

Strategic Business Transformation Through Lean Six Sigma

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Abstract

This paper presents an inclusive review on the application of Lean Six Sigma for strategic transformation of business process in a power generation organization. In today's very competitive business environment around the world, organizations need to be lean and mean as their source of competitive advantage. This is no different for the company under study. The organization enjoyed steady growth in profit since its involvement in power generation business. However, it is becoming more apparent that the organization needs to review its internal business process in order to operate at its optimum level. One of the options is to implement Lean Six Sigma. In year 2016, the management has decided to deploy Lean Six Sigma as a structured methodology to enhance the organizational performance. The organization has chosen to embark on Lean Six Sigma journey in conducting its business process transformation and improvement as well as cost optimization as the means to improve its profitability. This study attempts to evaluate the effectiveness of the implementation. The research is to explore in depth on the characteristics of Lean Six Sigma methodology and the factors which may influence its implementation. The challenges faced during the journey were examined to identify the limitations of the Lean Six Sigma methodology and any improvements that can be introduced to enhance its effectiveness.

Keywords

Lean, Six Sigma, Lean Six Sigma, Business Process Improvement, Structured Business Process Methodology, Cost Optimization, Critical to Quality.

1.0 Introduction

The study focused on one of the Independent Power Producer (IPP) in Malaysia. The company is the leading IPP in Malaysia with an effective capacity of 5.35 GW comprising of six power plants operated on oil, coal and gas. On the international front, as an independent water and power producer (IWPP), the company owns a net capacity of approximately 6.9 GW of power production and 444,500 m³/day of water desalination. Its' overseas projects are located in Bahrain, Saudi Arabia, Algeria, Australia and Oman. In 2016, the management of the company decided to embark on Lean Six Sigma journey as the strategy to improve the company's internal processes as to make it more competitive to face the ever challenging business environment. In the first phase of its implementation, a group of 25 personnel were trained as Green Belters and the Steering Committee has approved six numbers of pilot projects to be studied. In this paper, two out of six projects will be presented. The projects were Procurement Process and Cost Optimization and Human Resource Cost Optimization. Details of the projects and their outcomes are described later in this paper.

2.0 Literature Review

Lean Six Sigma is a synergized managerial concept of Lean and Six Sigma. Lean traditionally focuses on the elimination of the seven kinds of wastes/muda classified as defects, overproduction, transportation, waiting, inventory, motion and over processing. Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in (manufacturing and business) processes. In short, Lean exposes sources of process variation and Six Sigma aims to reduce that variation enabling a virtuous cycle of iterative improvements towards the goal of continuous flow (Bevan, 2006).

2.1 The Definition of Lean Six Sigma

Lean Six Sigma uses the Define, Measure, Analyze, Improve, and Control (DMAIC) phases similar to that of Six Sigma. Lean Six Sigma projects comprise aspects of Lean's waste elimination and the Six Sigma focus on reducing defects, based on critical to quality characteristics (Kumar, 2015). Lean defined as systematic approach to identifying and eliminating non value add (wastes) through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection (Mousa, 2013). Although several researchers have provided empirical evidences of the importance of lean on performance, some might have overlooked that the length of lean production adoption would be a catalyst in enhancing this linkage (Agus *et. al.*, 2013). The research by Bhanpukar *et. al.*, (2012) was to establish the connection between Lean Manufacturing and Six Sigma, the two powerful pillars of the modern industrial revolution. The strong data based approach ensures the objectivity of the whole process and eliminates the traditional mistakes of experience based or gut-feeling based decision making.

