Productivity gains through PDCA approach in an Auto Service Station

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Abstract

Improving productivity by eliminating the unnecessary activities have always been the vital prospects in an automobile service parts station. This paper is a case study in the service station of a reputed organization where rejections were monitored on the daily basis starting from finding root cause of rejection followed by action plans. Productivity of the service station is improved using PDCA tool of lean manufacturing. During the study, it was observed that the services offered by the service station was not sometimes well received by the customers and there are still areas for amendments. By using the PDCA tool the productivity was improved significantly by reducing the overall time that was previously consumed in unnecessary activities i.e. changing daily rejections monitoring process to weekly monitoring process. The time saved could thus be used in other productive activities of service station and the rejections got maintained in each quality gate thereby boosting the employee morale and customer satisfaction.

Keywords: Lean manufacturing, productivity, PDCA, auto service station, Kaizen, process mapping.

1. Introduction

Application of the lean philosophy in any organization might result in a system which is leaner from the beginning and needs less improvement during its lifetime. Lean targets to make the work simple enough to understand, do and manage. To accomplish these three goals at once there is a belief held by some that Toyota's mentoring process, (loosely called Senpai and Kohai, which is Japanese for senior and junior), is one of the best ways to foster lean thinking up and down the firm's structure. This is the process undertaken by Toyota as it helps its suppliers improve their own production. The closest equivalent to Toyota's mentoring process is the concept of 'lean sensei', which encourages companies, organizations, and teams to seek outside, third-party experts, who can provide unbiased advice and coaching. Application of the lean theory has confirmed to be an effective way of improving manufacturing systems. Lean is often mentioned to as a philosophy, as a way of thinking. Nonetheless, it also embraces methods and tools to support its execution (Mor *et al.*, 2016)a. Determining when to apply which tool in the improvement processes is not bounded by any formal standard. Indeed, a huge Lean implementation experience has been gained by industry on this topic. This has contributed to the development of an empiric, and yet solidly proven, body of knowledge on the sequential application of methods and tools for achieving a lean system. Reduced costs, eradication of waste and process integration are the basics for success of industries who have adopted lean tools (Rahul and Kaler, 2013).

Lean manufacturing utilizes a wide range of tools and methods; the choice of tools is based on the requirement. Many parameters contribute success of lean. Organizations which implemented lean manufacturing have higher level of litheness and competitiveness. Lean is applicable for all the type of the organization regardless of their size, lot of work has been carried out in manufacturing sector that to in different functional areas. Waste elimination, inventory control and productivity improvement are the key benefits across the lean implemented enterprises in Indian context as well as globally. Mor *et al.* (2016)b revealed that green-lean methodology can improve the process flow and employee morale, and it also lowers down the ecological regulatory non-compliance risk. However, lean manufacturing provides an atmosphere that is highly conducive to waste minimization.

2. Literature Review

There are quite a good number of studies presented in the body of literature focusing on the awareness and Potential for implementation of lean tool in different sector. Storch *et al.* (1999) shown that lean ship production requires continuous and uniform process flows, build strategies must be established and followed which reflect the proper work breakdown, especially block breakdown, even at the expense of design convenience (Rahul and Kaler, 2013; Mor *et al.*, 2017a; Mor *et al.*, 2017b). Achanga *et al.* (2005) research identified the critical factors that constitute a successful implementation of LM within manufacturing SMEs. Leadership, management,

finance organizational culture and skills and expertise, amongst other factors; strong leadership and management permeates a vision and strategy for generating, while permitting a flexible organizational structure (Mor *et al.*, 2016)c. Good leadership ultimately promotes effective skills and knowledge enhancement amongst its workforce. Garg *et al.* (2016) applied the SMED technique which resulted in reduction of 86.6% in setup/changeover time and significant cost savings. *Norani et al.* (2010) research identified the, main reason for failure of implementation of lean manufacturing is due to letdown in managing the change process during a lean manufacturing transformation, organizational change management.

