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PRODUCTIVITY IMPROVEMENT OF HIGHWAY ENGINEERING INDUSTRY BY IMPLEMENTATION OF LEAN SIX SIGMA, TPM, ECRS, AND 5S: A CASE STUDY OF AAA CO., LTD.

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Abstract

Purpose: The objective of this study is to improve productivity by means of lean six sigma, TPM, ECRS, and 5S in the highway engineering industry. The study was conducted from November 2017 to April 2018 from a case study of AAA Co., Ltd. The data were collected from the managers and supervisors and the problems were analyzed by brainstorming, cause and effect diagram, and Pareto chart. Referring to the results, it was found that production problems occurred from the asphalt process. The majority problem was wet rock and rock sticking to the conveyor belt.

Methodology: Considering the shed, the shed of stone storage could be changed from construction from net or fabric sieve to construction from the metal sheet. Regarding the conveyor belt, the conveyor belt could be changed from conveyor belt without roof to constructed conveyor roof from metal sheet. The messy construction area was improved by 5S. Essential materials and equipment were sorted in construction area, while the other remained materials and equipment were removed to another area.

Main Findings: The findings demonstrated that Lean Six Sigma, ECRS, TPM, and 5S can be seen as an effective technique that can reduce waste and improve business performance which can be applied in any industry as well as any size of the company. It very well may be viewed as the advancement of the improvement strategies among the representatives and as a preparation technique for the workers. The discoveries illustrated, in any case, that there are snags in the viable execution of the improved methods for any improvement reason.

Implications/Applications: The findings confirmed that it can be applied in both manufacturing and services business. Due to the lower resource investment, it can be implemented in any company like small, medium, and large company.

Keywords: *Brainstorming, cause, and effect analysis, lean six sigma, TPM, ECRS, productivity, 5s, overall equipment effectiveness.*

INTRODUCTION

Presently, the road is the main transportation channel for both public and business transportation; thus, the road is very important to the quality of life and economic growth of Thailand. Having good quality roads will help people to travel conveniently, reduce traffic problems and travel accidents as well as increasing investment from foreign investors. Road construction involves a large amount of budget. In addition, the construction of asphalt roads also requires a lot of raw materials, including 1) stone such as stone dust, rock type 1/2, 3/4, and 3/8, 2) rubber such as rubber-type AC60/70, polymer, and asphalt, and 3) heating processes between 160 and 180 Celsius degrees. The asphalt production process needs to be planned in order to meet customer requirements on good quality, lower cost, and on-time delivery.

From the study, it was found that the operation plan was not in accordance with the plan due to the changing weather and the rain which caused the wet rock and rock sticking to the conveyor belt. These are the obstacles in the production of both delayed and poor quality. In addition, rock sticking to the conveyor belt caused the machine to worked harder. Thus, this study contributes recent studies by improving the overall equipment effectiveness by the application of lean six sigma, TPM, ECRS, and 5S. Setting up a new construction area according to the principle of 5S enables employees to work more easily.

LITERATURE REVIEW

The literature review will be gainful for advocating the model described in detail in the next section.

Productivity

A general definition of productivity is the relationship between the output generated by a production or service system and the input provided to create this output (Prokopenko, 1987). Thus, productivity is defined as the efficient use of resources; labor, capital, land, materials, energy, information; in the production of various goods and services (Drucker, 1999). In addition, higher productivity means accomplishing more with the same amount of resources or achieving higher outputs in terms of volume and quality for the same input (Ruch, 1994). Moreover, productivity is viewed in terms of efficiency and effectiveness of work (Drucker, 1999).

Since globalization has an effect on continuous competition in all business industry. As a result, many researchers have recommended that the definition of productivity as the ratio between output and input as well as the terms of efficiency and effectiveness resulting from the use of that resources is narrow and inappropriate view for measuring the success of the

current business (Lammon, 2010; Riza, 2011). Thus, modern notion of productivity includes consideration of social and ecological costs, ability to create value for customers and stakeholders in the supply chain, ability to meet customers requirements that change over time, survival in high competition, and agility and speed in adapting to meet customer needs (Lammon, 2010; Riza, 2011; Abdurrahaman & Osman, 2017; Anjani & Baihaqi, 2018).

