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Framework for Implementing a Supplier Kanban System through Action Research Methodology

Abstract

Purpose: The aim of this study is to develop a framework for the implementation of a Supplier Kanban System

Design/methodology/approach: The research was conducted within a factory focusing on the warehousing and supplier-related operations using an action research methodology

Findings: The study period spanning over six years was aimed to reduce the inventory and the manpower required to manage this inventory. This initiative led to a substantial average savings of more than 500,000 Malaysian Ringgit annually

Research limitations/implications: The focus of the study is on a framework for implementing a Supplier Kanban System in a small or medium-sized company within the automotive industry

Practical implications: This framework is designed to be self-sufficient such that the members of the organisation can use it without the help of external experts or consultants

Social implications: Reduction in inventory stored in the warehouse, the amount of redundant work carried out by the employees and other non-monetary improvements which are difficult to monetise resulted in a much better work environment and happier employees

Originality/value: The changing in the paradigm of the manufacturing value chain affects the tier 1 and tier 2 suppliers in Malaysia. The lines and value chains posing challenges to the suppliers have brought the idea of the Supplier Kanban system. The Supplier Kanban System adopted the Action Research Cycles and Continuous Learning Cycles, and this process was documented and developed as the Framework for the Implementation of a Supplier Kanban System.

Keywords: Action Research Cycle; Automotive Industry; Continuous Learning Cycle; Supplier Kanban System.

1. Introduction

The present study discusses the framework for the implementation of a supplier kanban system to help small and medium-sized companies to reduce operating cost by reducing their stock holding and the resources required to manage these stocks by improving the supply chain management. Stock holding cost is one of the many expenses that affect the operating cost of a company and one which is within its direct control (Azzi et al., 2014). Lucintel, a leading global management consulting and market research firm, reported in 2012 that managing increasing costs while retaining competitive pricing and expanding the product portfolios are

some of the biggest challenges facing the automotive and automotive components industry. Thus, introduction of Kanban systematic arrangements are crucial factors in determining the companies' competitive performances directly and indirectly through their effects on other manufacturing practices and strategy (Matsui, 2007).

According to Romeira, Moura and Robaina (2020), the present trends in globalization has triggered a continuous and rapid change in the market that compels organizations to look for modern approaches to promote profitability and productivity. Similarly, customers now demands for shorter time delivery, quality, highly customized products and lower costs which prompted the industries to re-evaluate their production systems to become more flexible and efficient (Varela et al., 2014). Mohamad et al. (2019) added organizations need to create and offer better product and services, and additionally improve their manufacturing operations in order to remain competitive in global markets and handle changes in the market. In the same vein, Mojarro-Magana et al. (2018) reported that small and medium enterprises (SMEs) are significant contributors to the economy of a nation, and due to globalization and competitive markets, the SMEs have struggled to survive. A report from the Malaysian investment development authority also recorded SMEs to have contributed at least 40% of gross domestic product (GDP) to the country by providing jobs to almost 65% of Malaysians. Therefore, SMEs involved in/with manufacturing sector have to implement and practice lean manufacturing to achieve manufacturing excellence.

Furthermore, in the United States, 27 automotive component manufacturers filed for Chapter 11 bankruptcy protection in 2010 (Burbage and Weddell, 2010). In Malaysia, Leko and Watta failed to manage cost ('Watta Holding to end loss-making auto battery business,' 2018). Several companies try to reduce cost by implementing lean management techniques to contain rising operating cost and declining profitability (Akanmu, Nordin and Gunasilan, 2022). This situation is worsened by superfluous books, articles, journals, experts and gurus who continue to dwell on the success of Toyota and advocate Lean management as a universal solution for improving competitiveness and profitability. The lean management technique has helped Toyota Motor Cooperation to become one of the most successful automotive companies in the world for more than four decades. Their success is based on their sustainable performance standard in comparison with others in the industry (Osono, Shimizu, and Takeuchi, 2008; Womack, Jones, and Roos, 1991).

The consistent profitability of Toyota Motor Cooperation even in the most adverse economic conditions has captured the interest of industry captains, academics, consultants and management practitioners. Academics and management gurus have used several terms to describe the JIT management ideology or Lean management: philosophy, methods or practices. The present study deals with the value that the elements of lean management lend to the company. However, several companies have failed in their attempt to successfully implement lean management, because they fail to consider the complexity involved in the implementation process (Lander and Liker, 2007), they focus mechanically on the lean practices without considering other human aspects of operational management such as organisation culture and employee readiness (Agarwal, Green, Brown, Tan, and Randhawa, 2012; Matsui, 2007) and

they neglect the crucial aspect of human capital management (Agarwal et al. 2012; Bateman, 2005). Unsuccessfully investing in and implementing Lean management practices puts the company in a disadvantageous position because more resources are utilised to make improvements but do not yield the desired results. A company naturally tends to continue to invest in a flawed system built on a faulty foundation and hoping for it to work, which exacerbates the situation further.

