

Deployment of Lean Six Sigma in Practice, Challenges and Critical Success Factors

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Article history

Received:
18 Oct 2019

Received in revised
form:
15 Nov 2019

Accepted:
4 Dec 2019

Published online:
25 Dec 2019

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Abstract

This paper presents an inclusive review on the application of Lean Six Sigma as a methodology to execute strategic business process transformation in an organization. The company under study has enjoyed steady growth for almost twenty years in the business. However, in the last three years, it becomes apparent that the organization needs to review its internal business processes in order to operate at its optimum level and remains competitive. In this study, the authors attempt to evaluate the effectiveness of the implementation of Lean Six Sigma to meet the said objective. The research also explores in depth the characteristics of Lean Six Sigma methodology and the factors those may influence its implementation. There are suggestions that the Lean Six Sigma concept can be implemented to any kind of industry. However, there are also studies suggested that there are still many non-manufacturing organizations those perceive that Six Sigma will not work the best for them. In this review, the authors examine a number of Lean Six Sigma projects executed. During the deployment of Lean Six Sigma in the said organization, some projects were found successful while a number of other projects cannot progress as expected. Factors those contributed to the success as well as failure of these projects were reviewed and discussed. The problems faced during the journey were examined to identify the limitations of the Lean Six Sigma methodology and how these can be addressed.

Keywords: *Business Process Improvement; Critical to Quality; Critical Success Factors; Lean; Lean Six Sigma; Six Sigma; Structured Methodology; Transformation; Strategy;*

1. Introduction

Lean Six Sigma is a business improvement methodology that aims to maximize shareholder value by improving quality, speed, customer satisfaction, and costs: it achieves this by merging tools and principles from both Lean and Six Sigma. During the deployment of Lean Six Sigma in the said organization, some projects were found successful while a number of other projects cannot progress to achieve the desired result. A number of empirical studies have been undertaken in different countries and industry sectors to address these gaps in our knowledge on the adoption of Six Sigma [1]. The Lean process strategy is attributed to Taiichi Ohno, from Toyota. In the Toyota Production System, specific types of manufacturing “waste” which absorb personnel, resources, or time but do not add value to the overall process or to the end user of the services or products are eliminated. Lean focuses on reducing wasteful or non value-added steps in a process, and Six Sigma

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reduces process variation through the application of statistical methods. In many quality improvement projects, these different tools are complementary, which has led to merging them into a single strategy, the Lean Six Sigma methodology [2].

2. Literature Review

The leadership issue is crucial for the success or failure of Six Sigma implementation. The top management should create an environment where they support and endorse Six Sigma as the management philosophy [3]. The top management should actively get involved in Six Sigma implementation through project champions who sponsor and guide the projects till completion [4]. Lean Six Sigma is an approach that learns from past failures, one of them is insufficient support of management. In organizations where Lean Six Sigma has an emphasis on improvement, this starts with top management [5]. Organisations' CEOs and managers should pay attention to the critical success factors and should be aware of the most common failure factors that lead other organisations in the same industry to fail in their LSS projects. It is clear from the results in this paper that a lack of resources is a massive challenge for organisations, regardless of the evolution of the country or the size of the organisation. Thomas [6] observed that convincing top management was the most difficult task. Although initially the management were enthusiastic towards implementing the LSS, when it came down to the full implementation and, the issue of changing the main equipment of a critical process, it became increasingly difficult to motivate management towards maintaining focus on the LSS.

Apart from the leadership and commitment from management, the third aspect is the change management or change of organizational culture that either resulted or part and parcel of any deployment of Lean Six Sigma program. Since, Lean Six Sigma resulted in change of process, change of work methods as well as other form of changes, these need to be managed in a tactful manner. As described by Dhiraj et. al. [7], the more important issue is the change in organizational culture that puts quality into planning. Organizations without a complete understanding of real obstacles of six sigma projects or a comprehensive change management plan are likely to fail [8]. It can be deduced that one of the biggest challenge in deploying Lean Six Sigma in the subsequent Change Management or cultural change that it has resulted.