Lean Six Sigma

Lean Six Sigma is the latest generation of improvement methodologies occurred during the time of the late 1990s and early 2000s (George, 2002). It is an integration of lean and Six Sigma methods. Lean manufacturing focuses on reducing losses but cannot reduce the process variation whereas Six Sigma can reduce the process variation but cannot reduce losses or reduce production time (George, 2002; Snee, 2010; Eze, 2017; King, 2016). Therefore, both concepts are applied together, called the Lean Six Sigma which aims to eliminate losses in the production process and using statistical principles to reduce variation in the production process.

A DMAIC improvement cycle is the core tool and can be used as the framework for any improvement applications. The completion of one cycle continues with the beginning of the next. A DMAIC-cycle consists of five consecutive steps or phases. First, define step (D) is intended to clearly articulate the business problem, goal, potential resources, project scope, and high-level project timeline. This information is typically captured within project charter document. i.e., write down what you currently know, seek to clarify facts, set objectives, and form the project team. Second, measure step (M) aims to equitably build-up current baselines as the reason for development. This is an information-gathering step, the motivation behind which is to build up procedure execution baselines. Third, analyze step (A) aims to identify, approve and select main driver for end. Fourth, improve step (I) means to distinguish, test and actualize an answer for the issue, partially or in entirety. This relies upon the circumstance, for example recognizing inventive answers for dispense with the key main drivers so as to fix and avoiding process issues. At last, control step (C) is to install the progressions and guarantee maintainability; this is here and there alluded to as rolling out the improvement stick. When the arrangement has tackled the issue, the upgrades must be institutionalized and supported after some time (Heizer & Render, 2014; Ayuningrat, Noermijati, & Hadiwidjojo, 2016; Dasig, 2017).

Total Productive Maintenance

Total productive maintenance (TPM) is defined as the design to maximize equipment effectiveness, improving overall efficiency by creating an extensive productive-maintenance system, covering the total life of the equipment, spanning all equipment-related fields, planning, use, maintenance, etc. and with the involvement of all workers from top management down to operational employees to promote productive maintenance through motivation management or voluntary small-group activities (Tsuchiya, 1992).

Total productive maintenance gives an extensive organization-wide method to maintenance management which is usually separated into short-term and long-term elements. First, the short-term attentions focus on an autonomous maintenance program for the production department, a planned maintenance program for the maintenance department, and skill development for operations and maintenance individual. On the other hand, the long-term endeavors focus on new equipment design and reduction of origins of lost equipment time.

ECRS

ECRS is an effective approach of the motion study technique used to improve production lines proposed by Mogensen (1932). ECRS represents the four core principles. First, kill squander (E) found in assembling, for example, holding up time, pointless development and work step. Second, join pointless work steps (C) to decrease the quantity of working advances and complete preparing time. Third, modify any procedure step (R) for decreasing separation of moving or the quantity of developments. At long last, streamline (S) or propose a simpler technique for working or present new gear, for example, dances, installations, bolster apparatuses, or machine change, to help administrators.

ECRS is a typical strategy moving examination; accordingly, when any procedure faces with a wasteful working condition identified with human works, ECRS is right off the bat considered and gives powerful outcomes after execution. At the point when ECRS is acquainted with improving any procedure, the outcomes incorporate decrease in handling time and proposing proficient working advances that can lessen superfluous development and holding uptime. The improvement from ECRS prompts decrease in framework cost and vitality cost while the handling time is diminished. Moreover, material expense and waste expense are diminished when the enhancements are influenced to lessen material misfortune from improper working techniques (Kasemset, Boonmee, & Khuntaporn, 2016; Panti, Gempes, & Gloria, 2018; Taorid, 2016).

5S Practices

The 5S practice starts each program of progress. It is the apparatus for helping the examination of procedures running on the work environment. The 5S is the system of creation and keeping up efficient, clean, profoundly viable and top-notch working environment. Its outcome is the successful association of the working environment, decrease of workplace's, disposal of misfortunes associated with disappointments and breaks, improvement of the quality and security of work (Karkoszka & Szewieczek, 2007). The way of thinking of the 5S has its underlying foundations in Japan created by Osada

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in the mid 1980s (Khamis, Ab Rahman, Jamaludin, Ismail, Ghani & Zulkifli, 2009). The name 5S is the truncation of five Japanese words including Seri, Seiton, Seiso, Seiketsu, and Shitsuke. 80s.

