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A Collaborative Scheme with Vendor in Kaizen

A D Peterson and J F Chin*

School of Mechanical Engineering, Engineering Campus, Universiti Sains Malaysia, 14300 Nibong Tebal, Pulau Pinang, Malaysia.

Corresponding author *: chinjengfeng@usm.my

Abstract. The paper investigates a novel collaborative Kaizen scheme that involves vendor as the volunteered countermeasure provider in exchange for a fair sharing in gain. The skeleton of the scheme is made up of Plan-Do-Check-Act (PDCA). In Plan, the required improvement is first assessed by the Kaizen team to gauge the need to bring in vendor. The proposal must be scrutinized and undergoes negotiations for acceptable terms to both parties, which ultimately helps to build a long-term partnership. The scheme is presented as a case study in an Original Equipment Manufacturer (OEM) where energy consumption and maintenance cost for workstation lighting system at the production were reduced through the implementation of countermeasure proposed by vendor. The implementation cost was fully borne by the vendor and in return, the vendor would be paid in amount equivalent to the saving on the energy bill for the next nine months.

1. Introduction

The success of Japanese automotive industry has for the past decades attracted various studies on their manufacturing operation and management. One of the attributing factors is lean manufacturing. The concept was made known and popularized by Womack et al. [1] in their book titled “The machine that changed the world”. The essence is to streamline process and eliminate waste “Muda” [2-4]. Muda generally describes activities not adding value from the customer’s perspective. According to Ohno[5], there are seven classes of Muda: overprocessing, overproduction, defect, motion, work-in-process (WIP), idling and transport. The elimination of Muda calls for continuous improvement (CI) or Kaizen [6]. It is a team-based, goal-oriented and systematically deployed activity, coordinated at the enterprise level. A common structure of Kaizen is based on PDCA, which breaks down the Kaizen into four stages, as the name implies: PLAN – detain planning, DO – implementation of works, CHECK – measure the changes and ACT – refine the improvement [7-8].

Evident by the prevalence of more sophisticated supply chains, business activity outsourcings and technology development partnerships, the manufacturing sector has grown increasingly collaborative where independent parties with complementary strengths, work together to more effectively pursue on shared interests. Yasin et al. [9] estimated that as much as 75% of production cost for purchasing goods and services originated from external sources. Such phenomenon affects all levels of manufacturing organizations, and therefore calls for a new paradigm of management. Turiera and Cros [10] discussed successful partnerships between major organizations, for example, Coca-Cola & Heinz who developed 100% recyclable “Plant Bottle” which reduces carbon footprint by 19% in manufacturing. Microsoft & Toyota developed energy management system which connect hybrid Toyota vehicle and an electric system together to maximize the efficiency of charging. Many researches show engagement with external parties through lean practices enhances its success. Chong et al. [11] presented a case study

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where good practices were transferred to suppliers, in hope to improve their product quality and process capacity. Southard et al. [12] implemented Poka-yoke to track pharmaceutical products and achieved a better coordination with supplier in replenishment while reducing operational cost. Adopting Lean during vendor collaboration can reduces movement of raw materials, WIP storage, rework time etc. This could be achieved by using Lean tools such as seven wastes, 5S, JIT (Just-in-time), Poka-yoke etc [13-17].

The research investigates a special form of collaborative Kaizen scheme, where vendor acts as the volunteered countermeasure provider in a Kaizen in exchange for a fair sharing in gain from the project. This form of collaboration is interesting in view that conventional Kaizen is often deployed using internal capacity and resources of an organization. In many occasions, this would limit the options or countermeasures in the Kaizen, especially if new or unfamiliar technology is involved. On the other hand, vendor, owning and with better knowledge on the technology would be keen to promote their countermeasure and secure the business. The major concern by the organization however would be on the risk accompanying to the amount of investment, the success rate and the effectiveness of the countermeasure. The scheme presents an alternative paradigm whereby vendor is persuaded to significantly absorb the countermeasure cost (hence the risk) and in return being offered a share in the financial benefits. This could be considered a win-win scenario.

The arrangement of the paper follows as: Section 2 introduces the collaboration Kaizen scheme with vendor. Section 3 validates the scheme in an OEM electronic measuring system manufacturer. Section 4 discusses the collaboration and the implementation and Section 5 provides a conclusion.