This framework for the implementation of a supplier kanban system allows companies to self-evaluate the viability of implementing the system rather than depend on consultants and management gurus to determine the direction. To convince the company's top management, experts would be biased towards the implementation of lean management as a guaranteed solution based on others' success stories. Decisions based on an unbalanced view and without careful consideration will lead to additional cost, which will exacerbate the problem by diverting essential and limited resources towards its implementation. This framework is designed to be self-sufficient and encourages companies to utilise their internal resources to study and implement the Supplier Kanban System at a comfortable pace. An action research approach was used to conduct the study for the development of this framework (Lewin, 1946; Savin-Baden and Wimpenny, 2007; Stringer and Genat, 2004; Susman and Evered, 1978). The action research was conducted in a 30-year-old company manufacturing electrical components for the Malaysian Automotive industry.

Thus, with limited resources, an efficient framework for the implementation of a supplier Kanban system is developed for small and medium size company over an extended period of time. In comparison to previous studies, this framework incorporates simple step by step guide for small and medium size companies with limited resources of money, time and manpower and allows the companies to select some of the elements of the Supplier Kanban system and applied it at their own comfortable pace. This study identifies the gap in the shop floor Kanban system namely poor quality of parts supplied by the local vendors and justify why this gap is included as part of the supplier Kanban system implementation.

This study presents the introductory part as the gateway to the research by highlighting the problem in supplier system, followed by the research questions to answer. The study reviews past literature on what supplier Kaban system entails and its applicability in the Malaysian Automotive Industry. The section three discusses the action research cycle as the research methodology and how the approach has been projected to solve a real-world problem in implementation of Kaban system and address the research questions. Meanwhile section four addresses the outcomes from the application of Kaban system by presenting the financial implication in the company of study. Thus, the framework developed from the level 1 – assessment to level 3 – implementation is presented. Finally, the last section concludes by highlighting the solutions to the problem of storage space utilization of the warehouse.

2. Literature Review

Rapidly changing business environment in the Malaysian Automotive Industry, removal of protective measures and subsidies afforded by the government to infant industries have forced many companies to find alternative methods to reduce cost. The automotive industry is considered to drive industrialisation and several countries have focused on this industry to drive industrialisation and transform their economy (Dicken, 2014). In this context, intervention policies in favour of the automotive industry, termed infant industry, provide safeguards for new entrants in developing countries (Wad and Chandran Govindaraju, 2011). These policies were designed to be temporal in nature, which are not sustainable and should not be continued perpetually. These policies intended to provide the new industry a safe environment to develop within the country (Diekola, 2016). Subsequently, as the industry matures, it is expected to compete in the global market place, following which the protective policies are withdrawn. Countries such as Thailand have used the infant industry protection policy to encourage their industry and economy; consequently, Thailand is ranked globally as the 12th largest automotive manufacturer in the world (Ariffin, Lutfi, Sahid, and Policy, 2017). However, in comparison, Malaysia's automotive industry has stagnated within its borders and the policy appears to have failed (Ariffin et al., 2017; Wad and Chandran Govindaraju, 2011).

In recent times, Chinese car maker Geely has entered Malaysian automotive component market through the purchase of Proton. Chinese automotive components manufacturers with competitive pricing and high-quality products have disrupted the stable and complacent Malaysian automotive components industry, prompting some of the players to explore new methods to reduce cost and improve competitiveness. APM Auto-electrics is one such company in the Malaysian automotive components industry that suffered because of the influx of the more efficient automotive component makers from China. The present study was a result of the initiative of the company to improve its competitive position and stay relevant based on the implementation of a Supplier Kanban System.

What is Supplier Kanban System?

The core action research problem is to solve the warehouse storage space problem and manpower problem by improving the supply chain management. The preferred solution for solving the problem is the implementation of a Supplier Kanban System because:

- i. It is a continuation of the Shop Floor Kanban System successfully implemented;
- ii. It is the preferred direction of Malaysia's automotive industry's top management; and because of researcher and the organizations' explicit and tacit knowledge in the management of the Kanban System. Gummesson (2000) referred to the researchers insight and experience as 'pre-understanding' which alludes to such things as people's knowledge, insights and experience.

The Supplier Kanban System is intended to effectively manage and control the local suppliers. This objective is to be achieved by limiting the stock supplied by the local vendors thus reducing the demand for storage space in APMAE's warehouse. As the amount of stock held in APMAE's warehouse reduces, the manpower required to manage this stock will also reduce.

A study on 54 manufacturing firms in the United States over a six year period showed positive correlation between inventory leanness and firm performance, but there is an optimal degree of leanness beyond which financial performance will become negative (Eroglu and Hofer, 2011). A study among German firms has shown implementation of JIT results in lower inventory of finished goods and raw material (Obermaier, 2012).

Research is generally undertaken to either fill a knowledge gap or solve a problem. To fill a knowledge gap, the researcher must undertake a literature review to identify a gap and, then, conduct quantitative studies. On the other hand, to solve a problem, the researcher starts with identifying the problem. Literature review helps in understanding if a similar problem has been solved before. If that is the case, the literature review will focus on the challenges and difficulties faced in solving the problem. Therefore, a literature review helps in ascertaining the potential solution to the problem, methods used in the past to resolve similar problems and finding ways to use this newly found knowledge effectively and customise a new solution for the current problem.

