A STUDY ON OPERATIONAL ISSUES FACED BY MANUFACTURING FIRMS IMPLEMENTING TRADITIONAL KANBAN SYSTEM (TKS)

MOHAMAD FIRDAUS BIN MOHD YASIN

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Faculty of Industrial Management
UNIVERSITI MALAYSIA PAHANG

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project report and in my opinion this report is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Industrial Technology Management with Honours.

Signature :
Name of Supervisor : MR. WAN NAZRUL HELMY BIN WAN MOHD ZAIN
Position : LECTURER
Date :

STUDENT'S DECLARATION

I hereby declare that the work in this report is my own except for the quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature :
Name : MOHAMAD FIRDAUS BIN MOHD YASIN
ID Number : PC11029
Date :

DEDICATION

Dedicated to my beloved family and friends

Love of my life

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ABSTRACT

Just-In-Time (JIT) manufacturing philosophy is a systems that were originally designed for deterministic production environments such as constant processing times and smooth and stable demand. However, once implemented, JIT is fraught with numerous types of uncertainties, including variations in processing time and demand, planned interruptions such as preventive maintenance and unplanned interruptions such as equipment failure. These uncertainties lead to lowered production throughput, decreased machine utilization, increased order completion time and greater backlogs and overtime requirements. This disquisition focus on the study of the operational issues existed in the tool employed as control mechanism in JIT, the Traditional Kanban System (TKS). After an extensive qualitative study using in-depth interview and literature reviews, the performance of TKS were analysed and the weakness and flaw of the system were used as data of this research. The operational issues were then analysed and suggestion to address those issues were drawn out based on the variation (modification) of Kanban system.

Keywords: JIT, Kanban, TKS, Kanban variation, operational issues, system improvement

ABSTRAK

Just-In-Time (JIT) adalah sistem falsafah pembuatan yang pada asalnya direka untuk persekitaran produksi deterministik seperti masa pemprosesan yang malar dan permintaan yang lancar dan stabil. Namun, setelah dilaksanakan, JIT penuh dengan pelbagai jenis ketidakpastian, termasuk variasi dalam masa pemprosesan dan permintaan, gangguan dirancang seperti penyelenggaraan pencegahan dan gangguan yang tidak dirancang seperti kegagalan peralatan. Ketidakpastian ini membawa kepada penurunan pemprosesan pengeluaran, penurunan kadar penggunaan mesin, meningkatkan masa penyiapan pesanan dan tunggakan yang lebih besar dan keperluan kerja lebih masa. Fokus kajian ini ialah mengenai masalah operasi yang wujud dalam teknik yang digunakan sebagai mekanisme kawalan dalam JIT iaitu Sistem Kanban Tradisional (TKS). Selepas kajian kualitatif yang meluas menggunakan wawancara mendalam dan ulasan kesusasteraan, prestasi TKS dianalisis dan kelemahan dan kecacatan sistem yang telah digunakan sebagai data kajian ini. Isu-isu operasi telah dianalisis dan cadangan untuk menangani isu-isu tersebut telah dirangka berdasarkan variasi (pengubahsuaian) sistem Kanban.

Kata kunci: JIT, Kanban, TKS, variasi Kanban, isu-isu operasi, penambahbaikan sistem

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Just-In-Time (JIT) is a production methodology that encompasses economically designed product, efficient plant layout to reduce lead-time, worker involvement and motivation, improved data accuracy, reduced scrap, continuous improvement in all areas and implementation of the Kanban system. Kanban system is favorable because of its capacity to rule the production, its simplicity in production planning and scheduling, decrease burden on operators, simplicity identification of parts by the Kanban card attached to the container and significant reduction in paper work. Despite the fact that JIT is intended for an impeccable environment, for example, smooth and stable demand, steady processing time among stations and no breakdowns, in most practical cases, it is exceptionally uncommon to attain. JIT is loaded with various sorts of issues, for example, processing time variability, line unevenness and machine breakdown.

Traditional Kanban System (TKS) is the original Kanban system developed by Taiichi Ohno that were introduced as an instrument of accomplishing Just-in-Time manufacturing (Monden, 1993). However, rapid transformation of the manufacturing condition around the world is making TKS outdated. As a tool in JIT, TKS is also affected by the variability in the manufacturing and market condition. The market driven by highly variable and customize demand of product is making the demand unstable, thus impose challenges to the traditional way of how Kanban works.

