still not really explicit even in the literature. Metrics are either uncommon or incomparable [50]. Some authors support the idea in which Lean practices positively reduce stress in work [51], improve reliable autonomy [52]. Social sustainable improvement is an issue that research can overcome, as it is directly related to people's wellbeing, and measures already exist (although separately) in the form of worker's safety, long-term health, and even psychological safety [53]. On the other hand, the others underlined that Lean work created more intensive work stress [54].

Impact of Lean practices on manufacturing sustainable improvement

The application of Lean is not only limited to the automotive sector but also has been found in a wide range of manufacturing industries: electronics manufacturing, aircraft industry, furniture industry, ceramic industry, and multi-sector. Table 2 below shows the impact of lean and sustainable manufacturing: contribution, methodology, criteria, and result in three bottom-line performances.

Table 2
Impact of Lean on sustainable manufacturing improvement

No	Reference	Methodology	Results
1	[55]	Simulation and Case study	Reduce waste, lead time; Increase profitability
2	[56]	Three cases	Reduce Lead time and W.I.P
3	[57]	Case study: wood products manufacturing	Reduce material, labor, emission, disposal, water, energy
4	[58]	Survey 186 company in Chinese manufacturing	Positive of environmental and economic performance; Green supply chain management
5	[59]	Case study & Simulation model	Savings in continuous production costs
6	[60]	Ten companies	Reduce environmental impact
7	[61]	Five European companies	Reduce emission and improve environment performance
8	[57]	Case study: wood products manufacturing	Reduce material, labor, emission, disposal, water, energy
9	[62]	75 Brazilian automotive companies	Positive relationship between company
10	[63]	Eight manufacturing companies	Positive relationship

RESEARCH METHODOLOGY

A qualitative method has been conducted for this research to provide insights and understanding about the problems and answer “how” and “why” Lean can success applied and achieved sustainable improvement [64]. The case study method is selected to conduct this research. A leading manufacturer in automotive industry and Lean application in Vietnam are selected to conduct this study. Therefore, the adoption of this research approach was identified as suitable for this study. The case study is the most common research approach that is generally used in Lean research [65]. This is probably because this approach is valuable in terms of providing explanations of linkages among events, and it is suitable when a real-world event is being examined as in the case of Lean implementation at the empirical level.

The technique for data collection has been employed in this research including secondary documents, personal interviews, observation, and participant observation. Information from the personal interviews was conducted through prepared questionnaires. They involved a number of key personnel in the companies that included the general workforce of the concerned companies and involved in Lean projects. The data collected by three main sources including:

- (1) Documents, secondary data were collected and analyzed via results of the reports about the production improvement, quality assurance, cost reduction, and other activities related to Lean implementation of the case company.
- (2) Targeted participants individual interviews via the semi-structured interviews questionnaire are the ones who has experience in years and directly take part in the Lean implementation plan. The interview questionnaire focused on the following question:
 - What is the general process to conduct a Lean project in your company?
 - How long does the time-frame for a general project?
 - What is the priority of Lean techniques do you use to solve the problems of production lines?
 - Are the human factors and communication changes important during Lean project?
 - How the environmental issues are considered in the Lean project?

Participation observing through joining Lean projects in case company to get more data and compared to interview results on Lean project implementation. After receiving the interview and observe results, the authors recorded and took notes on all the related documents including sustainable outcomes. Table 3 summarizes the data sources and information gathered. The use of multiple sources was valuable to address a broader range of historical issues and develop converging lines of inquiry.

Table 3

Data collection sources and information gathered

Sources	Description	Information gathered
Document review	Lean reports; Quality Circle Control (QCC) reports.	Data on Lean/QCC system and team organization; Data on before-after Lean/QCC implemented.
Interviews	Manager of Continuous improvement department; Manager of QC department; Company master trainer.	Lean structure, organization structure; General aspects of the company on sustainable improvement; Mechanism of Lean project was implemented;
Observation	On site survey; Participated one Kaizen event.	How the Lean team solved the problems occurred during the project and achieved the targets on economic, social, environment.

The analysis of the collected data followed the case description analytical strategy. The goal was to understand how Lean were implemented and how they operate, go ahead and achieve sustainable outcomes. The findings are presented in the next section, starting with an individual description of the company Lean practices.