Despite the immense popularity and the wide-spread adoption of Six Sigma, there is an increasing concern across industries regarding the failure of Six Sigma programs. One reason many Six Sigma programs fail is because an implementation model detailing the sequence of Six Sigma elements/activities is not available [4]. A study by Vouzas et. al. [9] showed that integration of Lean Six Sigma with the performance management system can facilitate the implementation process of the former. This integration motivates managers and employees to increase the level of commitment and involvement.

3. Challenges in implementing Lean Six Sigma

As in many change management programs, the Six Sigma initiatives do encounter resistance and barriers in implementation. To highlight a vital one, Lean Six Sigma changes how people work but not necessarily the way they think [10]. Encountering employees' resistance when introducing a new business strategy is a

common phenomenon. This negative attitude was overcome with the support of top management, who designed and ran an “awareness campaign” to let the employees know the fundamentals of LSS and the benefits that it had brought to other organizations in various industrial sectors [11]. Based on the survey addressed by Pulakanam et. al.[12] , it shows that lack of senior management leadership is one of the top barriers to successful implementation of Six Sigma. Shirey [13] highlighted that another barrier to improvement was the lack of administrative rights necessary to make changes to the CMMS software that the FM team discussed as potential solutions to improve their ability to address FSRs and communicate with customers in a timelier manner. Some studies have investigated the reasons for not implementing Six Sigma, among which is lack of awareness, no perceived benefits and insufficient resources stand out. Other studies have focused on factors that may lead to its failure, finding that the lack of resources (financial, human and time), lack of leadership, lack of training and internal resistance are among the most important [14].

For the purpose of this study, the author has selected journals or write-up those specifically described their experience in deploying Lean, Six Sigma or Lean Six Sigma. Based on these 15 literatures, the author has ranked the most highlighted obstacles and challenges occurred in their respective Lean Six Sigma journey. This is as described in Graph 1.

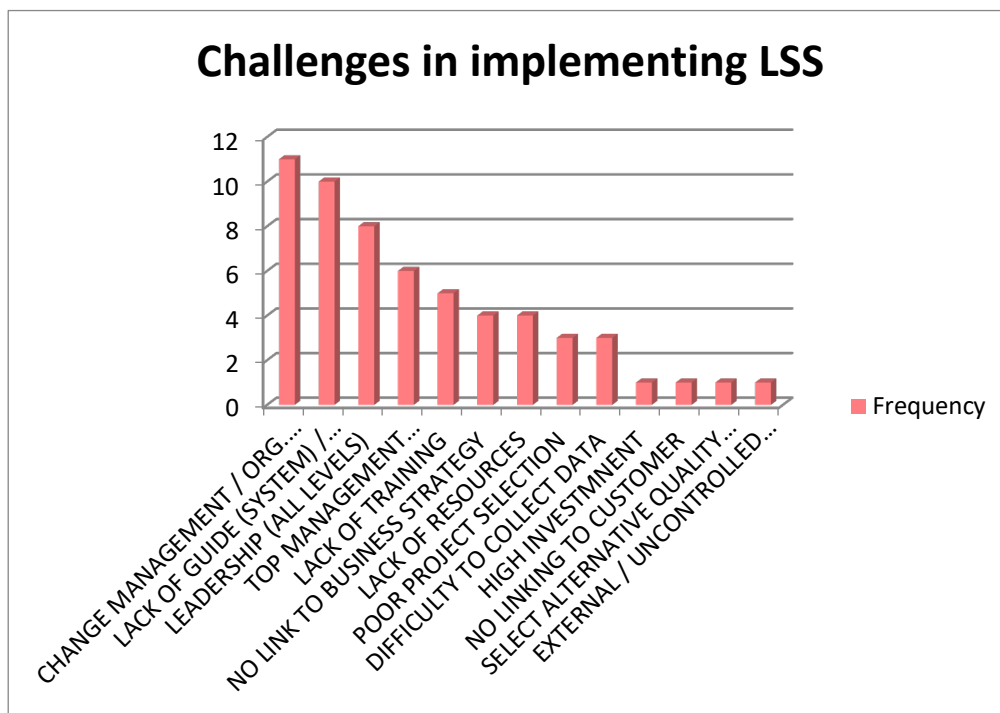


Figure 1. Challenges in implementing Lean Six Sigma

Based on the literature review conducted, the Top 10 challenges faced in sequence are as listed below:

- i. Change management / organization culture
- ii. Lack of guide, first time experience
- iii. Leadership at all levels
- iv. Top management commitment
- v. Lack of training
- vi. Not linking to business strategy
- vii. Lack of resources
- viii. Poor project selection
- ix. Difficulty to collect data
- x. High investment cost

However, the author is of the opinion that these obstacles were real and faced during the course of deploying Lean Six Sigma program. In addition to the factors described above, relatively unique to other organizations, for the organization under study, there were substantial external or uncontrolled factors, such as bound by contract or agreement with an external parties. This has hindered a number of projects from achieving the targeted result and there were projects cannot be continued due to the factors those beyond the boundary of the organization.

4. Critical Success Factors (CSFs)

A successful implementation requires readiness for change as well as cultural change, such as think and work differently, make decisions based on data and understanding the need for change as a progress condition [15]. The start of Lean Six Sigma in an organization involves a variety of activities. The successful implementation of Six Sigma quality management in an organization leads to process variations, quality and productivity improvement.

The identification of Leadership styles as one of the more important CSFs for the implementation of Lean Six Sigma, and its relatively smaller coverage in the Lean Six Sigma literature, leaves the field open to further research on which leadership styles are more conducive to a successful implementation [16]. Most point to management commitment, education and training, cultural change, and the link to business strategy being the most critical success factors in Six Sigma implementation [14]. Successful initiatives like Six Sigma requires top management involvement and provision of appropriate resources and training [17]. The top management must develop their leadership, actively initiate business strategies actively and organize a Six-Sigma steering committee. Alternative strategies must be generated and proposed by diagnosing and assessing the core business processes, and then developing the Six Sigma strategic goals and implementing the related action plans [10].

From the study by Balasubramaniam et. al. [18], the following five factors were reported in at least 60% of the literature. 1) No change in CEO during the Six Sigma initiative, 2) Identifying the right areas for implementing Six Sigma, 3) Appointing a separate infrastructure/body to support Quality programs in the company, 4) Encouraging team work, and most importantly, 5) Continued commitment to a achieve a successful Six Sigma initiative. From the five factors critical to the Six Sigma implementation, failure to follow two factors led to unsuccessful Six Sigma initiative in the low performing companies. The failure factors were: 1) Change in CEO during the Six Sigma initiative, and 2) Identifying wrong areas of application

for Six Sigma implementation. According to Vouzas et al. [9], prior deployment of quality management practices seems to facilitate Lean Six Sigma implementation. The integration is necessary in order to minimize subjective performance evaluation of individuals that leads to wrong results.

Based on the experience of executing the LSS program at the organization, the author would like to emphasize that correct or careful selection of the Lean Six Sigma Project is extremely important. As such, at this juncture one contribution that can be made is to establish a guide for correct selection of Lean Six Sigma Project. Based on the experience gained from the deployment of Lean Six Sigma at the organization under study, apart from Lean Six Sigma D – M – A – I – C structure, there is a step required before “DMAIC”, which is the background study to assess the readiness of the organization to embark on the Lean Six Sigma journey and this shall be followed by a guide for proper selection of Lean Six Sigma projects.