Over the years, researchers have done numerous study on how to responds to variability in manufacturing environment that employs Kanban system. Theoretically, they have developed many models in order to respond to unstable manufacturing environment such as unstable demand and supply, variability in process time and lead

time, line imbalance and information system of the traditional Kanban system to better works in nowadays challenging business. Through the research and development in previous research, it can be implemented in the manufacturing firm that use traditional Kanban to do a change in their old system without throwing out the Kanban system out of their firm.

1.2 BACKGROUND OF STUDY

The research is carried out to fulfill my personal interest in studying the operational issues of manufacturing system that employs Traditional Kanban system (TKS) to better understand how Kanban works theoretically and practically as well as to understand how Kanban system works theoretically and practically in unstable manufacturing environment. The study will also focus on the variation of Kanban system that would help give me insight about the solution to the problems faced by manufacturing firm that use traditional Kanban system. This research is also carried out based on the research by Junior and Filho (2010) on The Variation of Kanban System that study the numerous research done by previous researchers developing modified model of Kanban system.

1.3 PROBLEM STATEMENT

Nowadays, the unpredictable demand from customer is the most challenging factor in Just-In-Time (JIT) manufacturing. Without the proper information about what customer want, how many they want and when they want can really give problems to the stability of the manufacturing process. Worse, other factor that can contribute to manufacturing issues such as machine breakdown, variability in process and lead time, if not addressed properly can make the firm that employ JIT face serious trouble in term of customer satisfaction, thus lead to low revenue and profits.

The philosophy of JIT which main objective is to reduce inventory in the manufacturing process and warehouse is becoming thorn in a flesh because it disallow any over-production thus deny any managerial decision to simply produce more in advance to respond to unstable demand. The Traditional Kanban System (TKS) which were developed decades ago, is becoming outdated with its manual information system

without the ability to respond to variability in manufacturing process because it only works well in a stable manufacturing environment.

Therefore, this study aim to study the operational issues faced by manufacturing firms that employ Traditional Kanban System (TKS) in their Just-In Time (JIT) manufacturing environment. The operational issues then can be used as the basis to find any improvement opportunity to address the operational issues properly without changing the nature of the Kanban system.

1.4 RESEARCH OBJECTIVE

The objective of this study is to:

i. To identify the operational issues that exist in the Traditional Kanban System (TKS) implemented in a manufacturing firm.
ii. To suggest improvement to address the operational issues exist in the Traditional Kanban System (TKS) implemented in a manufacturing firm.

1.5 RESEARCH QUESTION

Based on the objective of this study, the following research question can be developed:

i. What are the operational issues that exist in the Traditional Kanban System (TKS) implemented in a manufacturing firm?
ii. How can the operational issues exist in the Traditional Kanban System (TKS) implemented in a manufacturing firm be addressed?

1.6 SIGNIFICANCE OF RESEARCH

This study is primarily conducted to study the operational issues of Traditional Kanban System (TKS) implemented in a manufacturing firm and the improvement that can be done to address those issues. I hope that this study will help students in management class to better understand what Kanban System is and what are the advantages and disadvantages of the system.

I'm also hoping that this study will help give some insight to the people in manufacturing firm about the operational issues that they might encounter if the firm

employs Kanban System and what they can do to improve the Kanban system if any of the operational issues arise in the process.

1.7 SCOPE OF STUDY

The focal point of this research is to study the operational issues of Traditional Kanban System (TKS) of a manufacturing system. Thus, only manufacturing firms that implement and follow the Traditional Kanban System (TKS) without any modification on the system, whether on the Kanban control or the information system will be used as the subject in this study. I'm well-aware that most big company are using a modified type of Kanban system with advanced information technology. Thus, finding a subject of study might find be hard. This in turn may cause this research to fail in achieving its objective.

The research also aim to propose improvements to Traditional Kanban System (TKS), if and only if there're operational issues exist. Improvement proposed to address the issues will be based on literature review and theoretical assumption. The limitation on is the improvement proposed is not entirely feasible in the targeted firm.