The APMAE (APM Auto-electrics Sdn. Bhd) of Malaysia has successfully implemented the Shop Floor Kanban System. The implementation of the Supplier Kanban System is a natural progression for APMAE as a continuation to the successful Shop Floor Kanban System. The directors of APMAE expect a Supplier Kanban System as a potential solution. There are only sporadic studies conducted on the implementation of a lean manufacturing system within the automotive components industry in Malaysia. Some of these focuses on identifying the level of lean implementation in the Malaysian Automotive Industry and others focus on the framework for the implementation of a lean framework in the Malaysia Electrical and Electronic Industry (Muslimen, Yusof and Abidin, 2011; Salimi, Hadjali and Sorooshian, 2012). However, no research literature could be found on the more specific area of Supplier Kanban System implementation within the Malaysian context. As such, this research will add to the body of knowledge in the specific area of Supplier Kanban System implementation within a Malaysian automotive components manufacturing industry perspective.

This research focused on developing a framework for the implementation of a Supplier Kanban System for the automotive components industry in Malaysia. This research is useful for small and medium sized industries within the automotive components industry with the aim of implementing a Supplier Kanban System. The Supplier Kanban System has benefited APMAE as a company. The system helps to reduce the cost of operations and improves the competitiveness of the company. The framework developed is easy to implement and can be adopted by companies which are small and medium size. It takes into consideration the limited resources available to small and medium size companies and focus on breaking the huge task of implementing the Supplier Kanban System into smaller manageable portions. The learning experienced during the implementation was compared to the writings of scholarly journals for parallel finding. The results show national cultures do not influence the results and Supplier Kanban System can be implemented in companies with similar setting anywhere in the world.

Why Supplier Kanban System?

The present study relates to solving a problem and, hence, the literature review helped find potential solutions to the problem by identifying key elements essential for the successful implementation of a Supplier Kanban System and avoid any potential pitfall in the implementation. To summarise, the following keywords appear repeatedly and consistently in academic journals and form the basis of the present study: training; leadership; commitment; teamwork; systematic quality management; communication; housekeeping; and visual management (Aghazadeh, 2004; Anand and Kodali, 2009; Chang and Lee, 1996; Cheng, 1991; Fawcett and Myers, 2001; Gunasekaran and Lyu, 1997; Harber, Samson, Sohal, and Wirth, 1993; Inman and Mehra, 1990; Lee and Ebrahimpour, 1984; Prasad, 1995; Rosário, Oliveira, and Moreira, 2008; Schonberger, 1984; Steele, 2001; M.M. Yasin, Small, and Wafa, 1997; Mahmoud M. Yasin, Small, and Wafa, 2003; Zhu, Meredith, and Makboonprasith, 1994).

The following 12 items appear repeatedly in literature as potential problems in the implementation of the Supplier Kanban System: Lack of supplier support; Suppliers' inability to deliver materials on time; Substantial distance between suppliers and customers; Poor production quality; Poor quality of supplied parts; Difficulty in establishing systems to support Just In Time (JIT); Poor and/or inaccurate data; Difficulty in establishing accounting support for JIT; Training difficulties; Lack of JIT information; Lack of top management support; and Lack of employee support (Agarwal et al. 2012; Anand and Kodali, 2009; Bortolotti, Boscari, and Danese, 2015; Gahlaut, Matson, Matson, and Miller, 1999; J. Liker and Rother, 2011; Matson and Matson, 2007; Matsui, 2007; Nordin, Deros, and Wahab, 2010; Salimi, Hadjali, and Sorooshian, 2012; Shah and Ward, 2007; Wong and Wong, 2011). These elements were considered during the development phase of the framework for the implementation of a supplier kanban system.

Furthermore, according to a research conducted by the United States on 95 firms reported that implementation of JIT improves competitive advantage and performance by reducing the quality costs and throughput times and lowering the inventory levels (Bortolotti et al., 2015). Focusing on the hard practices without enough attention on the soft practices leads to poor performance of JIT implementation (Akanmu & Nordin, 2022; Akanmu, Nordin & Gunasilan, 2022). According to Mojarro-Magana et al. (2018), before starting a kanban system implementation program, the planning stage should be established, and within it, the integration of human resources should be encouraged as the relationship between Kanban and human resources has been found to be a sustainable and successful implementation of the Kanban system. As a result this study profoundly establish the planning stage as little information are available regarding Kanban system and its related practices. Thus, the developed framework provides a long-term analysis of the Kanban

This study therefore created a new perspective in order to improve the implementation of the Kanban system. The Supplier Kanban System implementation framework is divided into three levels. One can only advance to the next level if the current level has been completed. If the current level has not been completed satisfactorily or there are some requirements in the current level which cannot be fulfilled it is better for one to abandon the implementation or delay the implementation until all the requirements are fulfilled.

Within each level there are several steps which have to be completed and only when all the steps in the current level have been satisfactorily completed and performed, can one move to the next level. This framework is designed in a similar fashion to a computer game where one can advance to the next level only when the current level has been completed. One progresses slowly through the steps in each level, which allows the participant to advance to the next level upon successful completion of the current level, until they reach the final third level. There is no time limit for completion and one can plan the timing of their journey according to their available resources. There is a minimum threshold level for the resources, below which it may not be possible to drive this initiative to successful completion. Secondly, this framework requires active participation and support from the company's top echelon without which this project is doomed to failure. In the context of this framework, one of the resources which are deemed absolutely necessary is top management's commitment.