First, Seri (sort) is aimed to sort, organize the workplace, and eliminate unnecessary materials. Through the suitable sorting, it can identify the materials, tools, equipment and necessary information for realization the tasks. Sorting eliminates the waste material (raw materials and materials), non-conforming products, and damaged tools. It helps to maintain the clean workplace and improves the efficiency of searching and receiving things, shortening the time of running the operation. Second, Seiton (set in order) aims to visualize of the workplace and place for everything (e.g. painting the floor distinguishes the spots of capacity of every material or transport ways, drawing out the states of instruments makes it feasible for the snappy setting aside them on the consistent spots, shaded marks license to recognize the material, save parts or reports and so forth.). It ought to execute the isolation of things and imprint the spots of their putting away. Third, Seiso (shine) aims to clean and remove wastes or dust. Regular cleaning permits to identify and to eliminate sources of disordering and to maintain the clean workplaces. During cleaning, it checks the cleanness of machine, working environment and floor, snugness of gear, cleanness of lines, channels, wellsprings of light, current information, clarity and fathomability of conveyed data, and so on. Essential is the dealing with and upkeep of individual cleanliness of the administrator. Next, Seiketsu (standardize) aims to be constant place for things, consistent guidelines of association, stockpiling and keeping cleanness. Worked out and actualized norms as techniques and directions grant to maintain control on the work environments. Norms ought to be informative, clear and straightforward. With respect to during planning and improving, it ought to include all members of the procedure on the given working environment; it means direct specialists. The gathering knows the best explicitness of its own exercises, and procedure of elaboration and from that point forward, use gives them probability of understanding the quintessence and every part of the activity. In the point of guaranteeing all the simple access, mandatory gauges ought to be found inconsistent and unmistakable spots.Finally, Shitsuke (sustain) aims to be automatic realization of the above-mentioned rules (Sharma & Singh, 2015).

Executing the possibility of the 5S will request from laborers the minimized self-restraint associated with actualizing and complying with the principles of normality in cleaning and arranging. It prompts expanding the cognizance of representatives and diminishing the quantity of non-acclimating items and procedures, upgrades in the inner correspondence, and through this to progress in human relations.

RESEARCH METHODOLOGY

The goal of this examination is to improve efficiency by methods for lean six sigma, TPM, ECRS, and 5S in the thruway designing industry. The investigation was directed from November 2017 to April 2018 from a contextual analysis of AAA Co., Ltd. The information was gathered from the chiefs and directors and the issues were broke down by conceptualizing circumstances and logical results outline, and Pareto diagram. The operational performance is measured by the overall equipment effectiveness (OEE). After measuring current operational performance, the analyzed and improved process was developed by means of lean six sigma, TPM, ECRS, and 5S. Next, the operational performance after improvement was measured, meanwhile, productivity or improvement growth was calculated by the ratio between the difference of OEE after improvement and current OEE divided by current OEE.

OEE = A x P x Q

OEE = Overall Equipment Effectiveness (OEE)

A = Machine Availability Rate

P = Machine Performance Efficiency

Q = Quality Rate

$$\text{Productivity/Improvement Growth} = \frac{\text{(OEE after improvement - Current OEE)}}{\text{Current OEE}}$$

RESULTS AND FINDINGS

Results from Defined Problem Process

Based on the participation and observation study together with brainstorming with managers, supervisors, and relevant employees, the results found that the majority problem was the wet rock and rock sticking to the conveyor belt.

Results from Measurement Process

Current operational performance is measured by current overall equipment effectiveness which is calculated as followed

Current OEE = Current [A x P x Q]

Current OEE = Current Overall Equipment Effectiveness (Current OEE)

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Current A	= Current Machine Availability Rate	= 96%
Current P	= Current Machine Performance Efficiency	= 91%
Current Q	= Current Quality Rate	= 94%
Therefore ,		
Current OEE	= 96% x 91% x 94%	= 82.12%