1.8 EXPECTED RESULT

At the end of this research, I'm expecting to have the ability to answer the research questions thus achieve the objective. I am expecting to be able to reveal some of the operational issues which I think exist in the Traditional Kanban System (TKS). In addition, I'm expecting to be able to offer improvement solution to solve those operational issues.

Also, upon completing the research, the outcomes is expected to be able to help targeted manufacturing firm improve the Kanban system employed in the factory. It is also expected that this research can reveal some of the operational issues that exist within the Kanban system, so that it'll help people from manufacturing firm to understand the disadvantages that exist in the Kanban system and how can they overcome it if encountered.

1.9 OPERATIONAL DEFINITION

1.9.1 Just-In-Time (JIT)

Calvasina et al. (1989) characterize JIT as an rule of production control that tries to minimize raw materials and WIP inventories; control (take out) deformities; balance production; constantly simplifying the production process; and make an flexible, multi-talented workers.

1.9.2 Kanban

Kanban is the Japanese word for visual card of giving data to manage the stream of inventory and materials. Kanban framework underscores least level of inventory. It guarantees the supply of right part, in right amount, in the ideal spot and at the perfect time (Kumar and R. Panneerselvam, 2007). Kanban framework is a component to oversee and control stream of material in manufacturing. Card is utilized to manage material flow through all process. It was determined from downstream need and trigger upstream production. Upstream production is then started to restock those parts that have been withdrawn. (Bonvik and Gershwin, 1996)

1.9.3 Withdrawal Kanban

This is a visual card that determines the kind and amount of the part which the manufacturing process ought to withdraw from a past process. The withdrawal Kanban recognizes area in the past process where the parts can be withdrawn from.

1.9.4 Production Kanban

This kind of Kanban card points out the kind and amount of the segment which the past process must produce. The card will recognize the part to be created and the area where it must be put.

1.9.5 Waste

Waste can be characterized as something besides the minimum amount of resource which are completely fundamental to increase the value of the item (Rawabbdeh, 2005). It speaks to the useless resource, in this manner a methodical and consistent recognition and disposal of waste can free up resource and lead to more efficient, enhanced profit and improved competitiveness.

1.9.6 Manufacturing Firm

A manufacturing firm is any firm that uses parts, parts or crude materials to make a finished product. These products can be sold straightforwardly to customers or to other manufacturing organizations that utilize them for making an alternate item. Manufacturing businesses in today's world are normally comprised of machines, robots, computers and humans that all work in a specific manner to create a product. Manufacturing business frequently utilize an assembly line, which is a procedure where an item is assembled in arrangement starting with one work station then onto the next.. By moving the product down an assembly line, the finished good can be put together quicker with less manual labor. It is important to note that some industries refer to the manufacturing process as fabrication.

1.9.7 Pull System

A pull type of production system comprises of a succession of workstations including valued adding activity in every workstation (WS). In the pull system, from the current workstation, each one of the part or work is withdrawn by its succeeding workstation. As such, the work is pulled by the next workstation as opposed to being pushed by its previous workstation. The stream of parts all through the product list is controlled by Kanban Cards (Turbo, 1996).

CHAPTER 2

LITERATURE REVIEW

2.1 LEAN MANUFACTURING

The theory of lean manufacturing was primarily introduced and popularize in Japan, and the Toyota production system was a leader to employ lean practices. Lean manufacturing helps in enhancing production processes and boosting up the employees job satisfaction (Singh et al., 2010). Lean manufacturing is different from traditional manufacturing. The traditional manufacturing concept focuses on the inventory of the system, whereas lean manufacturing opposes this concept. The 'Lean' concept considers inventory as a waste in the organization. Understanding the differences between traditional manufacturing and lean manufacturing is very important for organizations if they want to follow lean practices (Andrew, 2006). The market is becoming more volatile day by day, so understanding market dynamics is a crucial factor if one wants to design manufacturing systems better (Gadalla, 2010). Lean manufacturing believes the simple fact that customers will pay for the value of services they receive, but will not pay for mistakes (Rawabdeh, 2005).