2.2 Lean Six Sigma in Non-Manufacturing Environment

Lean Six Sigma ($L6\sigma$) concept reported by Muthukumaran *et. al.*, (2013) can be implemented to any kind of industry for better performance; as a continuous improvement tool for betterment. The study by Ainuddin Omar *et. al.*, (2014) suggested that there are still many non-manufacturing companies those have come to the conclusion that Six Sigma will not work for them. This is because Six Sigma was originally developed for helping the manufacturing industry. Organizations such as health care systems, financial service providers and educational systems all doubt the usefulness of Six Sigma. While, Cliff Ladd (2012) described that the implementation of TQM and Lean Six Sigma is a substantial change that mandates a major commitment to transforming the organization in the following key areas: culture, process, and strategic objectives. A paper by Doug Penner (2013) has revealed the impact of these tools on project identification, patient access, wait times, billing, and several other important facets of medical practice operations. Lean Management helps public sector organizations streamline processes by addressing the causes of organizational inefficiency, building the management systems and capabilities to sustain new ways of working, and engaging everyone in making continuous improvement a part of daily work.

There are many of the impacts reported and noted in organizations presented in terms of reduction of (processing or waiting) time, increase in quality through a reduction of errors or 'failure demand', reduction in costs (through less resource), increased employee motivation and satisfaction (particularly related to RIEs) and increased customer satisfaction (Radnor, 2010). Lean Six Sigma is a large undertaking within any organization, and requires the support of upper management to be implemented successfully. One of the hardest things any organization will face when trying to implement Lean Six Sigma is the resistance to change (Stroop, 2013).

3.0 Problem Statement

The organization needs to embark on business transformation in order to remain competitive, i.e. for survival of the business. It is very fundamental for business organization to reduce its associated cost while delivering products of equal or better quality in order to sustain in the business. There are various tools, techniques and methodologies available. In this particular case, the organization has decided to embark on Lean Six Sigma journey. In this research, the author intends to examine the execution of process improvement initiatives by using Lean Six Sigma methodology. Their goals as well as the actual achievements including the challenges faced during the journey are reported herewith. The organization has never embarked on the kind of structured transformation before. Since its establishment, the organization enjoyed steady growth in profit. As such, much of the focus was to ensure the company fulfill its business obligations and reap profit from it. However, the current global economic situation resulted from sudden decrease in oil price has changed the business environment. Since the organization has never embarked on structured business transformation since its involvement in power generation business, the personnel within the organization largely has never been exposed to Lean Six Sigma methodology to conduct Business Transformation.

4.0 Research Methodology

The aim of this study was to bring out the benefits and to notify points that the organization must keep in mind. It is an attempt to trace the current trends on Six Sigma for an organization which faces global competition. The research strategy was made by identifying the Lean Six Sigma projects those currently under implementation stage. These projects have passed the Define, Measure, Analyze and Improve stages. The study of all the projects were then compared and presented in the following sequence 1) General overview of publication and the case industry. 2) General methodology of Six Sigma implementation and the methodology adopted by the cases industries 3) Tools and Techniques used in various phase by them 4) Benefits reaped by each of them 5) Critical factors for successful implantation of Six Sigma improvement strategy as well as the challenges faced along the process. Data collection was carried out since the first quarter of 2015. Outcomes of the studies and projects were analyzed and further elaborated in the following chapters.

5.0 Overview of the Case Studies (Projects)

For the purpose of this study, two Lean Sigma Pilot Projects were chosen as summarized in Tables 1 and 2. Those are at implementation stage, or "Control Stage" and the projects were:

- a) Procurement Process and Cost Optimization
- b) Human Resource Cost Optimization

Table 1. Overview of the Lean Six Sigma Projects

| Referred Name | Project Title | Project Leader | Scope |
|---------------|---|--|---------------------------------|
| A | Procurement Process and Cost Optimization | Head, Group Procurement | Centralized Procurement Process |
| B | Human Resource Cost Optimization | Head, Compensation & Benefit, Group HR | Group Human Resource |

Table 2. Methodology and Goals of the Projects

| Referred Name | Methodology | Project Objective | Project Goal | Other Benefits (Target) |
|---------------|-------------|---|--|---|
| A | DMAIC | 1. Improved procurement cycle time to 80% of PR to PO within 90 Days 2. To optimize procurement value 5% - 10% | RM6million of cost saving in 5 years, or approximately RM1.2million annually | Improve internal business process and practices |
| B | DMAIC | Optimize HR cost by reducing HR cost by 5%. i.e: Travel, Accommodation, Medical | RM1 million of cost saving in 2017 | Improve internal business process and practices |

5.1 Project A – Procurement Process Optimization

Since the formation of centralized Group Procurement Department in year 2015, the procurement process for the organization still has lots to be improved. Based on the data collected, the average processing time from Purchase Requisition (PR) to the issuance of Purchase Order (PO) were largely taken more than 3 months (or more than 90 days). The objective of this project was to achieve 80% of the procurement process can be done within 90 days from Purchase Requisition (PR) to the issuance of (PO).