SUSTAINABLE IMPROVEMENT BY LEAN PRACTICES IN CASE STUDY

In this paper, a leading automotive enterprise in Vietnam that implemented Lean in their production processes is chosen to be representatives for the case study (Alpha company). Data collected by three main sources including: Companies data reported; Interview participants; Observing the participation to get notices on-site in one process in the company.

Economic aspect. Alpha is an automotive manufacturer founded in Vietnam from 1995. They have completed fully five main processes including Stamp – Weld – Paint – Assembly – Inspection. Total employees in Alpha in 2018 are nearly 1,800 members with 1,300 operators and delivery members. Alpha is holding the leading position in the Vietnamese automobile market with a capacity of more than 60,000 units per year in 2019 with two working shifts a day. After 26 years, the production system in Alpha company has a huge increase from 16,000 units as designed to more than 60,000 units in 2019 without massive investment and manpower. The outcomes of productivity, quality, and cost are always maintained continuously by the company when applying Lean until now. Average, Alpha conducted about 1,000 Kaizen ideas per month. The company spent about 40,000 USD per year for Kaizen ideas award.

Social aspect: The philosophy “respect for people” in daily activities helps providing all employees within the company opportunities to achieve social contribution and self-realization. The yearly turnover ratio is only less than 1 percent. Through the work, our members always thinking, to be creative, and the relationship of mutual trust and mutual responsibility between member and manager is essential, in which the company gives the highest priority to ensure stable employment and strive to improve labor conditions. To encourage the creative thinking of all members of the company, every Kaizen idea is welcome and considered to apply and Yokoten (Expand). The company believes that these initiatives will not only lead to the management with respect for people, but also to customer satisfaction and social contribution, and thus the sustainable growth of the company and society (*The authors interview the company trainers and managers*).

Environment aspect: Every year, the Alpha company has implemented the “Environment Kaizen months” in the whole plant with many meaningful activities. This is an annual activity that has been implemented by Alpha since 2008, aiming to increase environmental protection awareness of all company members, as well as to further contribute to environmental protection in Vietnam. In

2018, the company has conducted an environment project of waste treatment called “Eco center” (Fig. 2). The purpose of this project is to make a one-way flow of waste and waste separated at the source. In order to minimize cost of collecting, moving and sorting, the project team proposed nine stations to gather all the waste. Project team also divided waste into four main routes with different transport methods include: (1) Mixed, (2) Cardboard, (3) Metal, (4) Water-sludge. The project team has applied Lean techniques including Value Stream Mapping to analyze and eliminate the Non-value-added activities in whole waste treatment process. Lean applying for waste operation improvement in Alpha include three stages: internal waste flow improvement, waste center operation improvement, and truck calling system improvement for new Eco center.

After applied waste flow mapping and combination waste routing, the project team saved 9 operators in total manpower for waste handling operation (save 23% manpower) and reduce 12 waste collecting routes from 28 routes to 16 routes (Fig. 3). In addition, all of wastes are separated and full managed between hazardous and non-hazardous waste by scheduling system visualized in control board located in each waste station.

