The Influence of Critical Success Factors of Lean Six Sigma towards Supply Chain Performance in Telecommunication Industry, Malaysia

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***Abstract* — Telecommunication industry has begun to appreciate and embrace Lean Six Sigma (LSS) not only to improve organisation productivity but also to enhance supply chain performance. The aim of this study is to survey which critical success factor (CSFs) of Lean Six Sigma that were could lead to better supply chain performance which eventually increases the competitiveness of the telecommunication industry in Malaysia. Research methodology is designed to empirically analyse data collected from 45 senior managers in the telecommunication industry. However, only 35 employees respond towards the questionnaire given. Hypotheses were tested using factor analysis, reliability and multiple regression analysis. The result of this study reveals the CSFs that significantly influence the successful implementation of LSS within the TELCO industry. The study identified project selection, prioritization and reviews the most critical to the success of implementing the LSS program, which eventually will enhance supply chain performance in TELCO industry. The result from this study provides valuable insight and knowledge to telecommunication firms on how to improve their understanding on the implementation of Lean Six Sigma and enhance supply chain performance in a developing country, Malaysia.**

Keywords— *Lean Six Sigma, Supply Chain Performance, Critical Success Factor, Lean, Six Sigma*

1. Introduction

Today, the difference in economic and landscape has forced for organizations to change their way of processing their company to minimize the cost while increasing their quality improvement by implement some strategies towards an organization [17]. Lean Six Sigma is one of a process improvement approach that focused in the area of improving the management and decreasing all of the waste made in an organization. The word Lean Six Sigma is the collaboration between two types of improvement, which is Six Sigma and Lean. Motorola Corporation was first developed and introduced into the world on what actually is Six Sigma. Actually, LSS originated from the system called Toyota Production system, which had become known and famous in the year 1973. Other than that, reducing cycle in in processing of the waste is the aim of the implementation of Lean Six Sigma.

There is a trend of combining two or more improvement strategies namely as Lean Six Sigma. The first to combine these two improvements is called The George Group [2]. Lean Six Sigma is a management approach to improve the effectiveness, flexibility and competitiveness in an organization while reducing the waste [18], [19]. The literature introduction of Lean Six Sigma was first known in the early 2000 during the starting of technology and the education on Lean Six Sigma was as part of evolution of Six Sigma [3]. Despite having differences of their

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roots, Lean and Six Sigma are sharing some common features which is continuous improvement, focus on customer satisfaction and employee involvement [24]. As such, the aim of this study is to survey which critical success factor (CSFs) of Lean Six Sigma that were could lead to better supply chain performance which eventually increases the competitiveness of the telecommunication industry in Malaysia.

2. Literature Review

2.1. Lean Six Sigma

Lean Six sigma is the combination made by the two improvement strategies, which is Lean Management and Six Sigma to reduce in order to reduce the cost and waste. For example, [14] to prevent the decrease in a cost, they used the lean management from the beginning of the project until the end. Both of Lean and Six Sigma gives each other something valuable and needed for all of the employees and workers as they provide knowledge in every problem that had been occurred [25]. [2] mentioned that these two combined improvements can reduce 3 or 4 out of millions of opportunities.

2.2. Communication and Assessment on Lean Six Sigma

In this study, the communication and assessment of on the project are needed in the organizations as for them, communication is very important. The researcher had said that communication are needed together with more knowledge in order to know a perfect strategy and gives awareness to al of the employees [27]. Knowledge, common objectives, shared values and trust relationship are emphasised in communication to differentiate which are fundamental element in organization's competitive edge and which of them are not needed.

2.3. Project Prioritization, Selection, Review and Tracking

In order to get a successful of Lean Six Sigma implementation, all of the company need to get a good performance shown. as a proper criterion must be drafted for the project selection and prioritization [13]. These writers, [9] had once mentioned attribute intuitively priorities value and classify them accordingly to their importance in an organization. The poorly selected project and project defined will lead to the delayed result at the end which can also lead to frustration on the employees [5].

2.4. Project Success Stories, Best Practice & Benchmarking

Best practice, Benchmarking are lack of a consistence definition for organizational changes. Leaders adopt so-called best practices with belief that implementing another organization's successful practices is some sort of magic bullet [12]. Three definition of best practice; award winning which use business excellence as benchmark; has industry wide acceptance and practice implemented by admired companies; they need to have a good benchmark and best practice implementation in their organizations.