Project scope:

- a) Value for Material
- b) Value for Services
- c) Value for Services & Material
- d) Time for Services & Material
- e) Time for Material
- f) Time for Services

Out of scope:

Non “procurement” related process

Project goal:

- a) Improved procurement cycle time to 80% of PR to PO within 90 Days
- b) To optimize procurement value 5% - 10%

Barrier to project success:

- a) Time conflict with current similar project
- b) Work commitments by the team members
- c) Limited experience of procurement staff in conducting Lean Six Sigma project
- d) Difficulty to gather complete data or information

Observation and findings:

In this phase the team has analyzed the fifteen (15) possible contributing factors those causing high procurement processing time. As shown in Figure 1 below, out of fifteen (15) factors, the team identified three (3) Vital Few X's those need to be improved. This was done by using analysis tools such as Boxplot, Scatterplot and Bar Chart. The team are able to identify the Vital Few factors thru statistical analysis i.e graphical analysis and hypothesis testing. The 'X' factor for cost and time are similar (high transactional volume) as shown in Figure 2 below. Finally, the team deduced that if the number of transactional process can be reduced, both 'Y' factors (cost & time) can be reduced or improved. This is as described in Figure 3.

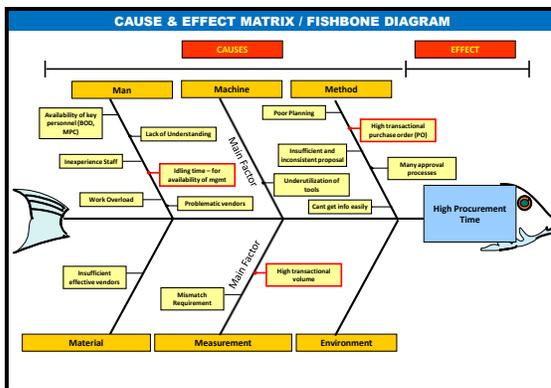


Figure 1. Cause and Effect Diagram

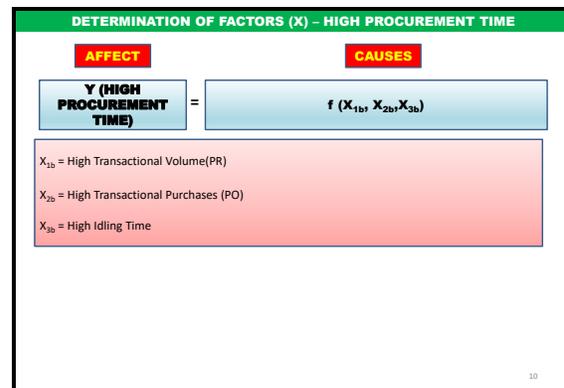


Figure 2. Determination of Vital Factors (Xs)