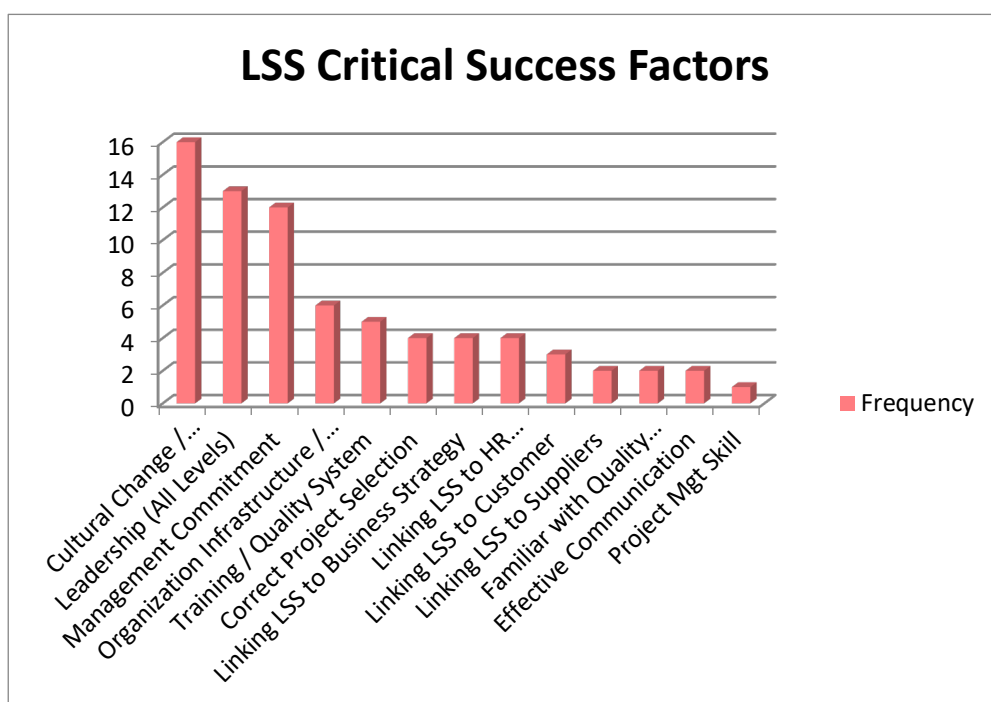


Figure 2. Lean Six Sigma Critical Success Factors

Based on the above analysis, the Top 10 Critical Success Factor for successful implementation of Lean Six Sigma can be ranked as follows:

- i. Cultural change or proper management of change
- ii. Leadership at all levels
- iii. Management commitment
- iv. Organization infrastructure (e.g. IT System)
- v. Training / Existing Quality System
- vi. Correct project selection
- vii. Linking LSS to business strategy
- viii. Linking LSS to HR

- ix. Linking LSS to customer
- x. Linking LSS to suppliers

5. Results

The results are based on 6 Pilot Lean Six Sigma Projects conducted in the organization under study, their outcomes and observations are as described below.