Introducing lean manufacturing in any type of industry has a straightforward impact on manufacturing processes. Today people have a different perspective on manufacturing processes. They comprehend that the value of any goods is determined from the client's perspective, not from an internal manufacturing perspective. Lean manufacturing concentrates on the end of squanders from the association. A waste is characterized as anything that does not increase the value of the goods. Lean tool

techniques when combined with SWOT (strength, weakness, opportunity, threats) analysis help in eliminating wastes within the organization (Upadhye, Deshmukh, & Garg, 2010). Lean manufacturing when implemented successfully results in an increase in production output per person and a reduction in the finished goods inventory and work in process (Seth & Gupta, 2005). Lean manufacturing when executed effectively brings about an increase in production yield for every individual and a decrease in the finished product inventory and work in process (Seth & Gupta, 2005). A definitive objective of a lean manufacturing framework is to eliminate all waste from the production. A lean framework is spoken to as two pillars: the first one is "Jidoka" and the second is 'Just-In-Time'. The main objective of a lean manufacturing framework is to create results of higher quality at the most minimal conceivable expense and at all time by eliminating waste (Dennis, 2007).

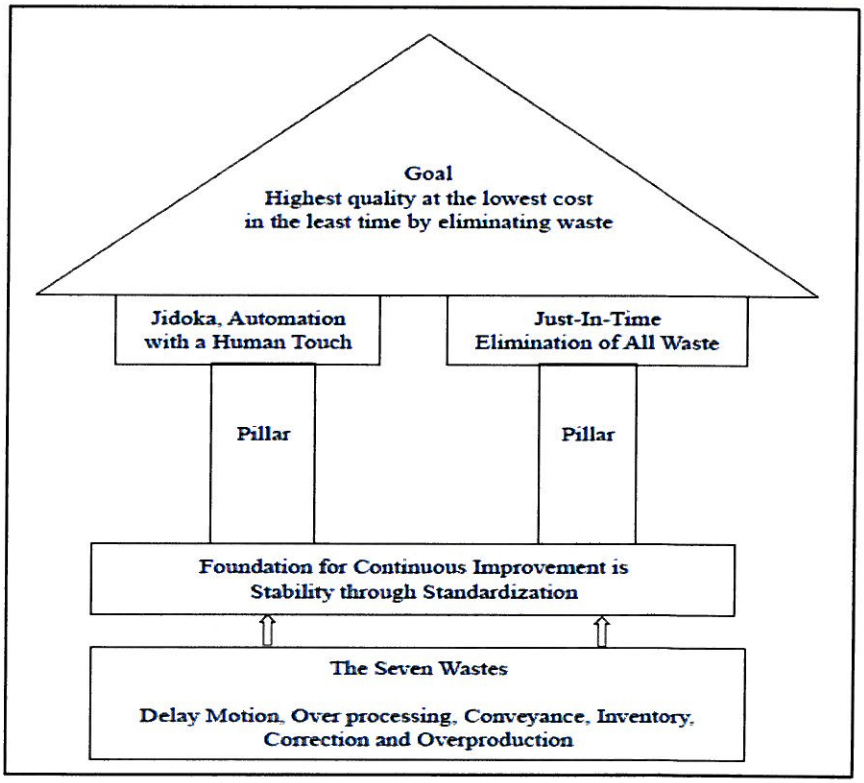

Figure 2.1: Basic Lean Concepts and Methods. (Source: Dennis, 2007)

2.1.1 The Lean Philosophy

The definition of lean, its principles and main ideas, come from lean philosophy. According to Womack and Jones (1996), lean is defined as an action that includes five

steps: the first step is defining customer value, then defining value stream, making it 'flow', establish pull, and the last step is pursue for excellence. According to Wong et al. (2009), lean manufacturing can be portrayed by an aggregate set of key elements or key regions. These key elements are accepted to be critical for its usage. In the 1980s, changing plant to lean production from large scale manufacturing was thought to be extremely troublesome. Workers did not assume liability for the quality of the item. They reacted just when they realized that administration really esteemed their abilities. The quote 'do it right the first time', urges workers to feel responsible for the items. Womack et al. (1990) explained how the development of vehicles manufacturing occurred from specialty generation to large scale manufacturing and afterward to lean manufacturing. The institutionalization of vehicle parts and assembly systems was carried out by Henry Ford. It takes a revolution, and as an issue low talented workers and specific machines made the cars affordable for the customers (people).