2. Collaborative Kaizen scheme with vendor

The collaborative Kaizen scheme (as shown in Figure 1) adopts PDCA as the methodological skeleton. It begins with the Plan stage which defines the problem. A Kaizen team is formed to grasp the current condition and assess in-house problem-solving capability before deciding to engage a vendor. To start the vendor engagement, suitable vendors will be formally invited to submit their proposals. Next, the Kaizen team reviews these proposals, makes selection and negotiates on price, lead time, risk and reward sharing etc. The outcome of the review would have to be presented for management approval so that contract could be issued.

Do stage is where the countermeasure is implemented by vendor, and progress to be monitored. The Kaizen team would provide the necessary supervision. Check stage compares the initial and improved stages to gauge the degree of improvement achieved. Act stage refines and standardizes the improvement. Upon the project's closure, the overall engagement is reviewed with achievement and shortcoming documented. The knowledge obtained would be shared within the organizations.

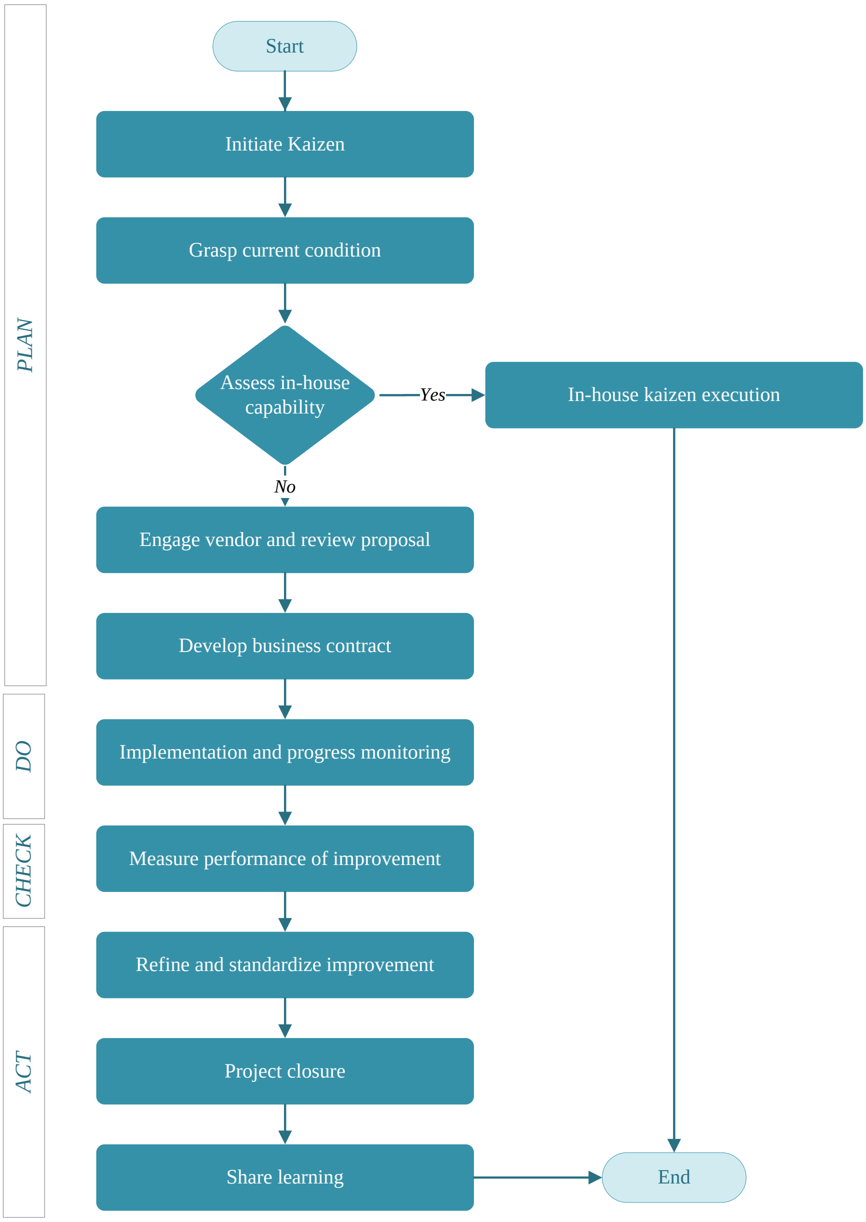


Figure 1. Collaborative Kaizen scheme with vendor

3. Collaborative Kaizen scheme with vendor

Company A is an OEM which develops electronic measuring systems and is currently based in Penang, Malaysia. Its products focus on technology fields such as Cellular (5G), Aerospace & Defense. The company adopts Lean practices and tools for daily troubleshooting and continuous improvement. Company A has also an established vendor data system which categorizes vendors according to the types of engagement support given to production floor.