2.5. Lean Six Sigma Training Program

The writer [11] had defined that having training program that was planned by firm's are to facilitate the learning job-related knowledge and the behaviour of employees. Training was served by the superior to increase the performance of employees, which in turns the employees will provide a competitive edge to the organization in the future.

2.6. Organization Performance

Supply chain performance act as an indicator to measures how well the organization can achieve their objectives and missions [22]. By having a good reward system as part of supportive organizational culture, the company can encourage all of the employees to be better for the organization process [16]. To improve the performance of the organizations, it need to be delivered cost-effective is by building operational capabilities [15].

3. Model Conceptualization and Hypothesis Development

Based on the theoretical framework, the chosen independent variable will be used to be tested whether it can give any impact to the dependent variable. This model shows some independent variable of critical success factor to do research on company that will effect on the performance of the company. The hypothesis shown formulated based on the framework and literature review.

There is a crucial success of the project was based on two core issues; human error and lack of clear communication between the employees and employers in an organization [1]. [6] suggest that by having a clear and good communication style to channel the information, any communications at all of the organizational levels to provide a hardworking and understanding team members to improve projects of

the company such as implementation of Lean Six Sigma. So, any explanation with clear in communication will decrease any disturbed channel and noises in communication to change. Thus, these hypotheses are made:

H1. The communication and assessment on Lean Six Sigma result has positive relationship with supply chain performance.

The Lean Six Sigma is essentially a strategy to reach both efficiency in resources and flow by making a prioritizing and selection on project review [4]. [10] mentioned that selecting projects to discussed the issues today of Lean Six Sigma questions by increasing the ability to get more success in the organization. Furthermore, there are studies that show a string need of study not only identify Lean Six Sigma barriers but also prioritize them which will provide a clear visualization to develop smooth implementation [26]. These are the hypothesis that can be made based on the literature from other journals:

H2. The project selection, prioritization and project status has positive relationship with supply chain performance.

The results from some researchers encourage that all of the employees in a company are needed to have some extra knowledge in order to reduce any errors that might be the reason of a failure on the implementation of these improvement. The Knowledge-based system (KBS) shows that making benchmark with international best practice will enhance the performance of the project.it will be together with both support form top management and techniques for the benchmarking and decision-making process [20], [21]. Thus, following hypothesis is developed:

H3. The sharing of project success stories, benchmarking and best practice has positive relationship with supply chain performance.

As we all know, training are often be said as expensive method to try, but it is a very successful plan to give to the employees. [8] pointed that educations and training were necessary to all of the workers, moreover to all of the employees. The writer also mention that all skills and expertise are seen most critical factors to the successful adoption of LSS were actually known as by not having a good and proper training, it will be the worst factor to fail the implementation. Effective training is essential in order for employees to acquire the relevant knowledge to find the best way to reduce an obstacle [28]. These are the hypothesis made according to the literature reviews.

H4. The Lean Six Sigma training program has positive relationship with the better the supply chain performance.