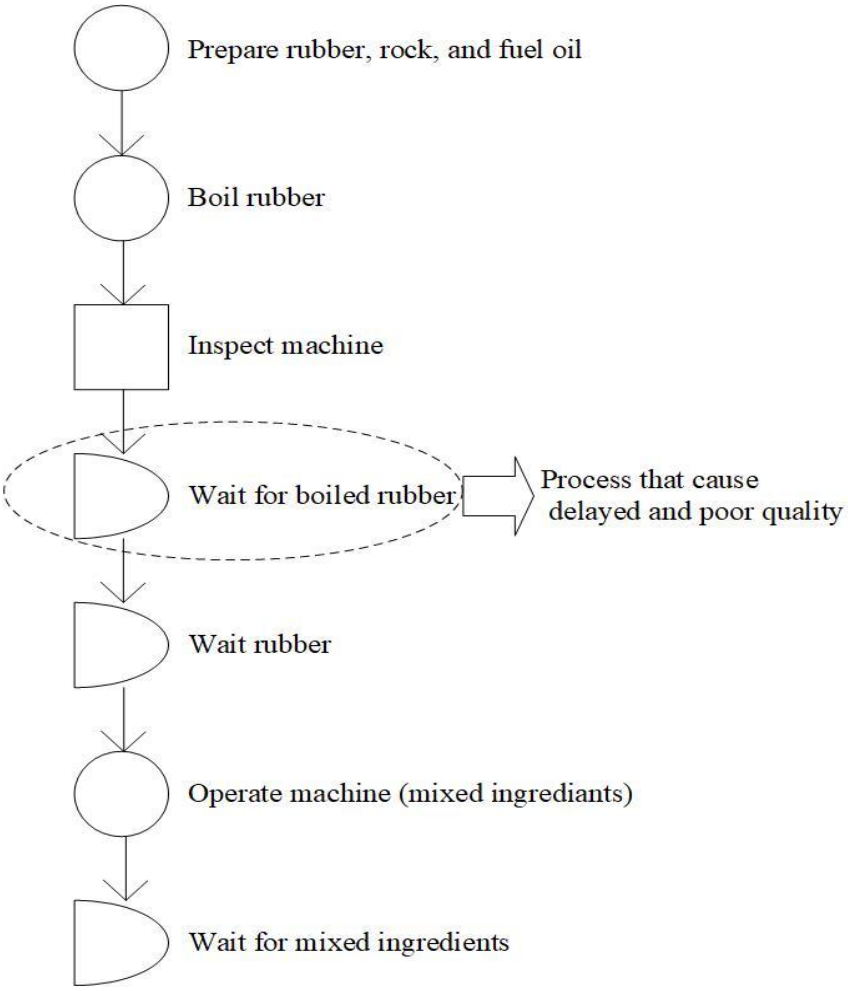

Figure 1: Flow Process Chart of Asphalt Production Process

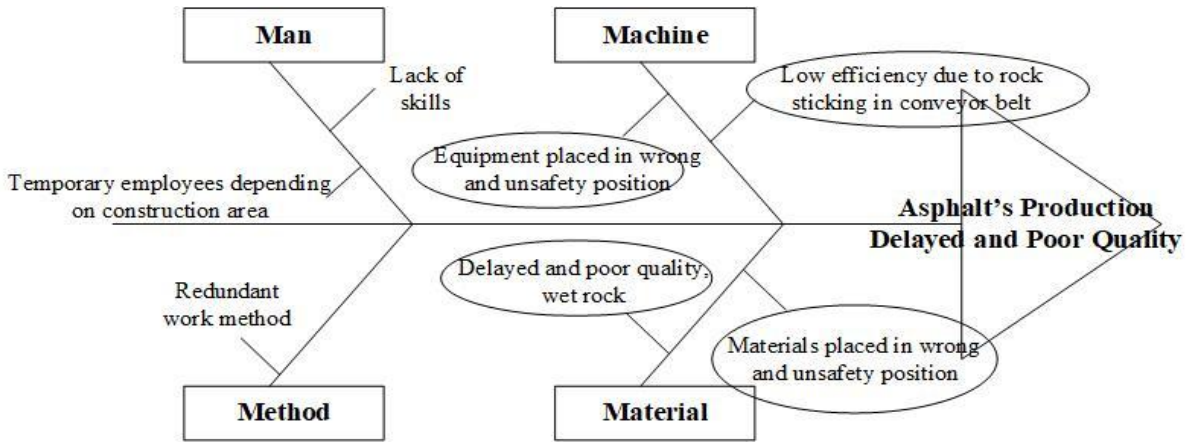

Figure 2: Results from the Brainstorming and Cause and Effect Diagram

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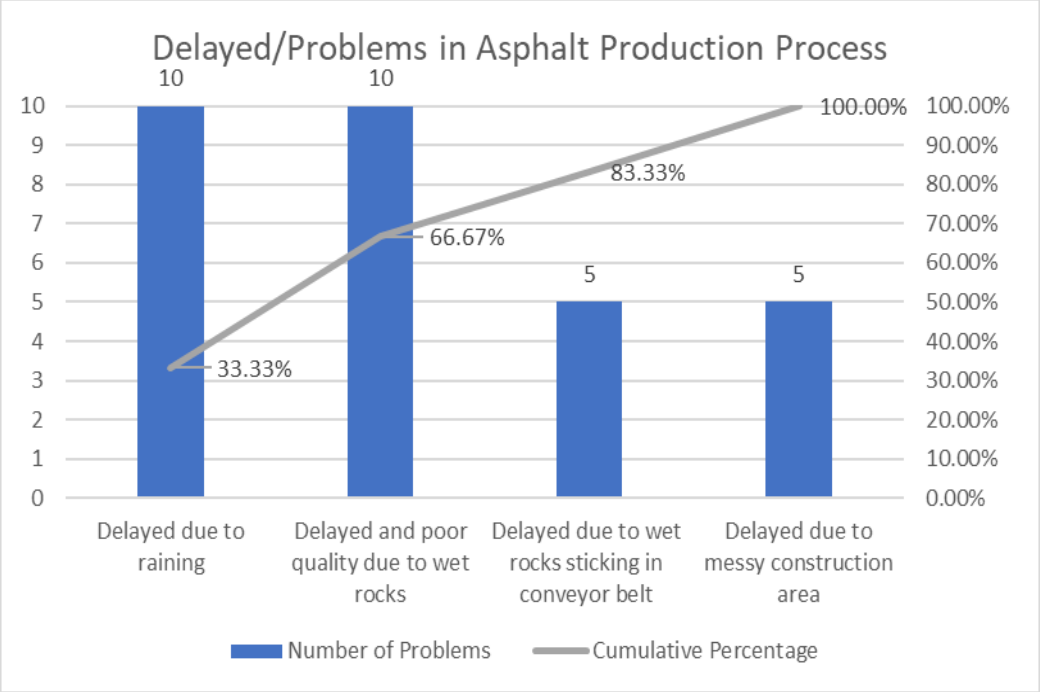

Figure 3: Defined Root Causes using Pareto Chart

Results from Analysis and Improvement Process

According to results from the pareto chart, the main delayed and poor quality problem occurred from the rain; however, rain is a seasonal phenomenon which cannot be eliminated. Thus, the remained problems including wet rock, rock is sticking in conveyor belt, and messy construction area.

Thinking about the shed, the shed of stone stockpiling could be changed from development from net or texture sifter to development from metal sheet. As to the transport line, the transport line could be changed from transport line without rooftop to built transport rooftop from metal sheet. The chaotic development territory was improved by 5S. Basic materials and hardware were arranged and put away in development territory, while the other remained materials and gear were expelled to another region. The general hardware adequacy changed from 82.12 percent to 90.23 percent, representing 9.88 percent of progress

Figure 4: Current Shed for Storage Rock Constructed from Net or Fabric Sieve

Figure 5: Improvement Shed for Storage Rock Constructed from Metal Sheet

Figure 6: Current Conveyor Belt

Figure 7: Improvement of Conveyor Belt

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Figure 8: Current Messy Construction Area

Figure 9: Improved Construction Area Using 5S Practice

OEE After Improvement = After Improvement [A x P x Q]

After Improvement OEE = After Improvement Overall Equipment Effectiveness

After Improvement A = After Improvement Machine Availability Rate

= 99%

After Improvement P = After Improvement Machine Performance Efficiency

= 93%

After Improvement Q = After Improvement Quality Rate

= 98%

Therefore

After Improvement OEE = 99% x 93% x 98% = 90.23%

Table 1: Comparing Current and After Improvement Overall Equipment Effectiveness

Details	Current (%)	After Improvement (%)	Improvement Growth (%)
Machine Availability Rate	96%	99%	3.13%
Machine Performance Efficiency	91%	93%	2.20%
Quality Rate	94%	98%	4.26%
Overall Equipment Effectiveness	82.12%	90.23%	9.88%

