

LEAN SIX SIGMA SUSTAINABILITY FACTORS:

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## **Abstract**

Lean Six Sigma has proven itself as an effective strategy for business success in both private and public sectors. The methodology has helped enterprise leaders recognize business processes as engines that drive performance excellence and help to deliver value. Lean Six Sigma offers a comprehensible road map, tools, and techniques for achieving superior performance. Many of the past Lean Six Sigma (LSS) researches focused on the study of success factors for LSS implementation. There is lack of research that explores the sustainability factors or factors for the continuation of LSS's drive after the LSS implementation stage. Hence, this research intends to establish the fundamental concept of LSS sustainability based on the principles of sustainability. In addition, the research also aims to develop a LSS sustainability framework based on literature review and case study on a company that had implemented LSS for 15 years. The proposed LSS sustainability framework consist of 5 important sustainability factors, which are Continuous Improvement Culture, Innovative Culture, Management Team's Approach, Employee Knowledge on LSS and Communication. The uniqueness of the framework is the framework not only summarized the key finding from literature review with regard to the sustainability and factors for sustainability of LSS, but the framework also reflects the actual setting of a company that has sustained LSS drive for the last 15 years.

A quantitative methodology was utilized for conducting this research. The survey questionnaires of 39 structured questions were developed and sent to 88 respondents through the emails. A total of 50 respondents responded answering all the 39 structure questions. Findings from the survey reveal the Employee LSS Knowledge and Continuous Improvement Culture has moderate relationship with organizational performance perceived by employee of company D. However the other 3 factors, innovation culture, communication and management team approach show weak relationship with organizational performance. This research suggested that company D need to increase education and training programs and pursue continuous improvement in order to continue to sustain performance. These results can help prevent or improve upon the weak relationship with organizational performance that many companies have experienced with these approaches and offer some explanations on potentially why these issues occurred. This research has also successfully developed a LSS sustainability model to predict the organization performance of company D.

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**List of Abbreviations**

LSS	-	Lean Six Sigma
MT	-	Management Team Approach
CI	-	Continuous Improvement Culture
CN	-	Communication
ELK	-	Employee LSS Knowledge
IC	-	Innovation Culture
OPC	-	Customer
PC	-	Cost
OPD	-	Delivery
OPS	-	Safety
AVEMT	-	AVERAGE OF MANAGEMENT TEAM APPROACH
AVEOPC	-	AVERAGE OF CUSTOMER

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background**

The business environment in the automotive industries is very competitive. The industries have to continuously strive to explore new improvement approaches in order to enhance and sustain competitive advantage. Many companies have recently begun to examine their corporate structure, approach, policy and compare versus the principles entrenched within the concept of sustainability.

According to the World Commission on Environment and Development (1987), sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This statement made sustainability a unified concept and idea that organizations should commit to adopt across all business units.

The concept of sustainability is broken down into three major focus areas: economic, social, and environmental. These three major focus areas are often referred as the Triple Bottom Line for sustainability Wang & Lin (2007). The



Triple Bottom Line is also denoted as “profit, people and planet” by Jackson, Boswell and Davis (2011).

The main idea behind corporate sustainability is that organizations today not only focus on their financial gains or economic sustainability, but should also expand the scope of sustainability and organizational responsibility to assess the businesses impact toward the environment and stakeholders.

## **1.2 Lean Six Sigma (LSS)**

Lean Six Sigma(LSS) is a business strategy which adopts the lean and six sigma concept and tools. The adoption of lean concept and tools was to reduce leadtime and create value in term of flow and hence increase proficiencies in all processes. The adoptions of six sigma concept and tools was to minimize the variation and create value in term of improved quality, cost and delivery of the final product and service to the customer.

The adoption of these two principles results in establishing a competitive advantage that will enable sales and profitability to grow. It builds a culture where involvement and mutual respect encourage continuous improvement.

The activities that cause the customer’s critical-to-quality issues and create the longest time delays in any process offer the greatest opportunity for improvement in cost, quality, capital and lead time.

The focus of Lean Six Sigma and the application of their tools are more encompassing.

- 1) Reduction of Wastes in the process and focusing on stabilizing and standardizing the Operations;
- 2) Applying the Six Sigma methodology and tools to reduce the defects and minimize the variations;
- 3) Both 1) and 2) is to ensure that the process is capable before focusing on the “flow” of the overall process to meet the customer’s requirement in term of just in time, pull system, and continuous flow.