Vinodh *et al.* (2011) analyzed the lean manufacturing practices in different industries and identified the critical factors for its success implementation which are totally committed management, highly trained, motivated and empowered employees working in a team. Internal integration of operations with suppliers and customers. Promotion of creativity and innovative culture. Streamlining of processes and waste elimination. Hodge *et al.* (2011) conducted a research to know lean tool for textile industries to eliminate waste and non-value added activities in US to enhance the customer satisfaction. Rymaszewska (2013) identified the lean manufacturing implementation challenges in small and medium enterprises (SMEs). Karim *et al.* (2013) developed an effective methodology for implementing lean manufacturing strategies and a leanness. VSM and MTM together offered a new approach to reduce lead time and to measure productivity based on Lean principle and standardized processes. Rahman *et al.* (2013) suggested that top management commitment, vendor participation, inventory management and quality improvement are important for Kanban deployment and towards lean manufacturing. Mahmood (2014) provided a better understanding of LP approach in order to enhance productivity, reduce cost and maximize customer value while minimizing waste during the production processes. Productivity is a relationship (usually a ratio or an index) between output (goods and/or services) produced by a given organizational system and quantities of input (resources) utilized by the system to produce that output. Chaple (2014) explored the enablers and barriers in executing lean tools in Indian manufacturing industry. Authors used multiple criterion decision-making methods to assess lean performance. Seifermann *et al.* (2014) worked on low cost automation method for a cellular manufacturing line. Dave *et al.* (2015) showed that lean along with information and communication systems and revealed that lean techniques will highly effective and efficient. Larteb *et al.* (2015) identified that success parameters of lean implementation are top management engagement, commitment, allocation of time and resources for improvement projects, strong management‘s leadership, and employee‘s development program. Kumar and Kumar (2015) established the significance of lean manufacturing elements related to Indian manufacturing industry, study also list the benefits gained, major obstacles faced and identifies the adverse effect such as over cost-cutting, exceptionally low inventories, over-dependence on lean guidelines, physical and mental health, society, product quality etc.

Chikhalikar (2015) identified the important lean tools and time horizon to implement lean tools and revealed that lack of information transmission, improper inventory management, bottleneck operation, material flow and transportation problem, JIT, Kanban, Kaizen, TPM, Six Sigma, 5’S, Single Minute Exchange of Die etc. are the key factors affecting lean implementation. Salem *et al.* (2015) showed that industries in Qatar need to give more credit to lean thinking in order to strategically advance current efficiencies as well as cope with competition at global level. Research also tells that there is difference in the levels of awareness, recognition, and appreciation of lean concepts in different industrial sectors. Choomlucksana *et al.* (2015) applied various lean tools and methods such as visual control, Poka-Yoke, and 5’S to help companies identify areas of opportunity for waste reduction and improve the efficiency of production processes at a sheet metal stamping process. Kogel and Becker (2016) showed that application of the lean philosophy during the design of a new production system might result in a production system which is leaner from the beginning and needs less improvement during its lifetime. It combines the theory of lean and production system design. The design support tool consists of three elements with a strong interaction i.e. steps in design, flow of different types of information and guidelines of lean design.

After reviewing the relevant available literature concerning the implementation of lean it has been observed that Kanban, Kaizen, Continuous Flow and TPM are the most commonly used lean tools in the organization.

3. Problem Formulation

In this section first organization’s current process of work followed by rejection monitoring is discussed and second, problems faced while performing their current process will be discussed.

3.1 Current Scenario

Auto service station daily working routine follow these steps:

- The customer arrives at the service station and entry at the gate is recorded.
- The service attendants attend the customer and note down his/her vehicle’s problem.
- The vehicle is moved to workshop where its maintenance work is done.
- After maintenance vehicle is moved to washing area for the beautification purpose.

- Finally, the vehicle departs.

In this process, three quality checks are performed to monitor rejections at each gate (Figure- 1).

Figure- 1. Current Work Map

3.1.1 Rejections

This section shows the various types of rejection that used to happen at each quality gate and these can be shown as:

- Quality gate 1 i.e. rejections are counted for this gate when customers query was not properly addressed and the attendant was not paying attention while queries are being noted down and acceptable rejections are 10%. Rejections at Quality gate 1 is due to various reasons and classified as R1 to R5 (Figure- 2).

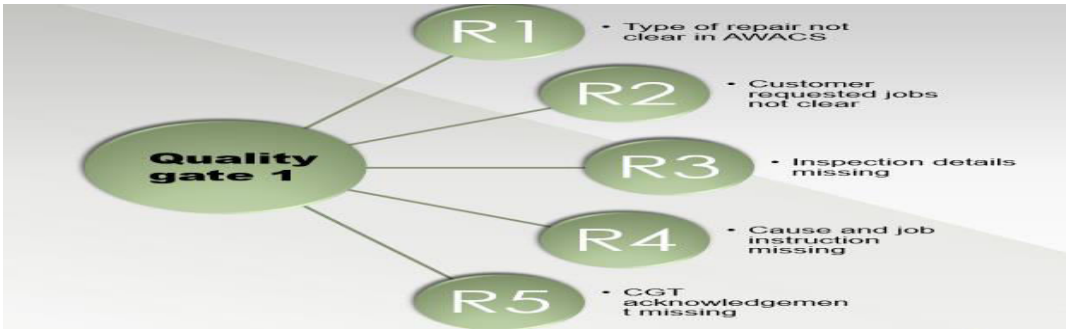

Figure- 2. Types of Rejections at Quality Gate 1.