From the point of perspective of Bhasin and Burcher (2006), lean is seen as a theory rather than a strategy. Supplier involvement is an unquestionable requirement if a firm wants to harvest the benefits of lean practices. In addition, lean manufacturing ought to be considered as continuous improvement to yield better outcomes. Bhuiyan and Baghel (2005) outlined the continuous improvement from the past to the present situation. Continuous Improvement (CI) utilizes distinctive philosophies to yield more favorable outcomes to the business. These philosophies include lean manufacturing, six-sigma, lean six-sigma and the Balanced Scorecard. Hopp and Spearman (2004) found that continuous improvement deliberations are intends to attain remarkable level of pull production (production is focused around genuine day by day request) through eliminating inconsistency in the system and subsequently reducing waste in the firm.

Clarity of the term waste must be caught on. There are two sorts of waste, the first one is visible waste and the second one is hidden waste. Visible waste is the outcomes from overproduction, waiting, transportation, improper processing, over the top inventory, overabundance movement and flaw. Visible waste is outcomes of variability. Dhamija et al. (2011), in his work expressed lean firm are those which use less material for their production, less people to perform the work, less time to design and develop, and lesser energy and space used. Lean firm concentrate on client wants and consequently producing high quality goods and services in most economical and effective way. Rose et al. (2011) purposed 17 lean practices which are thought to be

best possible and applicable to little and medium scale qualities. They proposed that execution of lean practices ought to be carried out in a continuous manner. Inconsistency in the endeavors may not lead any firm to rip full from lean practices.

2.1.2 Benefit of Implementing Lean Principle

Numerous creators have disputed that lean helps competiveness (Billesbach, 1994; Nystuen, 2002; Oliver, 1996; Parker, 2003; Siekman, 2000; Taylor & Brunt, 2001; Vasilash, 2001). According to Sohal and Eggleston (1994), two-thirds of organizations accepted strategic gain had been produced with greater enhancements coming from relationship with customers, quality constraints and market competitive positioning. Lathin (2001) expressed that conventional mass makers could expect a shrink of 90% in inventory, 90% in cost of quality, 90% in lead time and a half increase in the workers' productivity. Claudius Consulting (2004) insisted that lean manufacturing can help firms to cut expenses by somewhere around 15% and 70%, reduce waste by 40%, push productivity up to 15% to 40%, and reduce space and inventory necessities by 60%. Nystuen (2002) expressed that goods flow time can be lessened by 90%, inventory by 82% and goods lead time by 11% by applying lean manufacturing ideas in the firms.

2.2 JUST-IN-TIME (JIT)

2.2.1 What Is JIT?

Just-in-time (JIT) is the name ordinarily used to depict a manufacturing system where fundamental parts to produce finished goods are produced or conveyed at the assembly site as required. Taiichi Ohno (1988), originator of the JIT idea, defined JIT as "Just-in-time means that, in a flow process, the right parts needed in assembly reach the assembly line at the time they are needed and only in the quantity needed". Schonberger, an American researcher on operation management, had the same standpoint as Taiichi Ohno when he alluded to JIT as an issue which: deliver and convey finished merchandise just-in-time to be sold, sub-assemblies just-in-time to be built into finished products, manufactured parts just-in-time to go into sub-assemblies

and obtained materials just-in-time to be changed into assembled parts (Schonberger, 1982).

JIT is a Japanese creation manufacturing theory that speaks to "an aesthetic ideal, a natural state of simplicity" in the efficiency of production (Zipkin, 1991). In spite of the fact that absolutely defining JIT is always difficult (Mia, 2000; White and Ruch, 1990), JIT production is by and large alluded to as a manufacturing system for achieving greatness through continuous improvement in productivity and waste elimination (Crawford and Cox, 1990; Lummus and Duclos-Wilson, 1992; Orth et al., 1990; Suzaki, 1987). A more particular definition is given by Calvasina et al. (1989) which expressed that JIT is a system that control production, and seek to minimize waste materials and WIP inventories; control (eliminate)flaws; production stabilization; continuously ease the production process; and make an adaptable, multi-talented workers. According to Schonberger (1987), JIT is the most paramount productivity enhancing system innovation since the turn of the century. Gleckman et al. (1994) expressed that JIT has grew up, and is perceived as a logical management theory. The idea of JIT has finished its development from a manufacturing strategy to a much more extensive theory of improvement (Vokurka and Davis, 1996) that can help the US producers once again, gain and maintain competitiveness in the worldwide business (Yasin et al., 1997).