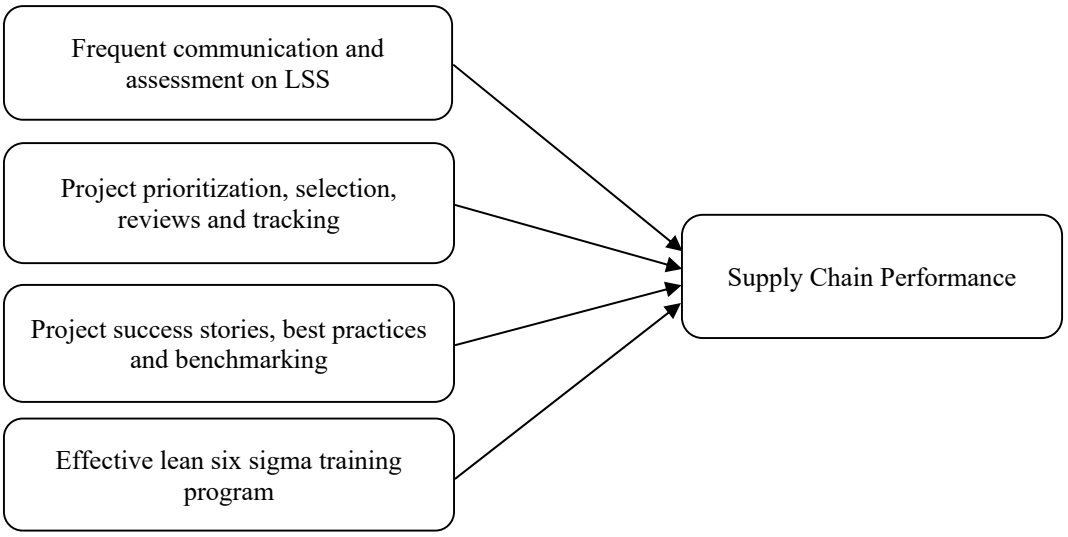

Figure 1. Lean Six Sigma Critical Success Factors

4. Research Methodology

4.1. Data collection

The data collection tool was used in this study to analyse the data from the questionnaire. All of the respondents was given a questionnaire by email. There will be many types of answered form the respondents as they will have their own opinion. The questionnaire was answered by 45 employees in nine TELCO firms. A set of questionnaires was given to each respondent through *google form*. All of the respondents takes about seven to ten minutes in order to finish all of the questions give to them. For this study, only a week was given to them to answer the questionnaire.

4.2. Data analysis

All of the data information of the questionnaire was being collected within one company only. The result of hypothesis testing will be interpreted later. The data collection from the survey is analysed by using SPSS. A descriptive statistics and multiple regression were used to analyse the data [7]. On the other hand, sample of t-test method will be used to compare the means of two set of observation that related in a single sample or respondent. The procedure computes the difference between values of the variables for each case and test whether there is an average difference. The t-test and the p-value are all given together with an interpretation of what that was mean. If both of them has lower than 0.05, it will be rejected as they are not significant and has no relationship with each other.

5. Result and Discussion

5.1. Respondents Profile

There are 35 respondents which consists the majority of the respondent is female with percentage of 54 are female and 46% are male. The ranges of respondents' age which are majority at age 31-40 years for 43%. Other than that, it also shows the educational status of the respondents which are mostly degree and no one from PHD level. There are from 9 different departments with the highest number of years work in organization for over 11 years. There are about 13 employees has experienced with LSS while other 13 employees had not have any experienced with LSS.

Questionnaire contained some variables that were chosen from journal and describe in research framework. Variables are measured using Likert scale with '1= strongly disagree' until '5=strongly agree'. Likert scales are often used in quantitative research where respondents will determine their agreement on the questions given. This survey was distributed by using an e-mail on *google form* with a total of 35 respondents within 9 units in the same company.

Table 1. Measurement model result

Dimension	Valid n	Mean	Min.	Max.	SD	Cronbach's alpha	Factor loading
CA1 - Use of LSS problem-solving tools/techniques to solve problems	35	3.80	1.00	5.00	0.531	0.719	0.632
CA2 - Good communication between different departments	35	3.80	1.00	5.00	0.677		0.644
CA3 - Effective top-down and bottom-up communication	35	3.77	1.00	5.00	0.646		0.596
CA4 - Clear, consistent communication of mission statement and objectives in your unit	35	3.83	1.00	5.00	0.618		0.871
PPR1 - Having project selection and prioritization on projetc.t improve company competitive advantage, business profitability etc.	35	4.06	1.00	5.00	0.591	0.887	0.843
PPR2 - Periodic project review to ensure projects are proceeded according to schedule	35	4.14	1.00	5.00	0.733		0.824
PPR3 - Project tracking system to track the project status	35	3.94	1.00	5.00	0.838		0.571

PB1 - Extent to which LSS data (cost of quality, errors etc.) are used as tools to manage LSS performance	35	3.63	1.00	5.00	0.547	0.830	0.768
PB2 - Extent to which LSS project success stories and best practice are available to employees	35	3.57	1.00	5.00	0.558		0.691
PB3 - Extent to which LSS project success stories and best practice are available to managers and supervisors	35	3.57	1.00	5.00	0.608		0.835
PB4 - Extent to which LSS project success stories and best practice are displayed at employee work place	35	3.63	1.00	5.00	0.731		0.870
TP1 - Specific LSS training (yellow, green, black belt) given to employees throughout the company	35	3.71	1.00	5.00	0.622	0.893	0.753
TP2 - LSS awareness training among employees is ongoing	35	3.66	1.00	5.00	0.765		0.785
TP3 - Training in statistical techniques (histogram, control charts, etc.)	35	3.69	1.00	5.00	0.758		0.795
TP4 - Availability of resources for employees training in company	35	3.74	1.00	5.00	0.741		0.863
TP5 - Training in interactive skills (communication, leadership, meeting skills)	35	3.94	1.00	5.00	0.765		0.746
SCP1- LSS program improves partnering relationship	35	3.60	1.00	5.00	0.695	0.992	0.779
SCP2 - LSS program improves product development	35	3.63	1.00	5.00	0.646		0.884
SCP3 - LSS program improves competitive profile	35	3.57	1.00	5.00	0.608		0.904
SCP4 - LSS improves time to market	35	3.51	1.00	5.00	0.658		0.890
SCP5 - LSS improves the product quality	35	3.63	1.00	5.00	0.690		0.802