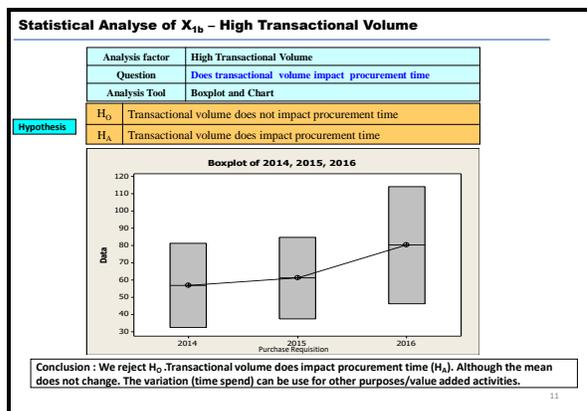


Figure 3. Factors Causing High Procurement Time

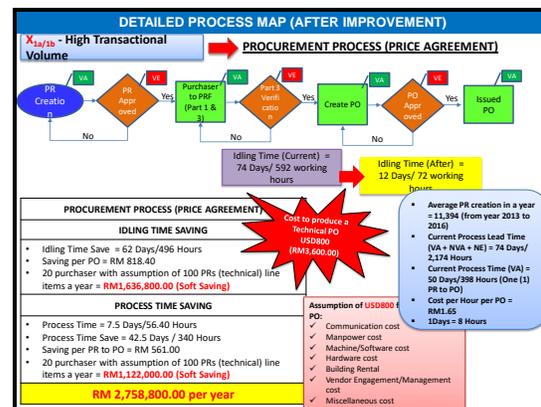


Figure 4. Revised Procurement Process Map

Action items and way forward:

Below is the list of action items to be implemented:

- a) To have more price agreements for future and to identify similar type of purchase.
- b) Introduction of E-Sourcing to Payment (I-Valua; An integrated software system to enable complete on-line procurement process including E-Sourcing & E-Bidding), as described in Figure 4.
- c) Reduction from current unit rate by longer the price agreement period.
- d) Identify parts those can be reversed-engineered or buy local

Summary of Project A

Based on the data collected in September 2017, it was observed that 78% of procurement processes were done in less than 90days. With the implementation of Phase I of the Procurement Transformation Program, an amount of RM3,237, 996/= managed to be saved (Soft Saving) through the implementation of “E-Auctions” in year 2017.

For procurement process optimization, it was observed that the root cause of the problem was due to high transaction of low value procurement process. Low value in this case referred to value of below RM250,000. It was like a person going back and forth to a grocery shop to purchase goods, but each time it was done in small quantity and low value. As such, the efforts required were heavily multiplied. The way forward was to establish more price agreements and contracts. In this case, apart from the time required to conduct analysis to determine the root cause, more time is actually required to carry out the remedial actions of to establish more agreements and contracts. These are not straightforward as different skill level is required for the staff to work on contracts and agreements compared to the staff to carry out the bidding process. The implementation of E-Sourcing and E-Bidding through acquisition of I-Valua System has brought about RM3.2million of soft saving for the year 2017.

Following the success of this phase of Procurement Lean Six Sigma Project, the management has decided to embark on the subsequent project, i.e. to further improve the procurement process with the objective to achieve 100% of procurement process, i.e. from Purchase Requisition (PR) to Purchase Order (PO) to be completed within 90 days or better.

5.2 Project B – Human Resource Cost Optimization

It was observed that since the year 2006, the number of employees has doubled. However, the corresponding generating capacity (MW Electricity) has only increased by 26%. It was also observed that the overall Human Resource expenses year on year has increased by approximately 8% per year. The objective of the project is to optimize Human Resource cost to ensure that the organization remains competitive and sustainable in the long run.

Project scope:

- a) Travel and entertainment expenses
- b) Training expenses
- c) Overtime / Payment-in-lieu
- d) Medical expenses including insurance

Out of scope:

- a) Salary
- b) Fixed Allowances
- c) Staff Benefits
- d) Statutory Payment

e) Variable Payment (Bonus)

Project goal:

To optimize HR cost by reducing HR cost by 5% from the approved budget for year 2017.