2.2.2 Progression of the JIT Concept

Based on history, the Just-in-Time (JIT) methods previously put into operation during the late 1920s at Henry Ford's incredible industrial complex in River Rouge, Michigan as he streamlined his moving assembly lines systems to make cars. In My life and Work, Henry Ford stated that, "We have found in buying materials that it is not beneficial to purchase for other than prompt needs. We purchase sufficiently just to fit into the arrangement of production... If transportation were flawless and an even stream of materials could be guaranteed, it would not be important to have stock at all" (1922)

Then again, JIT did not authoritatively set out in its progressive track until the Toyota Motor Company of Japan gave careful consideration to Ford's operation strategies and built its creation framework with respect to what it saw. Toyota took in an

incredible arrangement from studying how Ford's plant worked and was even ready to perform something that Ford proved unable to achieve: a framework that could deal with diversity (Stevenson, 2005).

The JIT methodology began to be created at Toyota by Taiichi Ohno, its VP of manufacturing, and a few of his associates since 1940s. At that time it was known as the Toyota Production System (TPS). The framework developed bit by bit and turned into a triumph during the 1980s when Toyota made astonishingly brilliant quality with a low price car contrasted with their American rivals. The advancement of JIT in Japan was presumably influenced by Japan that have few natural resources, yet crowded nation (Lim and Low, 1992). It's not surprising when Japanese are exceptionally touchy towards waste and inefficiency. Scrap and rework are seen as waste whereas overabundance inventory as a shrewdness in light because of the fact that it use up much room and depleted the resources. Lehner (1981) point out that a great part of the TPS started in the late 1940s and early 1950s, when Toyota was producing only for a local market that was not exceptionally solid. The organization had been operating on the traditional belief that it was most adequate to mass produce in large number of lot, "yet that kind of thinking has pushed us nearly out of business, in light of the fact that the large number of parts we were producing couldn't be sold", said Toyota's leader Mr. Fuji Cho (Lehner, 1981). Toyota couldn't lay off laborers due to "Japan's a "lifetime" employment framework", so Toyota administrators hit upon the basic yet profound thought that still infests its operations which is "overproduction is waste". Based upon that, Toyota make their production system better thus culminated the JIT idea.

As the triumph of JIT has become very popular, quality specialists W. E. Deming and J. M. Juran addressed on the requirement for American makers to implement numerous JIT principles from their Japanese rivals (Chase et al. 2006).

2.2.3 Benefit of JIT Implementation

In the latest investigation of the normal advantages accumulated to US producers from implementing JIT demonstrated some great figures: 90% lessening in cycle time in manufacturing process, 70% decrease in inventory, 50% of labor expenses are diminished and 80% decrease in space necessity (Russell and Taylor, 2006). Salaheldin (2005) inquired about on the JIT execution in Egyptian manufacturing firms

and further discovered ample alluring advantages, for example, enhanced quality; lower expenses; better relationship with laborers and suppliers; amplified utilization of space; full usage of workers, machine and equipment, parts and materials; and enhanced competitiveness with lesser paper work. Accordingly, there is most likely no ambiguity about the benefits and advantages of JIT on the operation of the organizations.

Other Benefits of JIT Implementation.

i. Waste are eliminated in production and material (Hobbs, 1997; Tesfay, 1990).
ii. Improved relationship internally (within a firm) and remotely (between the firms and its clients and suppliers) (Inman and Mehra, 1991).
iii. Reducing procurement expenses which is a biggest cost to most firms (Ansari and Modarress, 1990; Gargeya and Thompson, 1994).
iv. Reduced lead-time, decreased throughput time, improving quality of production, higher productivity and enhancing client responsiveness (Arogyaswamy and Simmons, 1991; Cook, 1996; Crawford and Cox, 1991; Hobbs, 1997; Norris et al., 1994; White, 1993).
v. Cherish authoritative discipline and managerial involvement (Francis, 1989). Integration of the distinctive practical areas in the firm. It particularly overcomes any problems between production function and accounting (Johansson, 1988; O'grady, 1988).

