

Guideline Development for Lean Quality Management and Economic Cost of Quality Analysis of Suan Dusit Rajabhat University's Environmental Center

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Abstract—The objectives of this research are to study operating conditions and management of Suan Dusit Rajabhat University's Environmental Center according to the 11 aspects of lean management to develop manuals for 7S activity operation, risk management, job description and key preferment indicator (KPI) as well as to analyze economic cost of quality. The study used mixed research methods consisting of qualitative research with an emphasis on participatory action research (PAR) and quantitative research as a research method to create collaboration among administrators, staff and researchers conforming to the 11 aspects of lean management. The developed manuals help create effective organization and encourage the staff to have strong discipline as well as reduce or eliminate waste opportunity in the future operation. They can also be used as aspects for performance assessment of staff. In addition, the lean thinking concept promotes effective system in terms of the decrease in costs and time. Focusing on reducing waste, less time investment is required for work-in-process (WIP) and waste of waiting is eliminated during service or product delivery which affects customers' satisfaction. It will also partly develop the operation and establish higher standards of Suan Dusit Rajabhat University's Environmental Center.

Index Terms—quality management, lean thinking, economic cost of quality

I. INTRODUCTION

Quality management is necessary in the operational development of every organization. It is an important strategy to create appropriate and effective operation, to lower cost and expenses as well as to immediately respond to customers' needs. The improvement in quality partly helps increasing sales and lowering the organization's cost which will later results in higher profit. Generally, if the organization can answer the needs of its customers promptly, manufacture a large number of products to

achieve economies of scale and become well-known for its high quality product development, the total sales of the organization will be raised. Similarly, quality development will help lowering the cost, increasing the number of products, eliminating redundant tasks as well as decreasing wastes and quality insurance cost. Therefore, more organizations are currently interested in quality management and they are adopting quality management tools into their organizational practices to develop staff and improve work efficiency to be able to satisfy customers' needs [1].

At present, not only private sectors but also government sectors are giving precedent to quality management. Some government sectors have embraced the use of quality management tools. In the past, the government mainly paid attention to the final products or service rather than the final results or the satisfaction of the people. Unlike the government sectors, private sectors have given priority to the final results. However, the government sectors have turned their attention to the final results or the satisfaction of the people and continuously improve their service to serve the needs of the people. Because of the Royal Decree on Rules and Procedures for Good Governance of 2003, the government sectors have to continuously develop and improve the quality of services. Both evaluation and analysis of the operation are required to seek guidelines for improvement. The key step is allowing the officials to take part in the improvement [2]. One concept that the government sectors can adopt is lean government referring to the concept that will improve and develop the government work system by decreasing wastes caused during the operation of the government sectors and private sectors to finally get to the core of practice.

As more attention is given to better quality management, both government sectors and private sectors have to perform the operation according to the needs of customers. The most important factor is to maintain the manufacturing quality. The quality management tools are

the keys that the administrators have to hold on to with clear vision and strong belief in the continuous quality development. In addition, if the organizations wish to improve and develop more effective system by eliminating wastes, they need to adopt lean quality management system into the operational development. The lean practices will help increase work efficiency and decrease operational cost. Effective organization must be well-prepared for rapid changes and unexpected situations, such as customers' needs, fierce competition, and increase in manufacturing cost. These factors are unavoidable; therefore, the administrator must understand and analyze the situations and deal with them by improving the organization to be able to cope with those problems [3].

According to the aforementioned information, government sectors have turned their attention to the quality management by adopting new equipment into the operation to increase work efficiency [4]. Some universities not only offer services to their students but also provide other services to outsiders. Suan Dusit Rajabhat University's Environmental Center has given precedence to quality management with its goal to become the best environmental center by 2015 and promoted its vision to increase customer satisfaction with high quality services and products. Therefore, Suan Dusit Rajabhat University's Environmental Center has insisted on improving the quality of services. Suan Dusit Rajabhat University's Environmental Center has received certification of accreditation to ISO/IEC 17025 from Thai Industrial Standards Institute (TISI) which is a good beginning for its quality management. The strategies can also increase the efficiency of service delivery process (instruction and service analysis) under the lean thinking concept. To do so, Suan Dusit Rajabhat University's Environmental Center may confront with higher management cost leading to the cost of quality. The analysis of cost of quality is required in the study of opportunity cost and return in the form of effective lean activities which had been developed to project appropriate cost control for each lean activity [5].