3. Methodology

An action research methodology requires two research projects to be undertaken concurrently: a thematic action research project to solve a real-world problem and a thesis action research project to develop academic content (Perry and Zuber-Skerritt, 1992). The thematic action research resulted in the company saving 232,000 ringgit annually on space utilisation and 324,000 ringgit annually on manpower. The thesis action research project developed a framework for the implementation of a Supplier Kanban System in a small and medium-sized company. The present study discusses the Supplier Kanban System framework, which was developed using the continuous learning cycle (Coghlan and Brannick, 2009; Coghlan, Rashford, and de Figueiredo, 2015). Each of the four action research cycles has a corresponding continuous learning cycle, which in turn was used to review and understand the experience, followed by an in-depth analysis of the evidences found during the various action research cycles to develop the Supplier Kanban Implementation Framework. This framework articulates the experience and learning acquired during the implementation at APM Auto-electrics such that other companies with similar problems can benefit from the experience of the implementation of the framework at APM Auto-electrics.

The present study spanning 4 years from May 2012 to December 2016 adopts an action research methodology. The researcher is also the general manager of the plant. The action research was conducted over four cycles, the problem was then resolved and further cycles did not lead to any significant improvements. The unit of analysis for this action research is the warehouse and part of the production interacting with the operation of the warehouse. The research methods involve participant observation, participant interview, focus group interview and document research. The document research triangulates the findings of the participant observation, participant interview and focus group interview.

3.1 Participant Observation

The researcher observed the operations in the unit of analysis, namely, the warehouse and part of production. The processes were mapped using swim lane diagrams. These activities were

undertaken for 2 weeks and were conducted thrice during each of the action research cycles within the research period. The initial observation was to identify the problem and the subsequent observations were to evaluate the effectiveness of the intervention.

3.2 Participant Interview

The personnel involved in the warehouse operations and parts of production were interviewed to understand the faults in the current operations and how they could be improved further. Participants included those who actually carried out the job because of their in-depth understanding of the job and its process. The interview findings helped in identifying the cause of the problems currently faced in the warehouse. Interviews were conducted twice during the course of the research: first, before the intervention to understand the type of action to be taken and, second, after the intervention to solicit participants' perceptions on the improvements undertaken. The second interview provided an opportunity to gauge the effectiveness of the improvements.

3.3 Focus Group Interview

During the interviews, there were a conflicting statements and acrimonious remarks made by the participants against members of other departments and their superiors. The focus group included participants from the different departments to understand these conflicts better and get a balanced view and better understanding of the acrimonious remarks. The focus group interviews were conducted twice –before and after the intervention. This was done to solicit collective views on the effectiveness of the improvements. The selection of the participant was deliberately done in this manner to get views that cut laterally and longitudinally across the whole organization. Pseudonyms were used to protect the identity of the personnel involved in the participant interview and throughout this action research study. A coding system was devised to assign a special identification code for every participant.

The focus interview for the first group 1 was done specifically to understand the process and problems involved in production floor relating to Complete Knock-down Components (CKD) supplied by warehouse to Production. In group 2, the focus interview was done specifically to understand the process and problems involved in ordering of parts from supplier, issuing purchase orders, issuing schedules, receiving goods from suppliers, storing the goods, revising the schedules and communication with suppliers. Similarly, the focus interview for group 3 is specifically carried out to understand the inconveniences and problems brought on by the inconsistent and poor quality of parts from our suppliers and incongruent packing standards. The following table 1 2 and 3 present the lists of participants and their codes for groups 1, 2 and 3 respectively.

[Table 1. Participants from Group 1]

[Table 2. Participants from Group 2]

[Table 3. Participants from Group 3]

3.4 Document Research

Documents were analysed to understand the reasons for the failure of the suppliers' delivery and quality performance. The study documents were procured from the finance department, purchasing department, production planning and control department and the warehouse. Document research provided quantitative data and was used to establish the base position of the company before the interventions were initiated and to corroborate the findings of the participant observation, participant interview and focus group interview.

The action research methodology is employed as it meets the three key aspects of action research cycle as recommended by the international symposium of action research namely: a group of people working together; a cycle of planning, acting, observing and reflecting on the ongoing work; and making of public report of the outcome experience. This research proposes two types of knowledge: the process of participating and implementing the supplier Kanban system. Therefore, this research proposed to develop a framework for the implementation of a supplier kanban system through the process of reflecting on the experience, understanding and making judgement.

4. Results

4.1 Thematic Analysis of the Continuous Learning Cycle

The outcome of the thematic action research was the cost savings arising from the reduced space utilisation and the reduction in manpower. The thematic analyses comprise four action continuous learning cycles discussing the reflections and learning aspects in terms of taking actions, experience, understanding and making final judgement. The following thematic cycles are presented as an outcome to compared results with the quantifiable goals being evaluated:

4.1.1 Continuous Learning Cycle 1

The first cycle of the continuous Learning Cycle addressed the academic part of this action research. The first continuous learning cycle, addresses the issues of redundancy, absenteeism, mechanical attitude of the work team, divergent goals, cross functional team, autocratic manager and unheard voices arising from the findings observed, reviewed and analysed during the first cycle of the action research. Figure 1 shows the Continuous Learning Cycle 1.

[[Figure 1](#): Continuous Learning Cycle 1]

4.1.2 Continuous Learning Cycle 2

An overview of the Continuous Learning Cycle 2 is shown in [. This second learning cycle addressed issues that were identified in the second action research cycle. The learning discussed in this cycle is the positive effect of clearly defined rules, departmental mind-set,

interdepartmental dialogues, sense of belonging, long term sustainability, and importance of leadership, motivational effect of success and the effects of employee grievance.