3.1. Plan stage

There were 128 workstations in the production lines catered for processes such as assembly, debugging, testing, repair, inspection, button up etc. A Kaizen team was formed to investigate ways to reduce expenditures on workstation lighting. A workstation lighting comprises two lighting holders, two 36-watts fluorescent tubes, two electronic ballasts, switches and wirings. The Kaizen team consisted of one champion, one mentor, one team leader, one co-leader, and two representatives from production lines.

A SMART goal was determined that is to reduce the expenditure associated to the lighting system of the 128 workstations by 30% within the duration of two weeks.

To grasp the current condition, fishbone analysis was performed through the brainstorming amongst the Kaizen team members, as illustrated in Figure 2. Multiple causes were identified and using CNX analysis the findings were further classified into Constant (requires standard operating procedures), Noise (uncontrollable) and X (variables considered as key processes). X variable will be investigated for improvements [18]. Two main causes to focus on were high energy consumption and maintenance cost.

The electricity and maintenance costs from 2014 – 2016 are as shown in Table 1. Fluorescent tubes were no longer considered energy efficient and the maintenance cost was high due to multiple parts and replacements. Around 30% of workstations required servicing or repair yearly due to wear and tear. The works must be carried out by external vendor to comply with the company safety policy. The average replacement cost for a set of lighting was RM 90 per trip, which includes material (36-watt fluorescent tubes and ballast), wiring and workmanship.

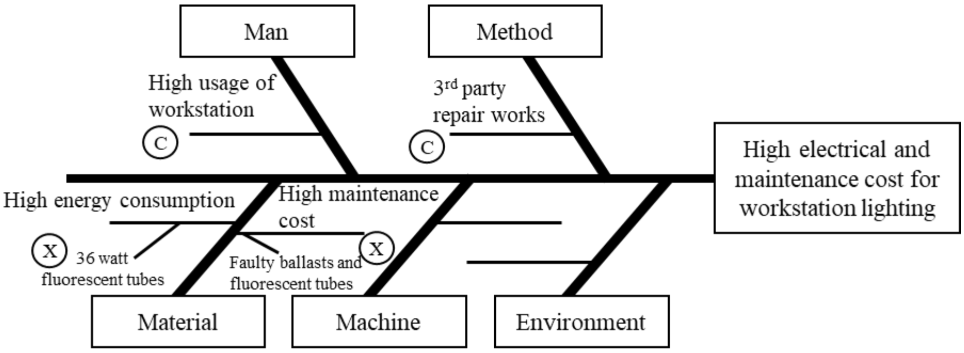


Figure 2. Fishbone analysis

Table 1. Energy bill and maintenance cost from 2014 to 2016

No.	Year	Electric bill (RM)	Maintenance cost (RM)
1.	2014	9,411.36	3,310
2.	2015	9,485.67	3,380
3.	2016	9,501.87	3,510

Potential countermeasures were identified by the Kaizen team, however they were deemed unsatisfactory. The Kaizen team initiated vendor engagement on the ground that mass installation of lighting needed expert knowledge unavailable to the company. Several potential vendors were formerly liaised. A draft contract and reviewing criteria were established and distributed to them. They were allowed an escorted Gemba walk to the production and data collection. Their proposals would be submitted within two days. After reviewing the proposals, Vendor X was selected. The countermeasure proposed by Vendor X was summarized in Table 2.