According to the aforementioned phenomenon, the researchers were interested in exploring the operating conditions and management to develop lean quality management manuals and analyze the economic cost of quality of Suan Dusit Rajabhat University's Environmental Center with suggestions and guidelines for developing the action plan.

II. OBJECTIVES

First, to study the operating conditions and management of Suan Dusit Rajabhat University's Environmental Center according to the 11 aspects of lean management.

Second, to develop manuals for 7S activity operation, risk management, job description and key preferment indicator (KPI) according to the lean thinking concept of Suan Dusit Rajabhat University's Environmental Center.

Third, to analyze economic cost of quality of Suan Dusit Rajabhat University's Environmental Center.

III. CONCEPTUAL FRAMEWORK

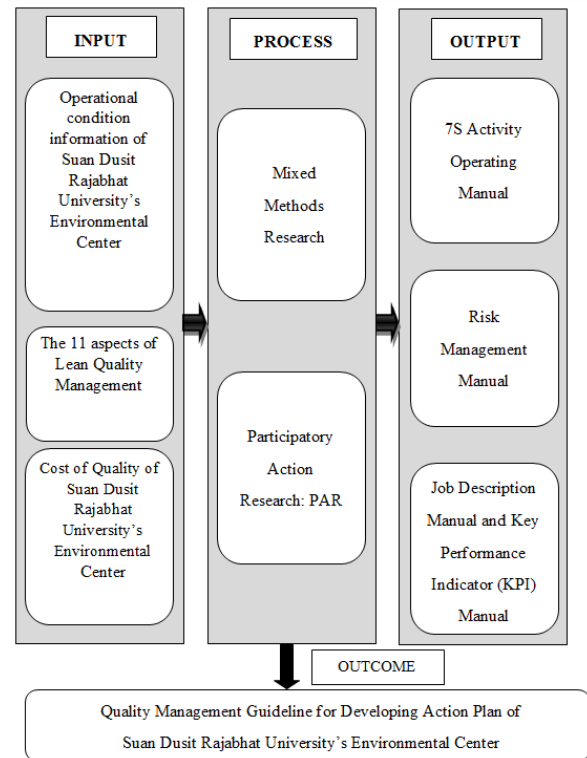


Figure 1. Conceptual framework

IV. RESEARCH METHODOLOGY

This research used mixed research methods between qualitative research and quantitative research with participatory action research (PAR) between administrators and staff of Suan Dusit Rajabhat University's Environmental Center as well as the researchers.

In the process of developing the lean quality management manuals and the analysis of economic cost of quality of Suan Dusit Rajabhat University's Environmental Center, there were 11 aspects to be followed and each aspects requires different research designs, including quantitative research, qualitative research and participatory action research (PAR), which was divided into 3 following phases [6] as cited in Supapich (2012).

A. Pre-Research Phase

In the pre-research phase, the researchers prepared themselves and the integrated network by creating good relationships with the staff at Suan Dusit Rajabhat University's Environmental Center as this is the key to successful participatory action research (PAR) (Smith, M.K., 2001).

B. Research Phase

The researchers adopted the PAOR process, consisting of planning (P), action (A), Observation (O) and Reflection (R), to carry out this participatory action research [7].

C. Development Phase

The manuals were developed according to what the researchers have found in the second phase to establish the standards for Suan Dusit Rajabhat University's Environmental Center by developing the operating manuals to be used as guidelines for the lean quality management and the analysis of economic cost of quality of the Environmental Center.

V. RESEARCH RESULTS

The operational results of Suan Dusit Rajabhat University's Environmental Center following the 11 aspects of lean management can be concluded into 2 parts, including 1) organizational assessment and 2) self and colleague evaluation, as illustrated in Fig. 2 and Fig. 3.