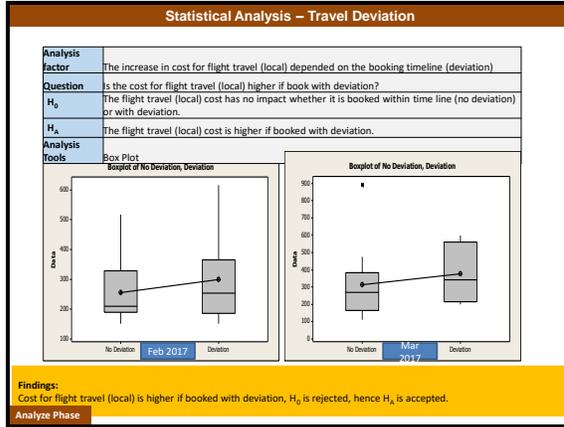


Figure 5. Statistical Analysis – Travel Deviation

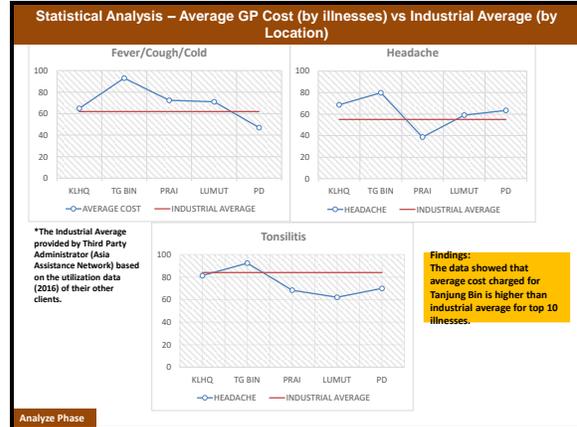


Figure 6. Statistical Analysis - Medical

For travel expenses, the analysis in Figure 5 showed that higher cost incurred for unplanned travels as well as deviation from the original travel plan. In terms of medical expenses, the analysis as shown in Figure 6 described variation of medical expenses between various operation sites.

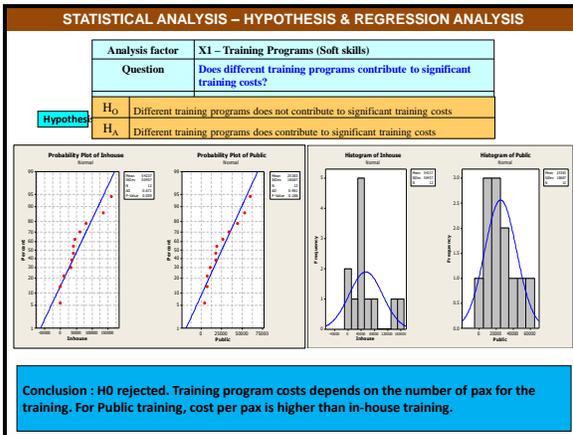


Figure 7. Statistical Analysis on Training Expenses

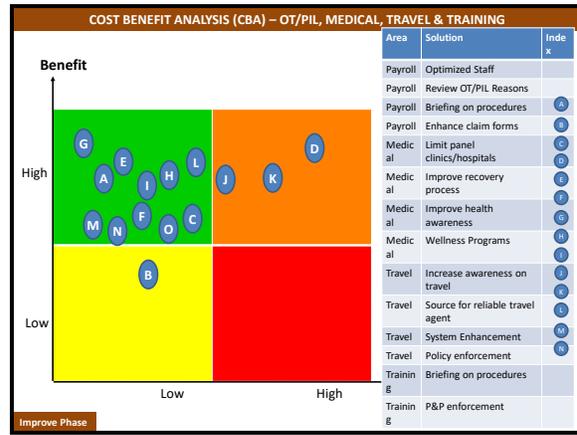


Figure 8. Cost Benefit Analysis

For training expenses, as shown in Figure 7, training program costs depends on the number of pax for the training. For Public training, cost per pax is higher than in-house training. The proposed solutions were then prioritized based on their benefits versus the time to implement. As described in Figure 8 above, the proposed solutions in Quadrant 1 were those will bring in high benefits and the shortest time to implement. Hence, the solutions fell in Quadrant 1 have been implemented immediately in 2017.

Observation and findings:

During the implementation stage of the program, some of the proposed solutions or initiatives appear to be “Just-Do-It” or JDI. Following the brainstorming sessions, the first part was to review the staff travelling and claims practices:

Table 3. HR Cost Optimization Initiatives

| SCOPE OF TRAVELS & CLAIMS | PREVIOUS PRACTICE | REVISED PRACTICE | IMPACT |
|---------------------------|--|---|--|
| Car mileage claim | Car pool - Optional | Compulsory Car pool | Mileage cost literally reduced by 50% |
| Domestic air travels | Domestic travel for Vice Presidents and above are on Business Class | All domestic travels on Economy Class only | Domestic air travels for the affected job grade reduced by 60 to 70% per travel. |
| International air travels | All international business travels on Business Class | Only those exceeding 4 hours flight duration eligible for Business Class | Approximately 30% overall reduction in this category. |
| Accommodations (Hotels) | Reservation made by respective departments according to eligibility of between RM250 to RM450 per night. | Compulsory to made reservation through a centralized unit – Seek for the minimum available hotel rate for the given location. | Approximately 50% saving per case. Previous practice, staff will select the hotel rate those near the maximum eligibility. |
| Entertainment expenses | Staff can spend in accordance to their eligibility | Require approval before spending, otherwise the claim will not be approved. | Reduce the actual claims under this category by more than 80%. |

In the implementation stage of the proposed solutions, there are several challenges and some level of resistance reflected by the staff, as such:

- a) Constraints of team members to collect data
- b) Inadequate support from other departments (In view that the revised practice contradicts with the previous “norms” those staff were comfortable with)
- c) Demand for time commitments from various team members
- d) Not clear on the analysis objective and how best to measure in analyze phase
- e) Acceptance from impacted parties upon implementation of the proposed solutions – Refer to Item (b).

Summary of Project B

The initiative to review and optimized the Human Resource (HR) expenses appear to be the most successful project of all. By December 2017, the total HR expenses was only RM24,473,075/= compared to the approved 2017 Budget of RM45million. This translated into direct **cost saving of RM20,526,925/=**. Despite of uneasiness among the staff when it was first implemented, the practice is now well accepted and it has significantly contributed in improving the organization’s bottom line.

It was also observed that for Optimization of Human Resource Expenses, the Lean Six Sigma Program has provided the platform for the cost optimization initiatives to be put forward. The Human Resource project appeared to be the most successful as it has recorded more than RM20million of cost saving, compared to the original project goal of only RM1million of cost saving from the approved HR budget.

5.7 Overall Project Achievements

The overall achievements in terms of cost saving is as described in the following table.

Table 4. Overall Projects Initiatives and Cost Saving Achieved

| PROJECT NAME | INITIATIVES | HARD SAVING (RM) | SOFT SAVING (RM) | REPORTING DATE |
|---|---|-------------------|------------------|----------------|
| Procurement Process & Cost Optimization | E-Bidding (I-Valua System) | | 3,237,996 | Dec-17 |
| HR Cost Optimization | Optimizing HR Travelling & Accommodation Cost | 20,526,925 | | Dec-17 |
| TOTAL SAVINGS | | 20,526,925 | 3,237,996 | Dec-17 |

As described in Table 4 above, the pilot projects have brought about RM20.5million of Hard Saving (direct saving) and RM3.2million of Soft Saving (cost avoidance). In addition to the direct benefits in term soft cost savings, the Lean Six Sigma Program has indirectly inculcates the critical thinking habits among personnel towards cost optimization in whatever task they are involved in.

During the course of conducting the projects, almost all teams reported that time constraints by the team members as one of the hurdles need to be overcome. In the case here, all team leaders and members are from respective sections and departments. All of the members have their own day to day operational task. Involvement in Lean Six Sigma is additional task to them. To overcome this, again it is important for the management to link the success of Lean Six Sigma to a fair reward system to ensure sustainability of the program. Another common problems faced was the difficulty to obtain data in terms of quantity as well as quality. Lean Six Sigma is a methodology that relies on data. As such, the outcome of it depends a lot on the input data. For the organization that is the first time embarking on Lean Six Sigma Program, it is now recognized that it is very important to archive data in structured way for easier analysis later. During these pilot projects, most of the data were those available in SAP. These are the most reliable and accurate data. For those data not available or not stored in SAP, the quality and accuracy of these data can be questionable.

6.0 Analysis Tools and Methodology

There are many tools and techniques for Six Sigma implementation used in various phases of DMAIC methodology. The use of all this tools and techniques by the case industries in various phases are as described above.