The figure below summarize it all about the Integration of Lean and Six Sigma to speed up value creation:

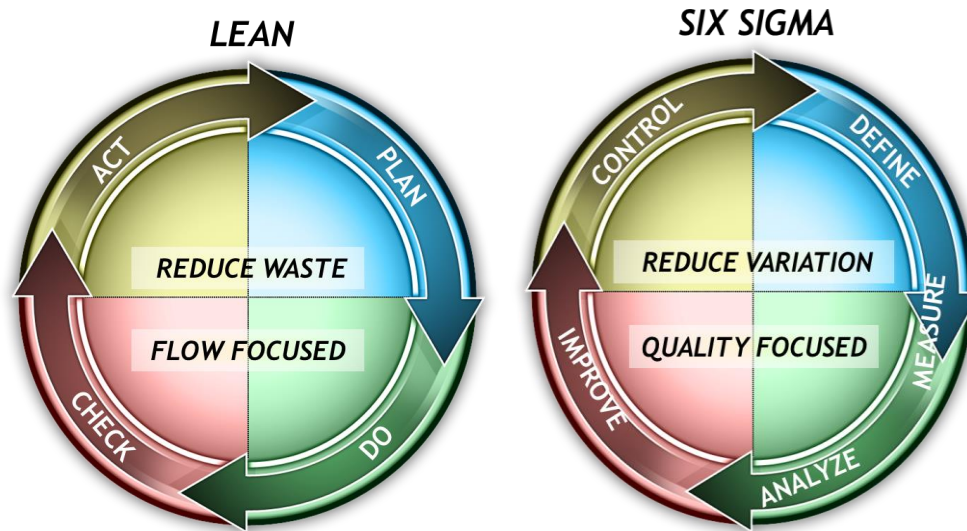


Figure 1.1 Lean and Six Sigma Principle

Note: PDCA cycle is known as the Deming Cycle.

However, several scholars (Harrison, 2006 ; Smith, 2003 and Bendell, 2006) have highlighted that if the two methodologies are implemented in isolation, the outcome can result in neither being done effectively; constrained by one another's needs in the organization. This could even create two subcultures with the organization, competing for the same resources Smith (2003). Hence, there is a need to balance the two approaches. The balance lies in creating sufficient value from the customer's viewpoint, so that market share is maintained, while at the same time reducing variation to acceptable levels so as to lower costs incurred, without over-engineering the processes.

Smith (2003) has shown successful lean six sigma efforts with impressive results in improvement when a combined approach was taken. However, in the

successful lean six sigma, Smith (2003) found that one of the two approaches become dominant in the improvement process. A fully integrated framework targeting specific industries will take away any such ambiguity over which techniques to apply where and in what situations.

### 1.3 Sustainability

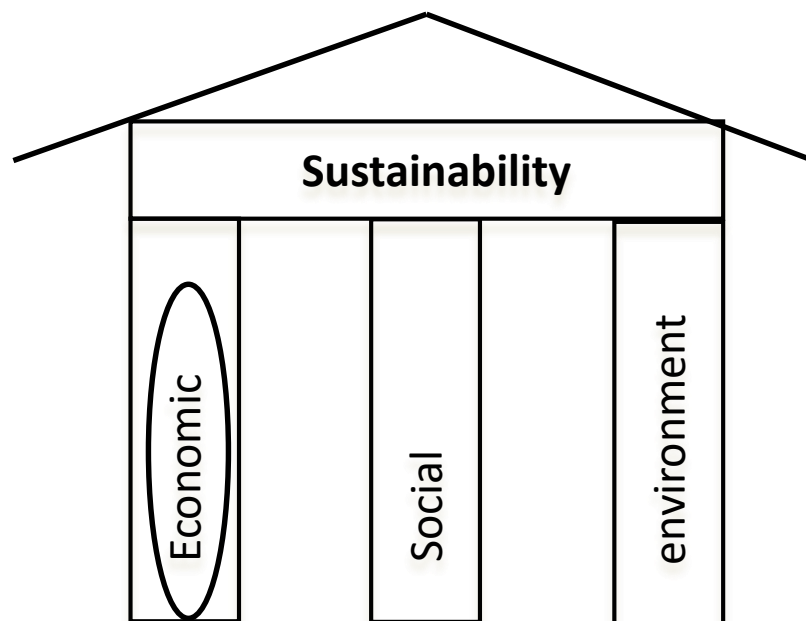


Fig 1.2 Three pillar of sustainability

The Triple Bottom Line for sustainability is also denoted as “profit, people and planet” by Jackson, Boswell and Davis (2011). Profit is associated

with economic aspect, people is associated with the social aspect and planet is associated with the environment aspect.

The World Commission on Environment and Development (1987) defined “Sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. The needs of the future depends on how well we balance economic, social and environment objectives. In the long term, the responsible use of natural resources now will help ensure that there are resources available for sustained industrial growth far into the future. It simply means the prudent use of all type resources, efficient use of labor and material. Sustainability through the application of lean six sigma principles will ensure efficient use of labor and material. Sustainability is a unified concept and idea that organizations should committed to adopt across all business units.