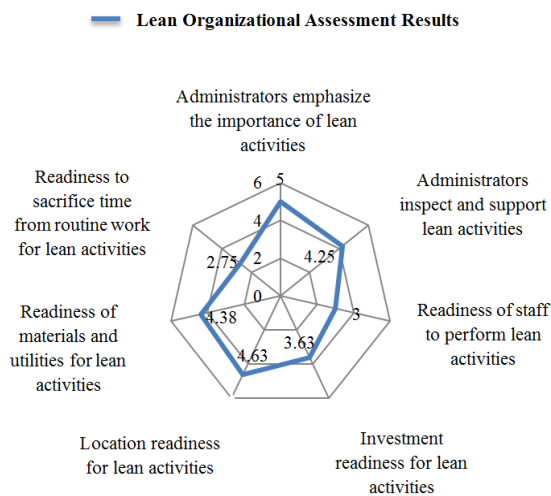


Figure 2. Lean organizational assessment results

From Fig. 2, the lean organizational assessment results of Suan Dusit Rajabhat University's Environmental Center were generally at the highest level. Considering each aspect individually, the investment readiness, the readiness of staff and the readiness to sacrifice time from routine work for lean activities were at the moderate level.

Comparison between Colleague Evaluation Results and Self-evaluation Results in Lean Operation

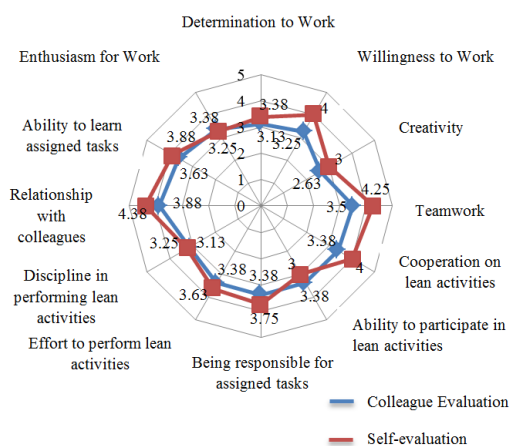


Figure 3. Comparison between colleague evaluation results and self-evaluation results

The comparison between self-evaluation results and colleague evaluation results is shown in Fig. 3.

According to Fig. 3, the colleague evaluation results indicate that the self-evaluation results were at the moderate level in almost all aspects, except for teamwork, while the relationship with colleagues and the ability to learn the assigned tasks are at high level. As for the self-evaluation, almost half of the self-evaluation results were at high level, excluding the effort to perform the activities, creativity, the ability to participate in the activities and the discipline in performing the activities. The enthusiasm for work was at the moderate level, while teamwork and the relationship with colleague were at the highest level.

In addition, the 11 aspects in the operation had led to the development of lean quality management manuals and consequently 3 manuals were created. A manual for S7 operation manual aims to create effective organization in the office and encourage the staff to the staff to have strong discipline. A manual for risk management helps reduce or eliminate waste opportunity in the future operation, while a manual for job description is to be used as operational framework and guideline for the staff with key preferment indicator (KPI) used as criteria for the operational assessment of staff.

As a result, the lean thinking concept has helped Suan Dusit Rajabhat University's Environmental Center to have effective system in terms of the decrease in costs and time as less time investment is required for work-in-process (WIP) and waste of waiting is eliminated during service or product delivery.

Concerning the analysis of economic cost of quality of Suan Dusit Rajabhat University's Environmental Center, the researchers have analyzed the economic cost of quality by calculating the cost and return opportunity of lean activities. The researchers have examined the working hours as follows:

Opportunity Cost Hypothesis

Cost per activity per staff is shown in Table I.

TABLE I. COST PER ACTIVITY PER STAFF

No.	Fixed Cost (FC)				Variable Cost (VC)	Average Cost (AC)
	Salary of participants (1)	Wage rate per hour ((1)/30)/8 = (2)	Working hours (Lean activity) (3)	Average salary per month (2)x(3)=(4)	Overhead and utilities of lean activity per person per month (5)	Total cost of lean activity per month (6)
1	13,350 baht	55.62 baht	22 hours	1,223.64 baht	187.50 baht	1,411.14 baht
2	15,000 baht	62.50 baht	22 hours	1,375.00 baht	187.50 baht	1,562.50 baht
3	16,920 baht	70.50 baht	22 hours	1,551.00 baht	187.50 baht	1,738.50 baht
4	17,100 baht	71.25 baht	22 hours	1,567.50 baht	187.50 baht	1,755.00 baht
5	18,000 baht	75.00 baht	22 hours	1,650.00 baht	187.50 baht	1,837.50 baht
6	18,000 baht	75.00 baht	22 hours	1,650.00 baht	187.50 baht	1,837.50 baht
7	18,360 baht	76.50 baht	22 hours	1,683.00 baht	187.50 baht	1,870.50 baht

8	19,500 baht	81.25 baht	22 hours	1,787.50 baht	187.50 baht	1,975.00 baht
Total				12,487.64 baht	1,500 baht	13,987.64 baht

Remarks: 22 refers to a number of working days in one month
8 refers to a number of working hours in one day

According to Table I, the cost per activity per staff per month is 13,987.64 baht, while the return hypothesis of the lean activity is illustrated in Table II.