Define Phase (D): Brainstorming, Pareto diagram, Pie, bar chart, SIPOC diagram and Critical to Quality matrix. Measure Phase (M): Pareto diagram, Control charts, Process map and Statistical Process Control. Analyze Phase (A): Pareto diagram, Histogram, Hypothesis testing, Analysis of variance, Regression, correlation analysis, Brainstorming, Cause & Effect diagram, Process map, FMEA, Root cause and why-why analysis. Improve Phase (I): Pie, bar chart, analysis of variance and brainstorming. Control Phase (C): Control charts, analysis of variance, Flow Chart and descriptive statistics. The usage of the tools were not specific but were based on the nature of the project.

7.0 Conclusion

From the study done through two pilot projects, we conclude that Six Sigma is indeed a business strategy that can provide a breakthrough improvement in the competitive era. In this paper, only two pilot projects were discussed and presented. This may not represent the entire spectrum of what Lean Six Sigma can offer.

It was observed that there were common challenges experienced by the team members during the deployment of Lean Six Sigma such as time constraints, difficulty to obtain past data as well as cost and time incurred. Nonetheless, based on the two pilot projects presented here, the benefits gained in terms of direct cost saving as well as cost avoidance have far exceeded the initial resources and financial investment made. In addition to the direct benefits, the Lean Six Sigma Program has indirectly inculcates the critical thinking habits among personnel towards cost optimization in whatever task they are involved in.

The future works may involve the application of Lean Six Sigma methodology in other areas within the organization such as power plant's operation and maintenance strategy as well as business development area and as whether or not Lean Six Sigma can be successfully applied as the methodology to assist the strategic planning for the organization to support the growth of the organization.

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Biography

Engr Noor Azam Md Saad is an Engineering Doctorate student at Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia. He obtained Masters Degree in Industrial and Technology Management from Universiti Kebangsaan Malaysia in year 2000. Prior to his masters degree, he graduated in 1990 as a Mechanical Engineer from Imperial College of Science, Technology and Medicine, London, United Kingdom. Engr Noor Azam is a registered Professional Engineer with the Board of Engineers, Malaysia and he is also a holder of Engineer (Steam Boiler) Grade 1 from the Department of Occupational Safety and Health (DOSH), Malaysia. He spends more than 25 years as field engineer serving in the area of operations, maintenance as well as engineering design and construction of large coal fired as well as combined cycle power plants and petrochemical plants. He is a qualified Lean Six Sigma Green Belt and is currently undergoing Step-up Program to be certified as a Black Belt. He is currently heading Business Process Improvement Department, responsible to conduct overall business process improvements as well as leading the cost optimization initiatives for the organization he is currently attached to.

Associate Prof Dr Astuty Amrin received her MSc in Corrosion Science & Engineering from University of Manchester (UMIST), UK, in 1999 and obtained her PhD (Mechanical) from UTM in 2005. She has wide experience not only in Materials/Corrosion Engineering but also in curriculum development of Life Long learning executives programme. She has been invited as a visiting Professor for Sudan University Science and Technology (SUST) in Khartoum, Sudan and King Mongkut's University of Technology Thailand (KMUTT) to conduct training and courses. Her research interests cover across multidiscipline area including Development of New Ti-based alloys, establishing accelerated corrosion test procedures for local car manufacturer, Oxidations of heat resistant alloys, Determinants of Academic Entrepreneurial Capacity, Integrity Management of ageing Offshore Structures and Service Quality of High Speed Broadband.

Associate Prof Dr Khairur Rijal Jamaludin has a Ph. D in Manufacturing Engineering from Universiti Kebangsaan Malaysia, Master degree from University of Warwick, United Kingdom and Bachelor degree from Universiti Teknologi Malaysia. In 1996, he worked with Malaysian national car maker before appointed as a faculty in Universiti Teknologi Malaysia in 1998. He has published many research articles in Journals in the field of Quality. He and his research group under the Genichi Taguchi Centre for Quality and Sustainability in UTM is actively involved with industry research as well as fundamental research particularly related to Taguchi method and Mahalanobis Taguchi system. He received direct mentoring about quality engineering from Shin Taguchi, son of the late Dr Genichi Taguchi.