[Figure 2: Continuous Learning Cycle 2]

4.1.3 Continuous Learning Cycle 3

The third Continuous Learning Cycle reflects on the valuable lessons learned and experience gained during the implementation of the third Action Research Cycle. The third cycle is shown in [and reviews celebrating success, vendor delivery review, effective quality control, visibility of top management and sustainability.

[Figure 3: Continuous Learning Cycle 3]

4.1.4 Continuous Learning Cycle 4

The final cycle of the continuous learning cycle is shown in [. In this cycle, the learning is on holistic thinking, hands-on leadership, first-hand view of shop floor management and celebrating success

[Figure 4: Continuous Learning Cycle 4]

The thematic action research resulted in the company saving 230,000 ringgit annually from reduced space utilisation and 324,000 ringgit annually from manpower reduction (Table 1).

[Table 4: Savings Realized from Thematic Action Research]

The outcome from the thesis action research is the Framework for the Implementation of a Supplier Kanban System. The framework was developed using the learning and reflections from the four action research cycles and was guided by the knowledge solicited from the literature review.

4.2 The Framework

The framework is divided into three levels, with level 1 focusing on assessment, level 2 focusing on preparation and level 3 on implementation. Each level has several steps which have to be completed successfully before one can move to the next level. The steps in each level can be carried out concurrently or consequently; however, one can only move to the next level after the current one is complete. If one faces difficulty in completing any of the steps at any level for whatever reason, one has to stop, reflect and decide on alternative methods to complete the step or abandon the project. This framework is designed to allow the user to evaluate and assess the current position before investing any resources into the project or to consultants. Each of these levels and steps was designed based on a real-life implementation of the Supplier Kanban System, which has proven to be successful in reducing operating cost and improving profitability.

4.2.1 Level 1 - Assessment

Level 1 is the most important and has three steps (Figure 1). This is the assessment stage which allows the company to determine its readiness for the implementation of the Supplier Kanban

System by answering three questions. The first two steps are internal to the company, that is, it is within the company's control. The third step relates to the degree of fluctuation in customer demand, and it is external and outside the company's control.

[Figure 5: Level 1 Assessment Stage]

4.2.1.1 Step 1 - Necessity

The first step in level 1 compels the company's top management to ask, 'do we really need to implement the Supplier Kanban System'? This step examines the company's need to implement the 'Supplier Kanban System'. The objective is to ensure that the 'Supplier Kanban System' is implemented for the benefits it lends to the company and is the preferred solution to the current predicament and not because everyone else is doing it. The company is facing a serious problem, and desperately needs to reduce its operating cost to improve its fortune and increase its chances for sustainability and continuity. Various options are available for reducing cost and improving performance as there will be many consultants and management gurus promoting solutions based on their field of expertise. Consultants, like opportunists, perceive the misfortune of companies and propose guaranteed solution to solve the company's problems and make them profitable.

Level 1 allows the company's top management to self-evaluate and assess the need to self-implement the 'Supplier Kanban System' rather than depend on consultants. If, after careful deliberation and consideration, they decide they want to adopt this solution for certain, the framework leads to step 2.

4.2.1.2 Step 2—Top Management Commitment

The second step of level 1 questions top management's commitment and clearly highlights the amount of resources which needs to be committed towards the implementation. It is imperative that top management be fully aware this is not just tokenism to satisfy shareholders and other interested parties but the need to translate into action. This step requires top management to look objectively at all resources available and review the amount of resources they are willing to allocate for the implementation of this endeavour. This framework focuses on stretching the implementation of the 'Supplier Kanban System' for long term based on the company's capability given the limited financial and human resources available to small and medium-sized companies.

Top management is the reservoir of resources and source of policy decisions. The importance of its involvement in organisational improvement activities has been cited several times by the likes of Kaizen guru Mazaaki Imai, father of the Toyota Production System Ohno, and many experts and scholars in field of Kanban and Quality Improvement (Imai, 1991; J. K. Liker, 2004).

This step allows the top management to review the necessary amount of resources and work rather than rely on consultants' advice. They obtain first-hand knowledge of the task rather

than a watered-down version presented by consultants. Additionally, it helps them to actively participate in the in the implementation activity. At this stage, if the answer to both the questions is in affirmative, it leads to step 3.

4.2.1.3 Step 3–Demand Stability

The foundation for the implementation of a Supplier Kanban System is stable customer demand. More than 15% fluctuation in demand is not viable for a Kanban System. In general, customer demand is not within the control of the company. When customer demand is unstable, the company can decide to abandon the project or seek alternative ways to stabilise the demand. A hybrid Kanban System which supports carrying minimum inventory, accepting minimum waste and lead time can be considered as an alternative option for coping with the fluctuating demand (Mishra, Kumar, and Garg, 2018). Instead, of focusing on customer demand, the company can monitor the minimum stock held in the company and use the reduction in minimum stock as a proxy for customer demand.

4.2.1.4 Outcome of Level 1

The outcome of level 1 will be a decision from the company's top management whether to proceed with the implementation or abandon it. The decision to proceed will give them an idea of what to expect and the required quantum of resource. Additionally, it will prepare the top management to make provisions for resources to implement the system.