Table 2. Summary of the countermeasure

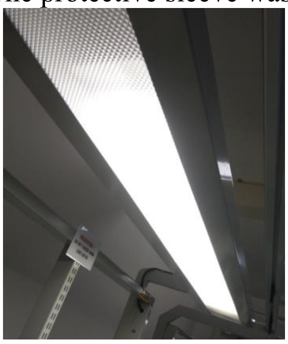
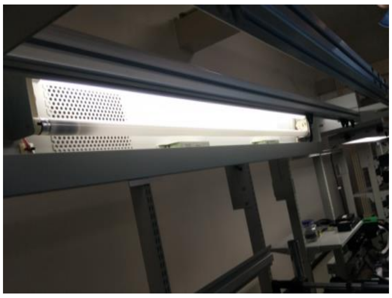
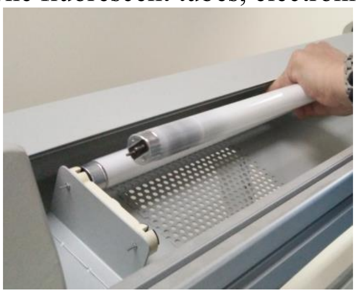
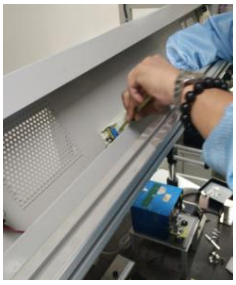
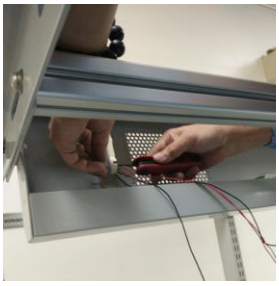
Countermeasures & Principle	• To convert conventional fluorescent lighting tubes into light-emitting diode (LED) tubes.
Improved/innovated ideas	• Less energy required changing from 36-Watt to 16-Watt. • Do not require electronic ballast.
Installation method & Sample	• The current lighting setting (the fluorescent tubes, electronic ballast, tube holder and wiring) would be removed and replaced with new LED tubes, wirings and tube holders.

An independent evaluation on the installation cost would be approximately RM5,000. The replacement cost for LED tubes would reduce approximately to RM 60/trip due to a lower material cost. In addition, LED is significantly more reliable and with a longer life than fluorescent tubes. It estimated that the failures of the lighting would reduce by 10%. Negotiation with Vendor X was done for better pricing, lead time and risk sharing. The final price of LED tubes is RM 25/2pcs, with one-year warranty. The vendor absorbed the whole installation cost in exchange for payment equivalent to the resultant energy cost saving over a fixed period. The saving would be calculated using the bill calculator by Tenaga Nasional Berhad (TNB) official website. The resultant saving is RM 836.93/month. For the next nine months, this amount would be paid to vendor on monthly basis upon confirmation of such saving by the finance department. The details of the business contract also include the current organization policy such as the vendor must have a valid business registration number, technical certification and payment term etc. The final decision, business contract details and implementation plan were discussed, complied for management and finance approval.

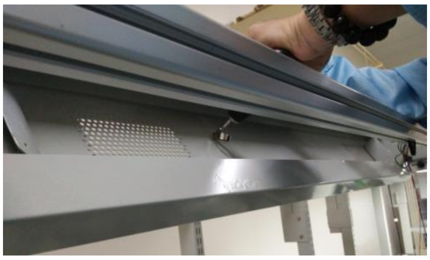
3.2. Do stage

Installation was performed in one day during the weekend when the production was not running. The workstations were cleared and sensitive equipment were covered to prevent dust and damage from the installation. The Kaizen team was stationed in the facility to monitor the implementation. Thirty minutes was required to install LED on a workstation as shown in Table 3. Lux meter was used to measure the brightness after the several installations. The LED tubes were slightly brighter than the fluorescent tubes but within the acceptable lighting criteria of 420 +/- 5% Lux. Production resumed as normal the next day without any disruption reported.

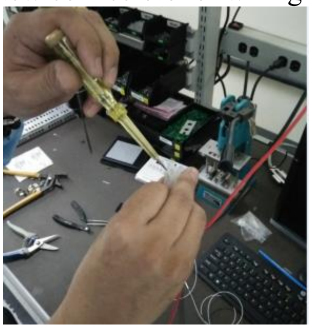
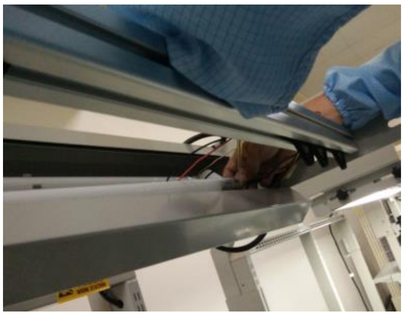
Table 3. Steps for workstation lighting installation

Step 1 The protective sleeve was removed, exposing the faulty fluorescent tube.  
Step 2 The fluorescent tubes, electronic ballasts, tube holders and wiring were removed.   

Step 3 New tube holders were drilled into the lighting frame and LED tubes were inserted.




Step 4 New connectors for wiring and LED tubes were installed.

Step 5 The new lighting system was tested and a protective sleeve was installed.


Observation:
The difference after the modification cannot be notice after the protective sleeve was place back.

3.3. *Check stage*

A comparison between initial and improved stage for the implemented countermeasure is shown in Table 4. The workstation lighting has been monitored for the next two months after the installation. Evidently, the implementation improved the efficiency and operational cost of the workstation. This can only be achieved with the support and expertise of Vendor X.