- Quality gate 2 i.e. rejections counted for this gate when customer's maintenance work is not carried out efficiently due to the carelessness of operator and acceptable rejections are 10%. Rejections are at quality gate 2 due to various reasons and classified as R1 to R3 (Figure- 3).

Figure- 3. Types of Rejections at Quality Gate 2.

- Quality Gate 3 i.e. rejections counted for this gate when the customer is not satisfied with the beautification work and acceptable rejections are 15%. Rejection for this gate is classified as internal and external (Figure- 4).

Figure- 4. Types of Rejections at Quality Gate 3.

Rejections are being monitored on the daily basis and follow these steps with proper documentation:

- Identifying rejections after having either test drive or from customer feedback.
- Classifying above rejections Quality gate wise.
- Identifying the employee who gave maximum rejections at each quality gate.
- Root cause analysis is done for that employee giving maximum rejections and later followed by proper action plan
- Fourth step is individually repeated for each quality gate.

3.2 Findings

Rejections are controlled by performing daily root cause analysis and followed by action plan at each quality gate for the employee whose rejections are maximum after performing rejection analysis. So, their current process leads to two following unwanted outcome:

1. Work stops for the employee whose rejections are maximum at each quality gate.
2. Morale and employee satisfaction.

4. Methodology

Kaizen is a commonly used lean tool for quality and productivity improvement, safety, and workplace culture. Kaizen emphases on executing small and daily changes that result in major improvements over time. Kaizen is the practice of continuous improvement. Kaizen is an exceptionally productive tool and technique of lean productive system which is gone for the selection of innovativeness and development to recognize and decrease non-adding work, and furthermore influence the progressions inside the most limited conceivable time, in this manner increment profitability. Here endeavors are made to apply and keep up nearly nothing however incremental changes consistently with a specific end goal to accomplish a recognized change. Our objective is to improve productivity by eliminating waste in form of unnecessary activities that are being carried in the organization and considering it, as a part of continuous improvement we should initiate Kaizen which in result will improve productivity and many other benefits to the organization. Here, PDCA is the Kaizen tool i.e. used for improvement to avoid unwanted outcomes. PDCA cycle is the lean working structure- the system for executing Kaizen. The acronym stands for:

(i) Plan: Plan is a two-step process where the first step involves identifying and defining the problem existing in a process. The second step comprises of the analysis of identified problem. Further, other actions are as follows:

- Determining the root cause of the problem.
- Determining what the expected outcomes are.
- Determining who the responsible parties will be for the improvement of the problem.
- Scheduling the steps of the correction.
- Justifying the need for the improvement.
- Collecting any data related to the problem.

(ii) Do: Once the plan has been created, the project scope statement signed off on, and the schedule made, it's time to execute the plan. During this phase, a solution will be:

Implemented on a trial basis.

- Continuously checked (see the next step) for efficiency.
- Permanently implemented (if the trial is successful).
- Measured for performance.

(iii) Check: As soon as the execution of the solution starts using the PDCA improvement methodology, it is needed to observe the performance of applied methodology solution over time. Service quality before and after the implementation is compared in the context of following questions:

- Did the implementation of a change reach desired results?
- What did not work?
- What was learned from the implementation?

(iv) Act: Should the proposed methodology work, then the solution should be standardized for the particular/case process improvement and implement it across the business practices. During this final phase of the PDCA cycle, one will want to:

- Identify any training needs for full implementation of the improvement.
- Fully adopt the solution for process improvement.
- Continue to monitor your solution.

5. Results and Analysis

The results obtained from PDCA cycle implementation i.e. the whole PDCA cycle is shown with each step involving many queries and responses for them as well in Table- 1 and second, result is shown in terms of time saved after PDCA cycle fully implemented in Table- 2.