4.2.2 Level 2–Preparation

Level 2 of this framework focuses on preparing the company towards systematically implementing the Supplier Kanban System (Figure 2). This level has eight steps. Each step is designed such that the project is reviewed holistically to consider all possible factors that may affect the implementation. The first step in level 2 is the appointment of a project leader, which has to be completed before the commencement of the other steps. The top management is responsible for the appointment of the project leader and allocation of resources. The project leader then takes the lead role and drives the project. The project leader evaluates the current position of the company and establishes the base position, which is used determine the goals and the timeline required to achieve these goals. The next step is the formation of the steering committee, work teams and establishment of a formal progress monitoring and reporting structure. The final step in this level is establishing a mechanism for identifying, recognising and rewarding the people who have contributed towards the success of the project. The six steps after the appointment of the project leader and resource allocation steps are preparatory, that is, the project leader should have all resources ready before the implementation level.

[Figure 6: Level 2 Preparation Stage]

4.2.2.1 Appointment of Project Leader

The top management appoints the project leader, a senior leader within the company with decision-making authority and experience in all aspects of management of a manufacturing establishment (Figure 3). The person must have first-hand knowledge in quality assurance, warehouse management and production and supplier chain management. Preferably, the person must be a long-term employee of the company and has a good understanding of the company's operation and its idiosyncrasies. Supplier Kanban Implementation is based on keeping the cost low by focusing on using the existing and available resources.

4.2.2.2 Resource Allocation

Top management must allocate a budget for project implementation. This budget must be available to the project leader when required. Top management must also allocate manpower and time in addition to monetary resources. In the context of manpower, the project leader must be authorised to assign additional responsibility, re-assign jobs or remove non-productive personnel without having to refer to the top management.

[Figure 7: Level 2 Preparation Stage Steps 1 and Step 2]

4.2.2.3 Base Position

The project leader has to establish the base position of the company (Figure 4). The objective of the Supplier Kanban System is to reduce the amount of raw material and component stock holding in the company. The project leader must identify the amount of stock carried by the company, the amount of space the stock occupies, the number of people required to manage this stock and the money required to manage this stock. This data will help the project leader estimate the amount of money required to manage the company's stock. The current position of the company has to be established quantitatively.

The base position of the company can be established by document research, participant observation, participant interview and focus group interview. The participant observation session will help the project leader obtain a clear view of the processes involved in the management of the warehouse and the suppliers. An experienced project leader's knowledge will help in identifying processes which can be improved and redundancies which can be eliminated. Participant and project interviews help in determining the accuracy of the information acquired from the observation and in clarifying and understanding the processes in detail. It also aids the project leader in heeding to the frustrations and difficulties faced by the personnel on the job. The project leader can also seek suggestions from the personnel regarding certain redundant processes and their improvement.

The project leader can use this time to observe and interview members who can actively contribute to the work groups that can undertake improvement activities.

[Figure 8: Level 2 Preparation Stage Steps 3 and Step 4]

4.2.2.4 Goals and Timeline

The project leader can identify the current position of the company based on the base line and the foundation to establish the future position of the company. The goals to be achieved and the time allocated to achieve these goals must be clearly established. These goals and timelines must be specified clearly and displayed for all the employees to comprehend; for example, reduce the stock holding in the company from the current weeks of production to 3 days. The time required to achieve the goals will depend on the availability of resources and the company's intent; the shorter the duration the more the resources required and vice versa. This framework is designed for small and medium-sized companies with limited resources and is flexible. Depending on the company's available resources, the project can be stretched over a longer term using fewer resources at present time and allocating more resources in future when they become available.

4.2.2.5 Steering Committee

The project leader needs to establish a steering committee to oversee the implementation of the project. The steering committee is responsible for driving the project and must be led by the project leader (Figure 5). The committee must be represented by the managers from all the departments in the company to ensure there is total company participation and commitment. In addition to managers, the steering committee must have supervisory staff from key departments such as warehouse and production where the improvement initiative is introduced. The supervisory staffs are the direct link to the people doing the physical jobs. This will ensure the expectation percolates to the personnel on the jobs and challenges they face are brought to the attention of the steering committee. The finance manager is another important member of the steering committee, who needs to ensure the funds required are allocated and available when needed. He or she is also the person who can regularly update the top management on the effectiveness of the improvements from a financial perspective. For example, if the values of the stocks in the company are declining, the finance manager can inform the top management regarding the proportion of the reduction, which is directly attributed to the Supplier Kanban System implementation.

[Figure 9: Level 2 Preparation Stage Steps 5, 6 and 7]

4.2.2.6 Work Teams

The work teams need to engage in various activities towards the project's success. The number of work teams will depend on the size of the project and availability of resources. The team must be cross-functional with members from different departments and levels within the organisational hierarchy. The project leader must actively assign projects to the work teams,

guide and monitor their progress. This is crucial because the cross-functional team has other job responsibilities which will take precedence; therefore, close monitoring is essential for timely completion of the projects.

4.2.2.7 Monitoring Progress

The project's progress must be closely monitored with established mechanisms. A proper project schedule must clearly define activities and deadlines and must be monitored accordingly. Any delay or regress has to be thwarted and corrective action initiated immediately to ensure the smooth completion of the activities. Monitoring can be done through regular pre-planned weekly review meetings with the work teams.