Results from Control Process

This study improved the delayed and poor quality of the asphalt process by building a shed and conveyor roof from a metal sheet which is rigid construction. The control process can be done by maintaining the shed and conveyor belt in good condition and ready to use all the time. Regarding construction area, 5S will be successful, requiring stringent maintaining systems, two-way communication between top management and bottom employees, announcement to all employees that 5S is fundamental and requires joint effort from laborers, the minimal self-control associated with executing and complying with the principles of consistency in cleaning and arranging.

DISCUSSIONS AND CONCLUSION

The goal of this investigation is to decrease squander and improve efficiency by methods for lean six sigma, TPM, ECRS, and 5S in the thruway designing industry. Brainstorming, cause and effect, and Pareto chart were used to identify root causes of wastes, bottleneck, and problems. From the characterized stage results, it was discovered that creation issues happened from the black-top procedure. The lion's share issue was wet shake and shake adhering to the transport line. The results from pareto chart reported that the main delayed problem occurred from the rain. Since it is natural season, rain cannot be eliminated. Thus, ECRS was implemented by simplifying shed building and conveyor roof. Rigid construction building requires maintenance in good quality.

Based on the cause and effect diagram, one of the delayed problems in asphalt production process occurred from delayed sorting and transportation. There are some large materials, tools, and equipment irrelevant asphalt production processes such as pillar, truck, and piling tools. This was improved by cleaning, classifying tools and equipment, and moving irrelevant tools and equipment to suitable area. Employees were familiar and inclined to work in the current method, which makes unsuccessful 5S practice. Thus, company announced and enforced 5S practice as one of the important policies. Meanwhile, managers and employees must follow them strictly, becoming a part of daily work.

Waste elimination is important for all business. Though lean production proposed that there are 8 wastes in the production process, it is unnecessary to reduce all wastes at the same time depending on problem analysis and limitations of each company. The results showed that even this study reduced only three wastes, i.e. waiting time, defect, and delayed of transportation, the improvement of overall equipment effectiveness is satisfied.

One of the well-known methods used to measure Total Productive Maintenance (TPM) is Overall Equipment Effectiveness (OEE). High level of OEE requires a high level of three ratios including machine availability, machine performance efficiency, and quality rate. Once any ratio is reduced, then OEE is low. Thus, it is related to the involvement of all workers from top management down to operational employees to promote productive maintenance through motivation management or voluntary small-group activities. In addition, the interruption and low level of speed of machine result in low level of OEE. In accordance with this study, company emphasizes on autonomous maintenance by creating the machine instruction, planning the maintenance program, training program for developing the skill for operations and maintenance individual, and designing conveyor belt roof for reduction of origins of lost equipment time.

Continuous improvement is known as Kaizen in Japanese. The utilization of the Kaizen standards guesses a constant correspondence between the chief and the workers (vertical correspondence) what's more, between the representatives on the equivalent progressive level (flat correspondence). The utilization of the Kaizen standards includes no real costs, however just more consideration regarding subtleties and commonsense approaches to improve and all the more proficiently. The straightforwardly gainful representative is especially energized with the goal that they can propose and make enhancements (Titu, Oprean & Grecu, 2010). After a point by point examination, the outcomes have seen that, even in the zones where no upgrades are required, for example, distribution center region, there are still a lot of potential outcomes to improve. A decent administration of HR in the association is one of the key goals of the association which ought to be plainly characterized and acknowledged by all individuals. The persistent improvement standards are the obstruction structure that ought to be based on, with the goal that we can get to a consistent and bit by bit improvement of the organization execution. Issues ought not to be associated with workers in light of the fact that accusing representatives doesn't take care of the issue. Critical thinking should utilize input procedures.