Table 1. Lean Six Sigma Projects Challenges and Success Factors

PROJECT	PROJECT TITLE	CHALLENGES	SUCCESS FACTORS	REMARKS
A	Electricity Distribution Strategic Business Improvement	<ol style="list-style-type: none"> 1. Electricity Bulk Supply Agreement 2. Customer Supply Charter 	<ol style="list-style-type: none"> 1. Management commitment 2. Leadership at all levels 3. Availability of data 4. Adequate training 	Project discontinued due to the main factors were beyond control of the company.
B	Procurement Process Optimization	<ol style="list-style-type: none"> 1. Change management (Procurement process procedure) 2. Time conflict with other on-going initiatives 3. First time experience in LSS 4. Difficulty to obtain detailed information/data 	<ol style="list-style-type: none"> 1. Management commitment 2. Leadership all levels 3. Adequate training 4. Data largely available in system (SAP). 5. Adequate training 	Challenge to deploy the changes. Only completed in 2019.
C	Inventory Management Optimization	<ol style="list-style-type: none"> 1. Require amendment of inter subsidiaries Agreement (OMA) 2. Plant's operation – Obligation to PPA 3. Difficulty to get commitment (Require management support) 	<ol style="list-style-type: none"> 1. Management commitment 2. Leadership at all levels 3. Adequate training 4. Data largely available in system (SAP). 	Result not fully achieved due to obligation to PPA (External factor)
D	Reduction of Plant's Outage Duration	<ol style="list-style-type: none"> 1. Plant's operation – Obligation to PPA 	<ol style="list-style-type: none"> 1. Management commitment 2. Leadership at all levels 3. Adequate training 	Result not fully achieved due to obligation to PPA (External factor). Project still on-going
PROJECT	PROJECT TITLE	CHALLENGES	SUCCESS FACTORS	REMARKS
E	Human Resource Cost Optimization	<ol style="list-style-type: none"> 1. Management of Change (Staff Resistance) 2. Availability of Data (Not all data available in the System) 	<ol style="list-style-type: none"> 1. Management commitment 2. Leadership at all levels 3. Adequate training 4. No external factors 	Achieved cost saving of RM20.5million from annual budget of RM45million.
F	Information Technology (IT) System Optimization	<ol style="list-style-type: none"> 1. Time constraint, existing work commitment of team members 2. Data not available in System 3. Change Management 	<ol style="list-style-type: none"> 1. Management commitment 2. Leadership at all levels 	The finding from the project was the gap that staff do not utilize the fullest capability of the IT System.

There are other challenges faced by the Project Team Members such as lack of time, occupied with other task, difficult to get commitment from colleagues from other departments etc., however, these factors are overcome by Management Commitment whereby the Project Team Members were partially relieved from their other task and were allowed to focus on Lean Six Sigma projects. This is also a proof that Top Management Commitment is a very important factor to ensure successful implementation of Lean Six Sigma Program in any organization.

The summary of top challenges faced by the Project Team is as described below:

Table 2. Summary of Lean Six Sigma Projects Challenges

PROJECT	External Factors	Change Management	Data Availability	First Time Experience in LSS	Time Constraint by Team Members
A	X				
B		X	X	X	X
C	X				X
D	X				
E		X	X		
F		X	X		X
SUM	3	3	3	1	3

Source: Author's own compilation

Based on the 6 Pilot Projects conducted, the most common challenges recorded by the Project Team Members are:

1. External Factors – The recommended Action Items were beyond organization's boundary
2. Change Management – Need to change the work culture or style of working, including change of Work Procedures
3. Data Availability – Not all data readily available & retrievable from system (SAP)
4. Time Constraints – By Team Members as well as other staff to support

Even though the Lean Six Sigma deployment is the first time for the organization, only 1 team reported that this is the problem. This is because the training conducted as well as the support and guidance from the external consultant is considered sufficient to close the gap.

6. Observation and discussion

From the literature review and the author's experience, it is observed that the top most challenge is the Change Management aspect or how to properly manage the changes those bound to occur as the outcome from the deployment of Lean Six Sigma program. The Change Management aspect is a very broad subject and it is in multiple dimensions, namely Vertical Change, Horizontal Change as well as Change of Mindset spanning across the entire organization.

Vertical Change is the changes those occur or affecting the organization from the top management right down to the staff at the shop floor, along the hierarchy of the organization. This involves how communications and work processes are being channeled from the top down as well as how communications and work processes are channeled upwards as well. The author observes that one example of Lean Six Sigma advantages is that it provides a systematic platform for workers at lower level to channel their present obstacles to perform a particular work efficiently to the top management.

Another aspect of change that bound to take place is the change of authorization level. This is also related to the Quality Management System implemented in the organization. In a number of instances after Lean Six Sigma analysis, it was found that certain authorizations are not necessarily performed by the "manager" for instance. For example in the application for electricity supply to a premise, it was found that because the original Application Form requires a manager to approve it before the connection is made, this creates "bottleneck" to the process. In the revised procedure, it is sufficient that only an Executive (at the front desk) can authorize the applications provided all necessary documentations are in order. This removes the bottleneck. However, this create new phenomena whereby the Manager felt that he / she loses the authority and the Executive on the other hand feel uncomfortable because of the new "responsibility" that he / she has to handle.