4.2.2.8 Appreciation, Recognition and Rewards

The project is undertaken as an extracurricular activity outside the regular job scope of the employees, where some of the employees and suppliers will contribute more than the others. The project's success will depend on these selfless and hardworking employees and motivated suppliers. Thus, it is important recognise their contribution and reward them in the presence of their peers. Therefore, the project leader must plan regular annual or half-yearly dinners or a simple gathering involving all employees to recognise the contribution of these individuals or companies by presenting them with trophies, certificates or monetary rewards (Figure 6).

[Figure 10: Level 2 Preparation Stage Step 8]

4.2.3 Level 3–Implementation

Following the preparations, the project must progress move to the implementation phase. Level 3 has ten steps which identify the activities essential for the successful implementation of the project. Step 3.1 to step 3.6 must be carried out consecutively, while the later steps can be concurrently carried out. Figure 7 shows the process flow for the level 3–Implementation stage.

[Figure 11: Level 3 Implementation]

4.2.3.1 Companywide Information Dissemination

Once the company decides to implement the Supplier Kanban Implementation system and the plan drafted by the project leader, this information must be disseminated to all the employees of the company, including the operators and the hands-on employees. The operators and the hands-on employees are essential to ensure success and, therefore, it is essential that the project manager and top management lays out plan to them rather than from the grapevine.

The top management must be active involved in the information dissemination exercise. It is important to show the employees that this is a top-level initiative and not that of an ambitious employee using this initiative for personal career progression. Companywide information

dissemination can be through the general assembly involving all the employees. It is imperative to invite the top management to launch the initiative before the detail briefing by the project leader. Therefore, all the employees must know that the top management is supporting and monitoring this initiative.

4.2.3.2 Small Manageable Tasks

The project must be broken down into smaller manageable tasks based on the available resources, such as manpower that will be carrying out the various tasks. If the company is small with limited manpower, the project completion time must be expanded by reducing the number of work teams and undertaking individual tasks. Although this extends the overall completion of the project, it will allow the employees to work thoroughly and efficiently at a comfortable pace. During the implementation in APM Auto-electrics, the researcher formed four work teams and grouped the project into four phases. At each phase, the Supplier Kanban System was implemented on one group of suppliers. The implementation was conducted consecutively, with the project team moving to the next group of suppliers when they were satisfied with the level of implementation on the current group of suppliers (Figure 8).

[Figure 12: Level 3 Implementation Steps 1, 2 and 3]

4.2.3.3 Inaugural Vendor Group Selection

This project is a Supplier Kanban System implementation initiative which eventually involves all the suppliers. Similar suppliers are grouped in small groups because of the limited resources available. Once these groups of suppliers have been determined, the Supplier Kanban System is implemented on each group sequentially. Start with the group of suppliers which will provide the most positive results. Clearly visible signs of positive improvement send a signal to the top management that the programme is working and, thus, removes pressure from the project leader. Plan the schedule such that all the suppliers are included in the system.

4.2.3.4 Vendor Briefing

The vendor briefing is the next step. The project team must inform the vendors of the company's intention to implement the Supplier Kanban System. The team needs to assess the capability and the readiness of the vendors for the implementation. Vendor briefing will serve as a platform for informing the supplier on the company's intention of implementing a Supplier Kanban System. It will also provide a forum for soliciting feedback on the apprehensions and confidence level of the suppliers to actively participate in and proceed with the implementation. This stage is important for the company as it provides a gauge for estimating suppliers' readiness and allows the company to determine how aggressively it wants to go ahead with the implementation.

4.2.3.5 Kanban Process Preparation

The project team prepares the Kanban process flow, Kanban cards and the customised Kanban paraphernalia once the first group of suppliers has been identified. The project teams will prepare the customised requirements involving the selected group of vendors. The items here will include the specific Kanban cards, transportation for collecting the parts, the delivery times, polybins with labels and minimum part storage at supplier's facility, among others.

The project team should consider supplier training and prepare the training method and material while concurrently preparing the Supplier Kanban process and paraphernalia (Figure 9).

[Figure 13: Level 3 Implementation Steps 4, 5 and 6]

4.2.3.6 Vendor Training

Once the Kanban cards, Kanban process flow, polybins and other essential materials for running the Kanban System are ready, the project team can engage in vendor training. The purpose of the vendor training is to familiarise the vendors with the process and methods to run the Supplier Kanban System. The vendors will be trained using the actual system, and mock trials should be conducted to fine tune and improve the understanding and expectation of the suppliers. This step is the final preparation before going live with the Supplier Kanban System and the project leader must ensure the supplier is ready before moving from the trial phase to the actual implementation. At this stage, the personnel conducting the training should include those who will be responsible for implementing the Supplier Kanban management system. Therefore, the suppliers and the company's employees together follow the learning curve as part of their job.

4.2.3.7 Progress Monitoring System

The next vital step is to monitor the progress of the implementation through regular pre-planned steering committee meetings and work group meetings and immediately address any problems encountered. The project leader must be readily available to address problems which cannot be handled by the lower management (Figure 10).