TABLE II. ANALYSIS OF OPERATIONAL COST TO SEEK RETURN OPPORTUNITY FOR SUAN DUSIT RAJABHAT UNIVERSITY'S ENVIRONMENTAL CENTER

No.	Salary of participants (1)	Working hours (Pre-activity) (2)	Average salary per hour (1)/(2)=(3)	Working hours (Post-activity) (4)	The increased working hours (2)-(4)=(5)	Return opportunity for the center (3)x(5)=(6)
1	13,350 baht	176 hours	75.85 baht	158.4 hours	17.6 hours	1,334.96 baht
2	15,000 baht	176 hours	85.23 baht	158.4 hours	17.6 hours	1,500.05 baht
3	16,920 baht	176 hours	96.14 baht	158.4 hours	17.6 hours	1,692.06 baht
4	17,100 baht	176 hours	97.16 baht	158.4 hours	17.6 hours	1,710.02 baht
5	18,000 baht	176 hours	102.27 baht	158.4 hours	17.6 hours	1,799.95 baht
6	18,000 baht	176 hours	102.27 baht	158.4 hours	17.6 hours	1,799.95 baht
7	18,360 baht	176 hours	104.32 baht	158.4 hours	17.6 hours	1,836.03 baht
8	19,500 baht	176 hours	110.80 baht	158.4 hours	17.6 hours	1,950.08 baht
Total				13,623.10 baht		

As shown in Table II, after adopting lean practices, the staff spends 17.4 hours per person per month less on the operation, worth 13,623.10 baht/month. This indicates that the activity has been operated under the lean thinking concept. As a result, the return opportunity of Suan Dusit Rajabhat University's Environmental Center can be valued at 13,623.10 baht per month.

From this activity operation, the comparison between the return opportunity and the cost of lean activity is demonstrated in Fig. 4.

Comparison between Return and Cost of Lean Activity

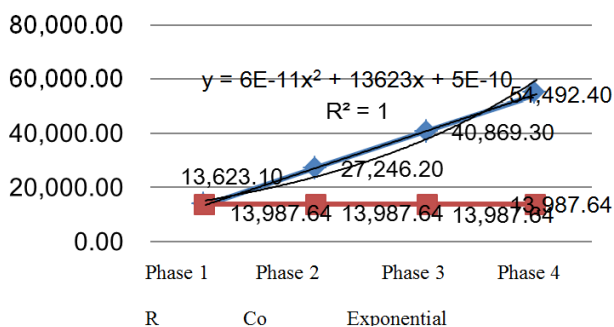


Figure 4. Comparison between return and cost of lean activity

From Fig. 4, the return of the activities in Phase 1 was 13,623.10 baht (decrease in time by 10%). The return of the activities in Phase 2 was 27,246.20 baht (decrease in time by 20%), while the return of the activities in Phase 3 was 40,869.30 baht (decrease in time by 30%) and the return of the activities in Phase 4 was 54,492.40 baht (decrease in time by 40%) as the cost of activities in each phase remains 13,987.64 baht. Moreover, after adopting the lean thinking concept, the staff spends 17.4 hours per person per month less on the operation, worth 13,623.10 baht per month. In conclusion, the return opportunity of Suan Dusit Rajabhat University's Environmental Center can be valued at 13,623.10 baht/month.