Table 4. Comparison between initial and improved stages

Initial stage	Improved stage
Cost concern: *High energy consumption and maintenance cost due to faulty ballasts and fluorescent tubes.*	Cost concern: *Achieved more than targeted reduction of 30% savings by using LED tubes without ballasts.*
Efficiency of workstation lighting: *Failure report shows approximately 30% of workstations required yearly repair works.*	Efficiency of workstation lighting: *Reduce yearly failure of workstations lighting by 10% due to longer life span of LED tubes.*
Financial validation: - *Finance department validated yearly expenses.*	Financial validation: - *Finance department validated cost reduction.*

Other complaints: - *Messy wiring of workstation lighting.*	Other complaints: - *Messy wiring of workstation lighting.*
	Post implementation monitoring: - *Workstation lighting conversion did not disrupt operations and no failures were detected within two months monitoring period.*

3.4. Act stage
The countermeasure improved the overall efficiency of the workstations. The changes did not disrupt operations schedule and no failures were detected. Refinement for workstation lighting cables further improved the tidiness of the cables using both cable ties and cable tie mounts for better 5S control. This improvement was shared with other departments for standardize of workstation lighting system and reductions of operation cost. RM 7,532.37 was released to vendor over the course of 9 months, as stipulated by the contract. The detail of Vendor X is updated into vendor engagement system. Kaizen team's experience was shared within the organization as shown in Table 5.

Table 5. Knowledge sharing

Knowledge Sharing
Objective: To reduce expenditure associated to the lighting system of the 128 workstations by 30% within the duration of two weeks.
Root causes: High energy consumption and maintenance costs.
Project timeline: 2 weeks
Duration of implementation: 1 day
Vendor's countermeasure
Vendor: X
Countermeasure: Convert workstation lighting system from 36-watt fluorescents tubes to 16-watt LED tubes.
Cost bearing: RM 4,605
Gain received: RM 2,927.37
Kaizen Team Financial Gain
Project review: 100% success and no disruption to production.
Finance gain: Electricity saving Year 1 – RM 2,510.79 Year 2 – RM 10,043.16 Maintenance cost saving Year 1 – RM 3,510 Year 2 – RM 1,950
Technical Knowledge
Conversion from fluorescent light to LED tube reduced electricity usage, maintenance costs.

4. Discussion
In this section, several aspects are discussed. First, the scheme offers detail planning, execution, control and review when vendor is involved. The purpose of the engagement is in line with the objective, namely to reduce both energy and maintenance costs. The scheme helps the Kaizen team to obtain external expertise to solve the problem. Decision makings at the planning stage were based on consensus, facilitated by several lean tools such as fishbone analysis. By outsourcing the problem-solving, the vendor became the execution party while the Kaizen team drives the engagement progress and monitoring. Flexibility was given to vendors in brainstorming for countermeasures and risk sharing criteria. Countermeasure proposed by vendor to fit all workstations with 16-watt LED tubes reduced the

energy consumption significantly while the maintaining the lux value within acceptable range. The implementation cost was fully borne by Vendor X in return for the energy savings for nine months. A rough estimate is the vendor gained additional 63.6% from the deal.

Several key considerations were not adequately addressed in this case study but worthwhile for further investigation. First is a mechanism to decide on conditions suitable to approach vendor. This also needs to be in line to the organization common direction. Second is finding the best way to choose vendors perhaps based on their proposal, experience (track record), post-project service level and also other strategic reasons. The decision must be reached through consensus and fact-based analysis. Third involves the development of a sound assessment method to decide the attribution of cost and gain from the improvement between the organization and the vendor. Fourth, the contract must be made explicitly with the approval from management and stakeholders. Fifth is the coordination of the Kaizen especially during the implementation and project closure to avoid any complication. Lastly is the adoption of lean manufacturing concepts such as the learning and vendor development. Knowledge sharing enhances the knowledge competence within the organization [19].

5. Conclusion

This paper presents a preliminary scheme to deploy Kaizen with the aid of vendor. PDCA is a well-defined methodology in promoting continuous improvement. The engagement has shown result in a win-win agreement. The countermeasures provided by Vendor X reduced both energy and maintenance costs. A few lessons were learned during the engagement. First, vendor was willing to absorb implementation cost to secure the business and greater reward. Second, the collaborative scheme gave Kaizen team an option to outsource tasks beyond their expertise to external party.

Acknowledgement
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