[Figure 14: Level 3 Implementation Step 7, 8 and 9]

4.2.3.8 Communication and Display Information

The information on the progress of the project must be communicated regularly to employees at all levels of the organisation and to all the suppliers participating in this activity. The information must be updated regularly and displayed in an area where it is accessible to workers at all levels of the organisation. Generally, information is only circulated among the management, and the workers at lower levels of the management hierarchy are often ignored. This system requires the buy-in from employees at all levels and, hence, the need for display

at easily accessible areas. This will provide an opportunity for the employees at the lower levels of the hierarchy to view, judge and provide feedback on the accuracy of the reports.

4.2.3.9 Launching the Kanban System

All the activities mentioned so far are in the trial stage. The system is tested and improvements as early issues are discovered. Then, the Supplier Kanban System is officially launched when majority of the issues have been resolved. Some deviation in the rules during the trial period may be acceptable but strict compliance to the established Kanban rules is vital after the official launch. The supplier and the company will be jointly responsible for the quality and proper records of all the Kanban activities must be maintained properly. To ensure integrity of the system is upheld, there must be regular stock count of the Kanban cards and audit of the Kanban System.

4.2.3.10 Sustainability

The last step in this framework is sustainability. In general, most systems work well initially and start to deteriorate when the close monitoring starts to wane as the system becomes mature and stable.

Therefore, it is critical to define the systems to ensure continuity and sustainability after the implementation when the focus of top management shifts. One effective method to ensure continuity is to link the Supplier Kanban System performance to the individual and departmental Key Performance Indicators (KPIs). The KPIs are tracked on a monthly basis. This will ensure top management monitoring and continuity. In addition, systems must be defined to track, monitor and annually reward top vendors and employees who have contributed significantly to the continued success of the Supplier Kanban System. When the Supplier Kanban activities are linked to the regular monitoring activity of the company, there will be some measures in place to ensure continuity and sustainability (Figure 11).

[Figure 2: Level 3 Implementation Step 11]

Overall, this systemic approach has proved to reduce the cost of operations in supplier Kanban system and enhance the competitiveness of the company. The framework developed in is easy to implement and can be adopted by companies which are in small and medium sizes. It takes into consideration the limited resources available to small and medium size companies and focus on breaking the huge task of implementing the Supplier Kanban System into smaller manageable portions

5. Conclusion

This research uses an action research approach to solve a real life problem of improving the storage space utilization of a warehouse. The action research had achieved its core action research goals of improving the quality of the parts supplied by the local suppliers and finding

a solution to the problem of insufficient storage space. A brief summary of the results is discussed below.

- i. Storage space utilization in the warehouse was reduced by more than thirty three per cent, from 1800 pallets at the onset of the action research to less than 1200 pallets. The initial target set for the reduced utilization was 1200 pallets but APMAE was able to reduce this to 1050 pallets. Monetising this shows an annual savings of RM 232,000.
- ii. The manpower in the warehouse at the onset of this action research was twenty four persons. This was reduced to fifteen persons, a thirty three per cent reduction. This resulted in an annual savings of RM 324,000.
- iii. The process of repacking the inventory of parts supplied by the local vendors was eliminated. This resulted in eliminating the double handling at the warehouse and helped in reducing the manpower from twenty four personnel to fifteen personnel leading to 324,000.00 ringgit as stated earlier.
- iv. The improvements in the quality of parts supplied by local suppliers allowed the production supervisors to spend more time on value added activities as opposed to the mundane process of exchanging bad parts for good parts.
- v. The elimination of the process of revising the delivery schedules reduce the amount of mundane and unnecessary administrative work done by purchasing department, PPC department and warehouse in managing the suppliers. This time can be used to do more value added activity.
- vi. A single communication system between APMAE's purchasing, warehouse, production, and the suppliers was achieved using Dropbox as a common sharing platform. This eliminated the need to send the updated information multiple times to multiple locations. This resulted in one time, real time updating and sharing of information.

These improvements have benefitted the company. Similar benefits can accrue to other companies that take this path and will be helpful in improving their competitiveness. The improvements in the supply chain management and warehouse operations were achieved by implementing a Supplier Kanban System. With this study, the framework developed will allow implementation of a Kanban system with no or little difficulty in reducing cost of operations. The systemic framework is set in place to design and implement Kanban system and subsequently get digitalized for any firm that is interested in upgrading. This framework can monitor and control not only the inventories and production but also to integrate all support services as well.

The framework for the implementation of a Supplier Kanban System was the result of a 4-year action research project, which helped the company save more than 556,000 ringgit annually. Moreover, there was significant improvement in the working condition. Reduction in inventory stored in the warehouse, the amount of redundant work carried out by the employees and other non-monetary improvements which are difficult to a monetise resulted in a much better work environment and happier employees. The Supplier Kanban System helped in improving the researched company's bottom line and working environment. The researcher hopes this

framework can be extended to other companies as well to realise their monetary and non-monetary benefits and improve their bottom line.

Therefore, this study has suggested that the framework can be effectively incorporated into any small or medium size enterprise. The industry policy makers should pay attention to restructure the practices, policies and strategies to align with technological advancement and managerial strategies considering Kanban system in logistics. By employing the thematic action research practically, many manufacturing and logistics companies (Azizi et al., 2019) increase their performance and achieve optimum competitive advantage. Lastly, the framework developed in this study consists of simple easy to follow steps and can easily be adopted by any company wanting to implement the Supplier Kanban System

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