### **1.3.1 Corporate sustainability**

Organizations today should not only focus on the business financial gains or economic sustainability, but should also expand the scope of sustainability and organizational responsibility to assess the businesses impact toward the environment and stakeholders.

An organization is considered as sustainable if the organization is inclined to initiate changes that created value to economic growth, social progress and environmental protection continuously and embrace the changes ultimately as part of organizational policy (Shrivastava and Director, 1995). A sustainable business depends on economics, especially the economics of sustainability (Guest, 2010), and Islam and Clarke (2005) demonstrate that sustainability is often associated with economics and aims at economic growth.

However, the primary effort on sustainability development shall focuses on the development of sustainable economic growth. This is because sustainable economic growth or financial gains is the fundamental requirement for an organization prior to initiate both social and environmental. The primary reason for a corporation existence is profitability (Murphy, 1994). Today's corporation need to focus this financial gains first in order to initiate the social and environmental aspect of the sustainability. According to Carroll's dimensions (1981), the existence of a company is to be profitable, but not at any cost. At the same time, society also demands that the company adhere to the regulatory law, and be a good corporate citizen.

Both social and environment initiatives need funding for implementation. This financial gain can be achieved by adopting the sustainability principles into the organization business activities through the Lean Six Sigma principle. Hence, this research shall only focus on the economic aspect of the sustainability pillars.

## 1.4 LSS Sustainability

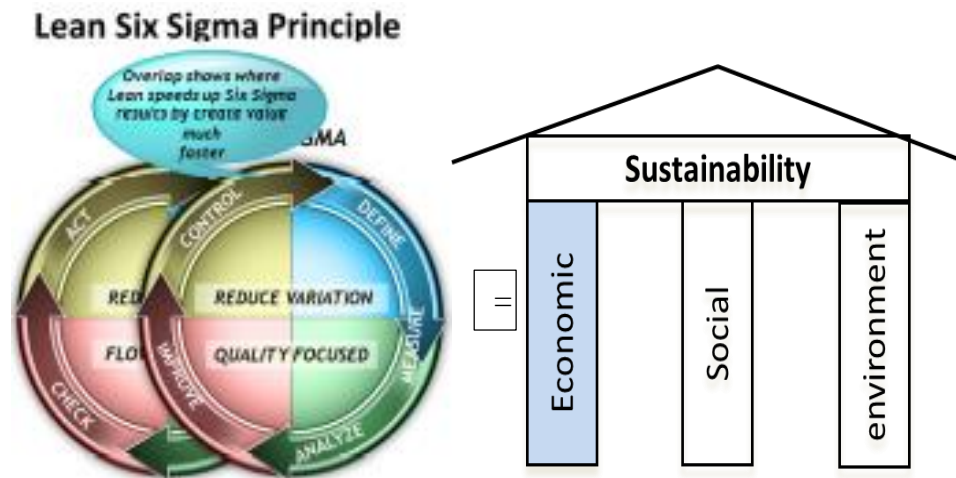


Fig 1.3 Lean Six Sigma Principle

From organizational economic perspective, sustainability refers to continuous value creation and addition, which is in line with the principle of Lean Six Sigma (Taghizadegan, 2006). The dimension of economical sustainability from Lean Six Sigma point of view includes variation elimination; add value; reduced complexity, improve accuracy and effectiveness across the entire business process (Reiling, 2008).

Many organization are embracing the LSS methodology as a way to achieve long-term improvement by delivering value needed to win and retain customer (Brewton, James , 2011). It is this value creation on continuous cost reduction and improved quality that sustain customer loyalty and hence continue financial performance are assured.

## 1.5 Problem Statement

Company D is an automotive multinational company (MNC) and operating in Singapore as a manufacturing plant for 35 years. It ships a wide-range of automotive products to all major vehicle customers at 166 locations around the world. The automotive products portfolio produced by this plant are powertrain(gas and diesel), active safety, passive sensors, crash sensors, semiconductors, and in-car entertainment system. It is a highly automated plant.

The main challenge for the company at this moment is to deal with the intense cost pressure in the fierce competitive globalized market as well as internal competition with the two sister companies located at Mexico and China. As such, to maintain the company competitive advantage, the main focus for the management team is to sustain the Lean Six Sigma drives of continuous business improvements, with the ultimate aim to enhance and sustain the company business performance. For the last 15 years, Lean, Six Sigma followed by Lean Six Sigma has been successfully implemented in the company as the main business improvement tools.

There were telltale sign that the company's 15 years continuation of the organizational performance maybe at risk of deteriorating. The cost pressure has resulted in employee loaded with more work over last few years. The bulk of the cost is from headcounts. To keep a tight rein on the high cost of labor, more work are loaded to this group of salaried employee. Would it impact the performance? Does the sustainability factors for the continuation of organizational performance still relevant or need changes?