The results demonstrated that the implementation of Lean Six Sigma, TPM, ECRS, and 5S techniques can be applied in AAA company operating in highway engineering industry which is the non-manufacturing industry as well as small enterprises. These techniques involve with Toyota Production System (TPS) which focuses on the active involvement of all employee categories, aiming too small but continuous development. Lean manufacturing is one of the options to reduce non-value-added activity (wastes) and improve operational efficiency of the organization. The efficient implementation of 5S technique leads to improvement in environmental performance and thus primarily related to reduction of wastes in manufacturing. It promotes neatness in storage of raw material and finished products, reduction in accident, and increase of awareness and morale of employees (Titu, Oprean, & Grecu, 2010). Regarding ECRS concept, all 4 principles are unnecessary to be applied at the same time depending on problem analysis and limitations of each company. The results showed that even though this study applied only one principle of simplifying process, the improvements are in satisfactory level.

The findings demonstrated that Lean Six Sigma, ECRS, TPM, and 5S can be seen as an effective technique that can reduce waste and improve business performance which can be applied in any industry as well as any size of the company. It tends to be viewed as the advancement of the improvement systems among the workers and as a preparation technique for the representatives. The discoveries illustrated, notwithstanding, that there are impediments in the powerful execution of the improvement procedures for any improvement reason. The most critical deterrents recognized are identified with consumption of correspondence, hole between the top administration and shop floor administrators and furthermore the deficient of preparing and awareness of this action among the workers. Along these lines, the full points of interest of the improvement strategies can't be knowledgeable about the business segment until every one of the downsides related with use of the improvement systems are perceived, totally fathomed and tended to. Consistent assessment in all degree of firms is one noteworthy driver to change the improvement culture of the organization. This assessment ought to be accentuated on the advancement and improvement of amount and nature of items, level of resolve and fulfillment of representative, level of amount and nature of correspondence, monetary execution, and consumer loyalty.

RECOMMENDATIONS

There are several recommendations as followed:

1. Japanese management and TPS techniques require a top-down methodology that turns out to be a piece of corporate texture. Educating TPS systems can't happen in a study hall or through courses, however where the activities really occur. To be viable, everybody must be completely mindful of the different structures that waste can take and be always cautious of any chances to assault and dispose of these squanders. Senior officials should normally stroll through the tasks, watching the exercises, posing inquiries, and showing their responsibility to the procedure. Time after time, organizations treat these procedures as projects that can be begun and halted as required. They only from time to time give it the essential help and time to turn out to be a piece of the corporate.
2. Though the principle of Japanese management and TPS techniques are related to no significant costs, just more consideration regarding subtleties and down to earth ways is required to improve and all the more effectively together with continuous improvement over time. Thus, it can be applied in both manufacturing and services business. Due to the lower resource investment, it can be implemented in any company like small, medium, and large company.
3. There are several Japanese management and TPS techniques. This study applied some of them, i.e. Lean Six Sigma, ECRS, TPM, Kaizen, and 5S, the results are satisfying. It is necessary for all businesses to analyze and select suitable tools for their situations which may be similar or dissimilar to this study, for instance just in time (JIT), lean production, six sigma, push-pull system, Jidoka, Poka Yoke, Kamban, 8 wastes, single-minute exchange of die (SMED), Hejunka, Genchi Genbutsu, visualization, respecting employees, team and suggestion system.
4. Though Japanese management and TPS techniques are pervasive implementations in worldwide business, European and Western management and techniques are widely applied as well. Since European and Western management are involved with high technologies, machines, and innovations, which require high level of investment, a business needs to calculate break event point and payback period before deciding to invest in training course for novel equipment utilization.

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REFERENCES

1. Abdurrahaman, D. T., & Osman, Z. (2017). Development of conceptual framework for Nigerian generation Y-ers' purchase intention and response towards indigenous celebrity-endorsed products: A PLS-SEM Study on Selected Mobile Service Providers in Nigeria. *Journal of Administrative and Business Studies*, *3*(1), 49-59. https://doi.org/10.20474/jabs-3.1.6
2. Anjani, B. R., & Baihaqi, I. (2018). Comparative analysis of financial Production Sharing Contract (PSC) cost recovery with PSC gross split: Case study in one of the contractor SKK Migas. *Journal of Administrative and Business Studies*, *4*(2), 65-80. https://doi.org/10.20474/jabs-4.2.2
3. Ayuningrat, M. P., Noermijati., & Hadiwidjojo, D. (2016). Green product innovation's effect on firm performance of managerial environmental concern and green communication. *Journal of Administrative and Business Studies*, *2*(2), 56-63. https://doi.org/10.20474/jabs-2.2.1
4. Dasig, Jr, D. (2017). A frontier in organizational and business process innovation in service management through lean six sigma Kaizen project implementation. *Journal of Administrative and Business Studies*, *3*(6), 263-283. https://doi.org/10.20474/jabs-3.6.2
5. Drucker, P. F. (1999). *Management challenges for the 21st century*. New York, NY: Harper Collins.
6. Eze, I. O. (2017). Corporate governance mechanisms and earnings management in Nigerian food product companies. *Journal of Administrative and Business Studies*, *3*(1), 1-9. https://doi.org/10.20474/jabs-3.1.1
7. George, M. L. (2002). *Lean six sigma: Combining six sigma quality with lean speed.* New York, NY: McGraw-Hill.
8. Heizer, J., & Render, B. (2014). *Operations management* (11th ed.). London, UK: Pearson Education Limited.