The combination of Vertical Change, Horizontal Change as well as the Change of Mindset is depicted in Figure 3 as follows.

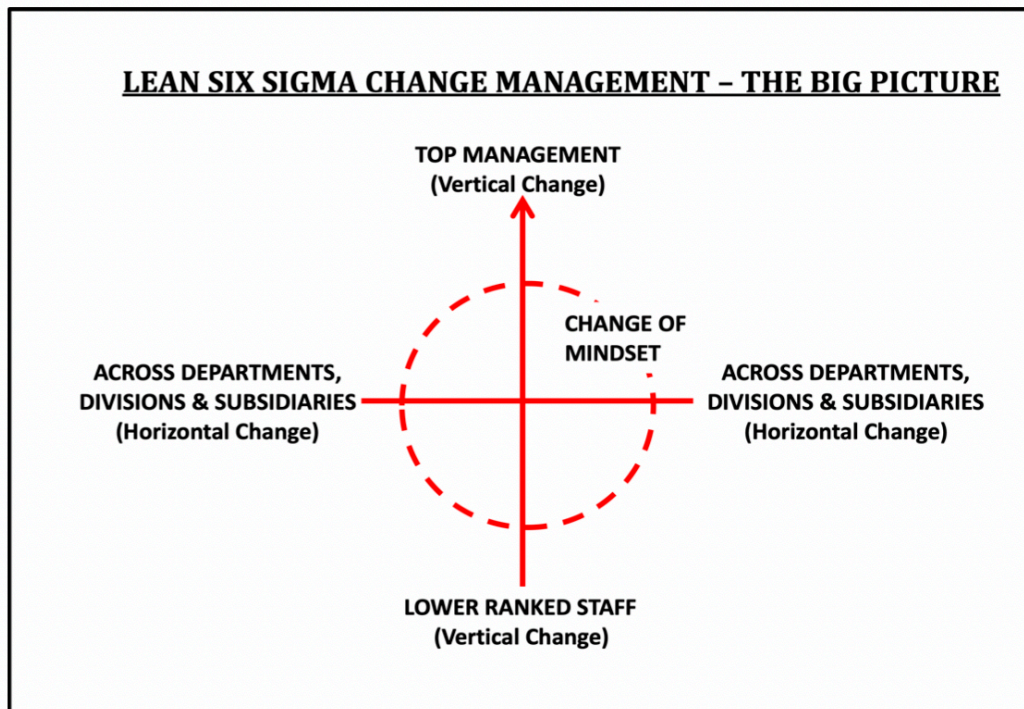


Figure 3. Lean Six Sigma Change Management – The Big Picture

Source: Author's own compilation

Horizontal Change involves the changes across the organization, or even beyond the organization's boundary. This largely deals with the work methods in the form of Procedures or Work Instructions. With Lean Six Sigma, once the work process being revised in one division, department or subsidiary, the new work process for a given process, e.g. procurement process, this shall be communicated across all other divisions, departments or subsidiaries.

The third category of change is the Change of Mindset. This could be the most difficult category of change and it requires time for everyone with the organization to dwell with it. As discussed earlier, with the changes occur both vertically and horizontally, the Change of Mindset is the one that hold all the changes together. It is very natural that any form of change will be faced with resistance. People will always be so used to perform task or work in a certain way. Changes resulted from Lean Six Sigma initiatives needs to be strategically communicated across and time has to be allowed for these changes to "settle". The time required is subjected to the nature of the organization. At this stage, Top Management belief and support plays a pivotal role.

The summary of changes involved is summarized and depicted in Figure 3. There are Vertical Change, Horizontal Change as well as the Change of Mindset. As described before, and agreed both in the literature review as well as the author's own experience, the Change Management aspect is the highest ranked challenge in the deployment of Lean Six Sigma.