VI. DISCUSSION

The results of the development of lean quality management manuals and the analysis of economic cost of quality in terms of effectiveness can be concluded that the keys to achieving the objectives and goals of these activities are support from the administrators, cooperation within the organization, teamwork, participation and clear vision. This also includes good sense of the staff which will result in effective teamwork and strong awareness which helps promote self-awareness and self-determination in performing these activities. In terms of quality of service, lean practices partly increase customers' satisfaction due to promptness of service with the maintained quality of service and products as well as effective communication and warm reception which create good relationships with customers each time. The customers receive comprehensive and fast service, while the environment management system is effective with fewer mistakes. This will result in satisfaction in terms of clearness and convenience of services concerning both documents and samples which is in line with the work of Mathew et al. (1977). The suggestions for adopting lean practices are to organize groups to continuously improve the operation, operational standards, preventive maintenance and staff trainings.

In addition, the activities have helped increase work efficiency as the staff can work faster and still maintain the standards and quality with the ability to improve their working procedures by excluding redundant tasks. The materials and utilities are arranged according to the designed system and staffs have strong discipline. They can train themselves to follow rules and regulations and take part in decreasing the procedures to make the process shorter. In terms of organizational development, the activities have developed the organization and established higher operational standards. The activities have led to organizational development in different aspects conforming to the study by Fawaz [8] which focusing on the application of lean manufacturing in continuous process in which one of the techniques used in this study is to create a map of value, starting with value stream mapping which shows the current status of the company with the sources of wastes and employing the lean techniques in solving the problems to increase the value in the process which will finally become a future state map.

However, these must be the outcome of successful activity operated by the staff according to the declared objectives and the organization can be a good example of effective organization in various aspects which has also been stated in the work of AlirezaAnvari, Yusof Ismail and Seyed Mohammad Hossein Hojjati [9]. The overall lean quality management and lean manufacturing under the lean thinking concept have improved the efficiency of the organization, promoted shorter duration of working time and generated higher customers' satisfaction. The 11 aspects of lean management include the operation of 7S activities which creates effective organization in the center, the review of service quality, the decrease in waste of waiting, the mapping of service system and work process, the increase in work efficiency with information and technology, the development of KPI within the organization, the delivery management, the risk management system, the follow-up assessment, the analysis of economic cost of quality and the development of lean quality management manuals to decrease the tasks that cause the most waste in the operation [10] and to answer the customers' needs in time leading to the highest level of satisfaction which is in accordance with the work of Spann and Rahman, M. [11] which has stated that the lean manufacturing adopted into the operation focuses mostly and mainly on the quality, time duration and responses to the needs of customers.

The completed 11 aspects of lean management have led to the development of 3 manuals, including S7 operation manual, risk management manual and job description manual with key preferment indicator (KPI) under the lean thinking concept used at Suan Dusit Rajabhat University's Environmental Center to be guidelines for the operation. Operating under the lean thinking concept, Suan Dusit Rajabhat University's Environmental Center has effective organization system in terms of the decrease in costs and time [12] while the quality of service is still maintained with effective communication and warm reception which create good relationships with customers each time. Finally, they also develop the operation and establish higher standards of Suan Dusit Rajabhat University's Environmental Center.

VII. SUGGESTIONS AND RECOMMENDATIONS

According to the research results, the researchers have some suggestions and recommendations as follows;

First, concerning the S7 activities, Suan Dusit Rajabhat University's Environmental Center should continuously perform lean activities and develop more guidelines for lean activities. The operation should also be assessed regularly to enhance the staff's enthusiasm.

Second, reviewing the quality of service mind, Suan Dusit Rajabhat University's Environmental Center should keep statistics on cases that cannot be analyzed with remarks. This information can be used to develop and improve services. There should be checklists of tools after field activities and the report should always be submitted so that the tools can be conveniently picked up for the next operation.

Third, as for the delivery management, Suan Dusit Rajabhat University's Environmental Center should keep

statistics on mistakes in reports and arrange meetings to seek guideline for improvement every 1 or 3 months. In addition, statistics on customer complaints should be kept and there should be meetings concerning these issues every 1 or 3 months. Statistics on customer inquiries should also be kept and there should be trainings for the staff so that they are able to provide answers to various questions asked by customers. Old customers should be contacted every 6 months instead of 3 months.

Fourth, in terms of risk management, Suan Dusit Rajabhat University's Environmental Center should perform the risk assessment every 3 or 6 months in order to improve work efficiency and prevent possible risks.

Fifth, Suan Dusit Rajabhat University's Environmental Center should validate the manuals before and after its application so that the manuals can be improved accordingly.

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