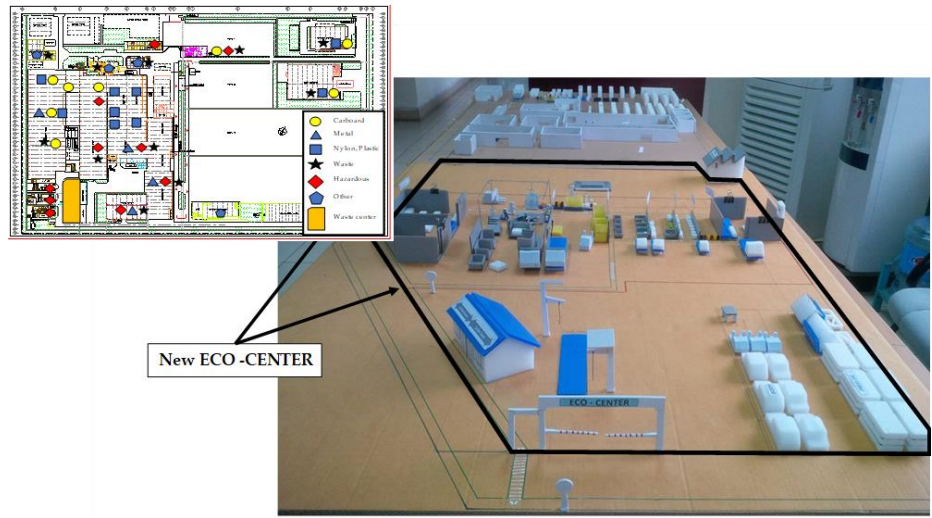


Fig. 2 Waste source mapping, visualize, and model of the Eco center

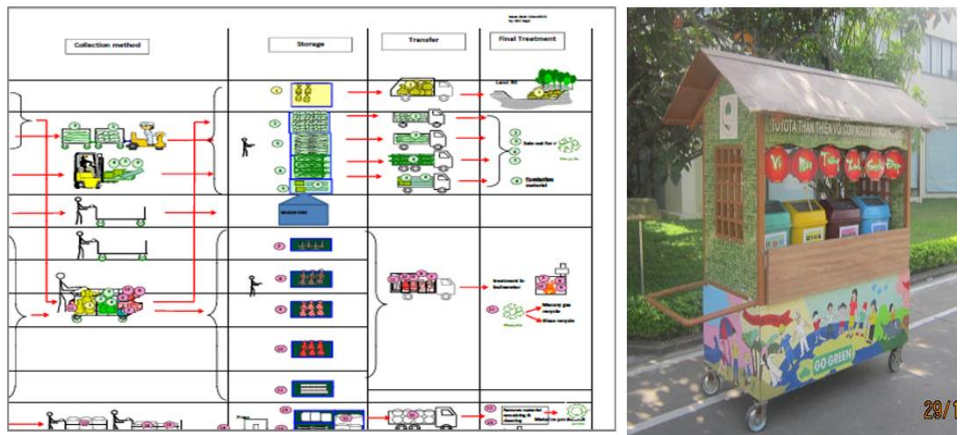


Fig. 3 Waste operation and training stand for team members

Finally, the company member is involved in various activities to improve safety such as training to behave safely in the workplace, improving the safety of machinery and establishing an occupational safety management system for employees. These activities have led to an occupational accident rate. Alpha continues to promote its occupational safety management system in conjunction with carrying out risk assessments. Six main categories of safety improvement are managed within the company including Car contact, Fire, heavy objects, Pinch, and electricity. Figure 4 shows the mapping of safety management in Alpha.



Fig. 4 Safety mapping management

CONCLUSION

This paper introduced the analysis of Lean techniques and practices to achieved sustainable improvement. This contributes to the Lean practice and sustainability literature by being the first systematic analysis linking Lean practices to sustainable improvement, which accounts for economic, environmental, and social improvement outcomes. Because of the information provided by the reviewed literature on Lean practices, it may be concluded that some major characterizes between Lean and sustainable improvement research.

Lean is not just about optimizing the flow of material or economic benefits, but also the environment and social improvement. Lean research still falls short of properly identifying, proving, and importantly addressing issues regarding its impact on long-term sustainability. Meanwhile, pressure from stakeholders for the development of effective, applicable, and scalable manufacturing strategies and practices increases day by day, which positively reinforces all three pillars of sustainable improvement. Implementing Lean techniques as a framework for analyzing the non-value-added activities, and identifying sustainable improvement chances, and environment saving. Applying Lean approach to a case study highlighted the importance of Lean practice including visualization, mapping, and waste elimination in any production or non-production activities. This more in-depth work would enable Vietnamese enterprises also to precise the impact of Lean practice on the company performance: economic, environmental, and social.

This study shows the Lean techniques and sustainable improvement achievement through an analysis Lean implementation at a leading automotive manufacturer in Vietnam. From the results of this study, managers and stakeholders in Vietnam and other developing countries

are provided insights into the contribution of excellent Lean techniques to obtaining sustainable goals. The experience of sustainable improvement through applying Lean techniques could be expanded to other sectors in Vietnam and developing countries.

Although the study has some contributions to the Lean practices and sustainable development, there is lack of measurement of three dimensions of sustainable including economics, social, and environment metric. Besides, the approach for this paper was conducted from a case study is limited to generalized to small and medium-sized enterprises. Next research should evaluate the sustainable dimensions by analyzing more detail in multi-case.

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