The deployment of Lean Six Sigma demands significant time from all parties involved. The time needs to be allocated is not only to the direct participants, which are the Project Team Leader, Team Members and the Coaches or external Consultant, it also demands substantial time from those "indirect" resources such as

the Project Sponsor (Plant Managers, Heads of Division or Heads of Departments) including the CEO as well. There are a number of “approval sessions” or known as “Toll Gates” as well as “Council Meetings”.

The observed man-hours required was based on the actual man-hours time spend during the deployment of Lean Six Sigma at the organization. The activities involved and their observed time are:

- Lean Six Sigma Formal Training – 2 days Training for each Phase (Total 10 days, or 70 hours)
- Project Selection Session – Half day session (4 hours)
- Preparation before Project Meeting – 4 hours
- Project Meetings – 4 hours per meeting, 2 sessions for each Phase
- Project Coaching (Tutorial) – 2 hours per session, 2 sessions for each Phase
- Toll Gate Meeting – 4 hours, 1 session in each Phase
- Council Meeting – 1 hour, 2 sessions per Program
- Others (Launching/Promotion) – 4 hours (Overall)

Team Leader is the person who is entrusted to drive the project to the Finish Line. Based on the Observed Man-hour, it is 173 hours in the span of 6 months (924 hours). This translates to 18.72%, or close to 20% of the time. In other words, for the case of the Project Team Leader, he or she will be loaded approximately 20% more to what he or she is currently doing. For the rest of the Team Members, the time spend is not less than 15% on top of their existing task. From this finding, the feedback that Time or Resource constraints is a valid reason as one of the major challenges in deploying Lean Six Sigma in an organization.

The third constraint is the difficulty to collect data. Lean Six Sigma relies on data, and its' huge amount of data. This is because the data required can be of multiple layers. For the case of Procurement Process Optimization, the data such as Purchase Orders generated, the amount (RM) of each Purchase Order as well as the date is available in the SAP System. The project objective was to shorten the time required for each purchase from initiation until the Purchase Order issued to the vendor. In order to analyze further to determine the root cause, the time spend for each of the procurement stage needs to be collected and these data or information are not all available initially in the system. As such, these additional data need to be collected manually, i.e. by interviewing or by getting the procurement personnel fill-in the additional information in a special “Log Book” for the Project Team members to collect it later. This kind of exercise is additional task to the personnel who are not even the Project Team members.

The fourth challenge is the proposed Action Items are beyond the boundary of the organization. The Author finds that this point has never been mentioned in any of the literature reviewed. For this case, it is related to Contracts or Agreements with External Parties those signed and agreed to long before the Lean Six Sigma came into the picture.

7. Conclusion

From the literatures reviewed as well as the experience gained during the deployment of Lean Six Sigma in the organization, the top-most challenge is the Change Management aspect. It is very broad and spread in the entire organization. It starts with the Top Management, down to the lower ranked staff as well as spans across the divisions, departments as well as subsidiaries. The Change Management aspect is on both sides of the world. It is the toughest challenge that can derail the Lean Six Sigma program, as well as it is also to main ingredient to ensure successful deployment of the program.

The management of change demands great support and belief from the Top Management of the organization. This acts like a double-edged sword. The Top Management commitment and support could be the next toughest challenge in Lean Six Sigma and on the other hand, it is the most important element if lean Six Sigma program is to be a success. The Top Management commitment and support also will lead to a spill-over effect of Leadership at all levels in the deployment of Lean Six Sigma. Leadership presents in various facets such as the Lean Six Sigma Projects Coordinator, the Project Team Leaders, Team Members, Heads of Divisions, Heads of Departments as well as the Heads of Sections, down to the Supervisors and others. All these factors lead to strengthen further the role of the Top Management in ensuring the success of Lean Six Sigma program in the respective organization. In conclusion, the success of the Lean Six Sigma deployment program pivoted strongly on the apatite of the organization's Top Management to strive for it.

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