This study use reliability analysis by using Cronbach Alpha and multiple regressions. A reliability analysis is such as internal consistency has been done in this study. Reliability analysis also acts as the indicator to measure the stability and consistency for each of the items in the questionnaire. Coefficient alpha that above 0.7 are considered as an acceptable and overall of the items were found to be reliable as the value is above 0.7. In general, all factors mentioned above have Cronbach Alpha above 0.7 which is strong. Other than that, the highest number of mean is 4.14 as 5 is the 'strongly agree' while 1 is 'strongly disagree' for this questionnaire. Factor analysis was used to reduced small number which means that it will simplify all the analysis while keeping any information.

Table 2. Multiple regression analysis

Model	Unstandardized Coefficient		Standard Coefficient	T	Sig.
	B	Std. Error	Beta		
Constant	1.465	0.880		1.665	0.106
CA	0.082	0.294	0.065	0.280	0.781
PPR	0.414	0.179	0.472	2.317	0.028
PB	0.170	0.201	0.148	0.855	0.406
TP	0.127	0.208	-0.135	-0.609	0.547
F Value				2.487	
Sig				0.065	
Adjusted R square				0.149	
R square				0.249	

The multiple regression analysis was used to test whether the independent variables can influence the dependent variable (supply chain performance). Table above shows the results of regression analysis of independent variables on dependent variable. The R square is 0.249 implies that the percentage of the variation in the dependent variable is explained by the variation in the independent variable which is 24.9%. Another 76.1% of the variance in the dependent variable cannot be explained by the independent variables in this study area. F-test is not significant since the p-value is more than 0.05; it means that the results of the model found to be not statically significant towards the dependent variable. These are the hypothesis made based on the t-test in previous table:

The variable for Communication and Assessment on LSS result is not significant. It is because the p-value for communication and Assessment on LSS result is 0.781 (78.1%), which is above the 5% significant level. Hence, explained that the communication on LSS is not related with dependent variable. These is because communication might not have much effect on the implementation of Lean Six Sigma in this industry.

The result for Project selection, prioritization and reviews is 0.028 (2.8%), which has lower number than 5% significant level. Therefore, Project selection, prioritization and reviews are significant. Hence, it has explained that Project selection, prioritization and reviews are positively related to the dependent variable. For this industry, making and selecting prioritization of the project is very important as they might severely effect on the implementation of Lean Six Sigma.

The Project Success Stories and Best Practice Sharing variables have a p-value of 0.406 (40.6%), which is higher than 5% significant level. Therefore, Project Success Stories and Best Practice Sharing are **not significant**. Hence, explained that the Project Success Stories and Best Practice Sharing are not related with dependent variable. Having project success stories may not have any impact on the industry.

The result for Effective LSS training program variable is **not significant** because the p-value for Effective LSS training program is 0.547 (54.7%) which shows higher percentage than significant level at 5%. Hence, explained that for Effective LSS training program is not related with dependent variable. Before this, the relationship from other journal shows that training is very important to every companies as it will increase the knowledge of employees and the company overall. Unfortunately, this study shows that training might not be one of the reason for Lean Six Sigma to be successful.

6. Conclusion

The result shows that there is not much agreement among participants on high importance and implementation of each CSFs of Lean Six Sigma and the performance of organization which is to find the importance implementation of Lean Six Sigma [23]. The result also indicates that the relationship among CSFs of Lean Six Sigma is mostly not significant to each other except for Project Selection, Prioritization and Reviews and Project Success Stories and Best Practice Sharing. This indicates that there are other variables that affect the organization performance towards successful of implementation of Lean Six Sigma. Moreover, the current study demonstrates that not only these four variables only affect Lean Six Sigma, but there are many other variables. In conclusion, this study has answered all the questions from the questionnaire.

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