9. Karkoszka, T., & Szewieczek. D. (2007). Risk of the processes in the aspect of quality, natural environment and occupational safety. *Journal of Achievements in Materials and Manufacturing Engineering*, *20*, 539-542.
10. Kasemset, C., Boonmee, C., & Khuntaporn, P. (2016). Application of MFCA and ECRS in waste reduction: A case study of electronic parts factory. Proceedings of the *2016 International Conference on Industrial Engineering and Operations Management*, Kuala Lumpur, Malaysia.
11. Khamis, N., Ab Rahman, M. N., Jamaludin, K. R., Ismail, A. R., Ghani, J. A., & Zulkifli, R. (2009). Development of 5S practice checklist for manufacturing industry. Proceedings of the *World Congress on Engineering 2009*, July 1 - 3, London, U.K.
12. King, J. M. (2016). Dubai wins: A content analysis of global media coverage of the 2020 world exposition bidding process using nation branding theory. *International Journal of Business and Administrative Studies*, *2*(6), 201-211. https://doi.org/10.20469/ijbas.2.10005-6
13. Lammon, D. (2010). *An examination of productivity in the utility industry* (Master thesis). Empire State College, State University of New York, New York, NY.
14. Mogensen, A. H. (1932). *Common sense applied to motion and time study.* New York, NY: Factory and Industrial Management, McGraw-Hill book company, Inc.
15. Osada, T. (1991). *5S's: five keys to a total quality control environment.* Tokyo: Asia Productivity Organization.
16. Panti, E., Gempes, M., & Gloria, P. (2018). The mediating effect of risk management strategies on the relationship between attitude constructs and sustainability of banana production in Southern Philippines. *International Journal of Business and Administrative Studies*, *4*(2), 68-77. https://doi.org/10.20469/ijbas.4.10004-2
17. Prokopenko, J. (1987). *Productivity management: A practical hand book.* Geneva: International Labour Office.
18. Riza, A.R. (2011). *Methodology development for calculating productivity and its losses to determine optimization regime in assembly line* (Master thesis). Malaysia: School of Manufacturing Engineering, University of Malaysia Perlis.
19. Ruch, W. A. (1994). Measuring and managing individual productivity. In H. H., Douglas (Eds.), *Organizational linkages: understanding the productivity paradox* (pp. 105-130). Washington, D.C, WA: National Academy Press.
20. Sharma, R., & Singh, J. (2015). Impact of implementing Japanese 5S practices on total productive maintenance. *International Journal of Current Engineering and Technology*, *5*(2), 818-825.
21. Snee, R. D. (2010). Lean six sigma: getting better all the time. *International Journal of Lean Six Sigma*, *1*(1), 9-29. https://doi.org/10.1108/20401461011033130
22. Taorid, A. A. (2016). Enhancing business process through research. *International Journal of Business and Administrative Studies*, *2*(3), 62-69. https://doi.org/10.20469/ijbas.2.10002-3
23. Titu, M. A., Oprean, C., & Grecu, D. (2010). Applying the Kaizen method and the 5S technique in the activity of post-sale services in the knowledge-based organization. Proceedings of the *International Multi Conference of Engineers and Computer Scientists, 2010*, Vol III, IMECS 2010, March 17-19, Hong Kong.
24. Tsuchiya, S. (1992). *Quality maintenance: Zero defects through equipment management.* Cambridge, MA: Productivity Press.