This study aims to address two research gaps, namely theoretical and practical gap. The theoretical aspect of the gaps were the LSS sustainability factors for continuation of the organizational performance while the practical aspect is the lack of research on the sustainability factors for the continuation of the organizational performance.

The theoretical gap is that majority of the prior Lean Six Sigma (LSS) researches focused on the study of success factors for LSS implementation (Okpala, 2013 ; Alessandro and Antony, 2012; Zhang et.al.,2012) . There is lack of research that explores the sustainability factors or factors for the continuation of LSS's drive post the LSS implementation stage. As such, the study aim to research into LSS sustainability factors continuation on the organization performance past the implementation stage.

From the practical gap perspectives, both Lean and/or Six Sigma approaches has been in existence for many years and prove to be ever popular in industries. Many companies implementing Lean and/or Six Sigma have varying degree of success. However, the success associated with these tools and techniques remain low. Of the companies which have used proven approaches, 77% of Lean and 76% of Six Sigma implementation fail (Mehta, 2004) to achieve the benefits associated with these approaches. Marsh (2002) and Hubert Rampersad (2014) show many companies fail to sustain the deployment of LSS of over past 10 years.

Company D LSS was able to sustain for 15 years. What were the sustainability factors contributing to its organization performance? Does the employee know which sustainability factors contribute to its success? Here, the 2<sup>nd</sup> gap aim is to examine the relationship between LSS sustainability factors and the organizational performance.

### **1.6 Aim of the study**

The study also aims to develop a LSS sustainability framework based on literature review and bases on the setting of a company that had implemented LSS successfully for 15 years.

### **1.7 Research Objective**

The objective was to investigate the influence of the 5 independent variables on the organizational performance. The other objective is to examine the relationship between LSS sustainability factors and the organizational performance. Finally, the objective is to develop a model to predict the organizational performance.

### **1.7.1 Research Question (RQ)**

A research question is the fundamental core of a research project, study, or review of literature. It focuses the study, determines the methodology, and guides all stages of inquiry, analysis, and reporting.

The following RQ were developed to guide the inquiry on whether the continuation of the organizational performance is still on track.

RQ1: What are the important LSS sustainability factors contributing to its organizational performance as perceived by employee within company D?

RQ2: What is the organizational performance level perceived by employee of company D?

RQ3: What is the correlation between the sustainability factors and organizational performance?

RQ4: Are there any difference on organizational performance among the different business units?

RQ5: How organizational performance can be best predicted for company D?

## **1.8 Research Scope**

The research scope will focus on the sustainability economic pillar of the LSS within the manufacturing engineering and operations of company D. The social and environmental pillar of LSS are not the focus of this research.

The group of exempt which are instrumental to sustaining the economic growth of company D are the salaried exempt staff. There are a total of 88 salaried exempt staff supporting the operation of the whole company. This group of employee comprises of Test Operation engineers, Test Development engineers, Production Operation engineers, Production Development Engineers, Industrial Engineers, Quality Engineers, Supplier Quality Engineers, and Program Readiness Leaders. They have direct impact on the factors influencing the sustainability of LSS drives on performance. This research will focus on this group.

This research excludes the design department because this department focus on new product development and design whose new product design may be manufactured in other countries in the global map. It has no direct impact on operational or organizational performance aspect of the LSS sustainability drives.

## **1.9 Significance of Research**

It will reveal to the employee and management of company D the LSS sustainability factors which has led the company to continue performing. It will also serve to reinforce and rejuvenate the LSS sustainability factors so that the continued performance will be sustained.

This research can serve as a reference for other LSS companies.

## **1.10 Operational definition**

Sustainability is defined as the ability of the organization to continue to drive the LSS journey for a long time.

LSS company is a Lean Six Sigma practicing company.

LSS tools are Lean and Six Sigma tools such as DMAIC, Xbar R charts, Cpk, ANOVA, and multiple regression. Lean tools are one piece concept, balancing of line, gemba, quick change over concept and cycle time reduction.

Company D is an automotive MNC operating for 35 year in Singapore as a manufacturing plant which has implemented six sigma and lean principles.

Management Team comprises of MD and his directors. They are the top management or senior leadership of the company. Management Team lead the

manufacturing plant. Management Team Leadership approach to issue facing the plant is to support middle management on all decision proposed or concluded. Management Team role is to provide and invest financial and engineering resources to long term growth plan.

MBB refer to Master Black Belt certification in the Six Sigma program. This is the highest level certification in problem solving using six sigma methodology. This level are usually teacher of six sigma program who are qualify to teach BB. BB refer to Black Belt certification in the Six Sigma program. This certification level is for an employee who can apply deep problem solving methodology using the six sigma methods. BB can teach, coach and guide a GB.

GB refer to Green Belt certification in the Six Sigma program. This is the entry level in the problem solving methodology for an employee.

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