Table- 1. PDCA Cycle

PLAN	
Queries	**Responses**
Determining the root cause of the problem	1. Work stops for the employee whose rejections are maximum at each quality gate. 2. Morale and employee satisfaction.
Determining what the expected outcomes are.	1. Rejections target limit for each quality gate would be maintained. 2. Employee morale would go high. 3. To save time and enhance productivity.
Determining who the responsible parties will be for the improvement of the problem.	1. Assistant manager i.e. rejection analyst. 2. Employee who are responsible for rejections.
Scheduling the steps of the correction.	1. Postpone daily root cause analysis and action to weekly. 2. Format of weekly report for monitoring rejections. 3. Look forward for the change.
Justifying the need for the improvement.	1. Unnecessary activities are waste to the organization and have to be removed. 2. Employee morale is the key factor to enhance productivity for any organization as it also helps in initiating Kaizen.
Collecting any data related to the problem.	1. Data was collected for last few months' i.e. daily reports and monthly rejection reports as well.
DO	
Continuously checked (see the next step) for efficiency.	1. Yes, continuously checked for 4 weeks
Permanently implemented (if the trial is successful).	1. Yes, permanently implemented as trial was successful.
Measured for performance.	1. Performance was measured weekly
CHECK	
Did the implementation of a change reach desired results?	1. Yes, the implementation reached the desired result i.e. rejection rates are under target limit. 2. Employees Morale also got boosted up as earlier scheme was having too tight standards. 3. Time also got saved after removing unnecessary activities.
What did not work?	1. Rejections are still manually done.

What was learned from the implementation?	1. Daily analysis was contributing to unnecessary activities i.e. waste to any organization.
ACT	
Identify any training needs for full implementation of the improvement.	1. Training to employees who are responsible for maximum rejections to make them aware of quality importance at the service station.
Fully adopt the solution for process improvement.	1. Yes, the solution was fully adopted in the working environment.
Continue to monitor your solution.	1. The solution is monitored continuously.

Table- 2. Rejections and Time Analysis

Rejections Analysis				
Before			**After**	
Quality Gate 1			Quality Gate 1	
May 2016	June 2016	July 2016	Sept. 2016	Oct. 2016
3.04%	6.3%	7.16%	2%	5.4%
Quality Gate 2			Quality Gate 2	
May 2016	June 2016		Sept. 2016	Oct. 2016
2.54%	3.84%		3.6%	3.06%
Quality Gate 3			Quality Gate 3	
May 2016	June 2016	July 2016	Sept. 2016	Oct. 2016
4.09%	7.9%	12.33%	12.78%	6.52%
Time Analysis				
In root cause analysis and action plan taken, Time consumed daily = 1 hr. 45 minutes For week (six working days) = 10 hr. 30 min. (approx.)			Time consumed in root cause analysis and action plan taken = 3 hr. 30 min. (approx.)	
			Time Saved = 7 Hrs. per Week	

After implementing PDCA tool of lean manufacturing it is observed that the rejection rate are still under set target limit i.e.

- For quality gate 1 it is 10%
- For quality gate 2 it is 10%
- For quality gate 3 it is 15%

The primary objective of using the PDCA tool was to eliminate the time involved in doing unnecessary activities and it was found to be successful, as the time was reduced by 7 hours/week which could be used in doing some other productive activities. Employee morale also get boosted because of the improved work flow and enhanced productivity of plant (Mor *et al.,* 2015, 2016; Rahul and Kaler, 2013).

6. Conclusions

Lean is characterized as a procedure for accomplishing critical consistent change in execution through the disposal of all squanders of assets and time in the aggregate business prepare. Its standards apply to almost all business operations, from the organization and item configuration to equipment preparations. Lean assembling is about dispensing with waste and non-esteem included assignments. Lean thinking eliminates waste for an organization even if it not manufacturing i.e. can be applicable to service stations as well. In the current study, the Kaizen tool under which PDCA working methodology was selected to eliminate waste in form of unnecessary activities and time as well. After analyzing the case processes at the service station, it is concluded that:

- Daily analysis of rejections was adding waste of time in form of unnecessary activities.
- Weekly analysis revealed not much effect on rejection rate because all stations were still under target limit set by the organization itself and resulted in saving of time to almost seven hours a week.
- Employee morale also get boosted because of the improved work flow and enhanced productivity of plant which are very important for any organization to get a competitive edge over others.

6.1. Limitations, Recommendations, and Future Scope

For Lean Manufacturing, it is always recommended to involve lean thinking in every aspect of organization planning and operations as this study showed the importance of kaizen in the organization and future studies can attempt to reduce rejections and improve the process and can also analyze the employee behavior for rejections.

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