2.3 KANBAN SYSTEM

2.3.1 What Is Kanban?

Kanban system is one of the apparatuses in lean manufacturing system that can attain minimum inventory at a time. Kanban system gives numerous benefit in managing operations and business in the firm. Using Kanban system is a key operational choice to be utilized as a part of the production lines. It serves to enhance the organization's productivity and in the meantime reduce waste in production process. The Kanban system obliges production if the needs of items is existed in the production

process. Manufacturing organizations particularly in Japan have executed Kanban system effectively as this system originates from this nation (Azian et al., 2013)

Kanban system is another theory, which assumes a critical part in the JIT generation system. Kanban is fundamentally a plastic card containing all the information needed for generation or assembly of any goods at each one stage and specifics all the way to be finished goods. The Kanban system is a multistage production scheduling and inventory control system. These cards are utilized to control production stream and inventory. This system encourages high production quantities and full utilization with diminished production time and work-in-process (WIP). (Kumar and R. Panneerselvam, 2006)

Kanban (kahn-bahn) is a Japanese word; when interpreted it actually signifies "visible record" or "visible part" (Surendra et al., 1999). In general, it alludes to some kind of signal; where in manufacturing, it alludes to Kanban cards. The Kanban system is focused around a client of a part pulling the part from the supplier of that part. The client of the part can be a real user of a finished item (outside the firm) or the production staff at the succeeding station in a manufacturing plant (internal). In like manner, the supplier could be the individual at the preceding station in a manufacturing line. The use of Kanban is that material won't be created or moved until a client sends the signal to allow it to do so. (Surendra et al., 1999)

2.3.2 Key Determinants in Kanban System

Based on the literature, there were key determinants in setting up the Kanban system. To guarantee the execution of Kanban system is beneficial, certain elements ought to be viewed as, for example, management of inventory, seller and supplier support, quality upgrades and quality control and worker and top management engagement. (Kumar, 2010)

i. *The Inventory*

Heizer and Render (2005) stated that the organization never accomplishes a low-cost strategy without great management of inventory. These researcher said that inventory are arranged into four classes. They are raw material inventory, work-in-

process inventory, finished products and maintenance, repair, operating inventory. Since inventories are vital in a firm, managing these inventories gets to be confounded since it involved capacity and holding expenses and space in manufacturing factory. Inventory management is a complex issue owing to enhance of genuine circumstances of a manufacturing firm. (Kobbacy and Liang, 1999)

ii. *Supplier Engagement.*

Kanban system obliges supplier engagement in giving quick responses to give supply of raw materials effectively. Essentially Kanban system just need least level of inventories in the production line where the inventories number ought to be equivalent with the production requirement. Thus, supplier engagement plays an essential part keeping in mind the end goal to is guarantee production lines works without any problems and productively. There are five vital criteria when picking suppliers which are quality, readiness to cooperate, specialized competency, location, and cost. The just-in-time (termed as JIT) is to kill stocks as opposed to move them to another point in the supply network. Once more, the best approach to accomplish this is through is the co-operation (Donald, 2003). The Japanese Kanban procedure of production is off and on again erroneously portrayed as a straightforward just-in-time management method, an idea which endeavors to keep up least inventories. The Japanese Kanban techniques includes more than adjusting production and supplier planning systems, where inventories are minimized by supplying these when required in production and work-in-process in is monitored closely (Donald, 2003).

iii. *Quality Improvement and Control.*

Kanban system not just helps organization in saving their expense by having less inventories yet it likewise controls and maintains quality enhancement of the production. Just-in-Time (JIT) is one of the components constituted in Total Quality Management system (TQM) (Flynn et al., 1995). For a viable JIT, all conveyed parts and items must accomplished certain level of quality guidelines before those parts and items are acknowledged for the following operations or reaching the client in the other end of supply chain end (input). This is because of the four main reasons includes

enhanced methods can make items with ensured qualities, giving the firm a competitive advantages, customers have ended up used to goods with high quality, and won't acknowledge anything less and quality also reduce expenses, for example, prevention, appraisal, internal failure and external failure expenses (Bernstein, 1984). Conventional organizations consider quality is expensive, deformities are brought on by workers and the minimum level of quality that can bring delight the client is sufficient. Firms practicing the Kanban system accept that quality prompts lower costs, which systems created most defect, and that quality can be enhanced within the Kaizen system (Balram, 2003).

iv. ***Employee Participation and Top Management Commitment.***

These days, engagement and great affinity among workers and management get to be as society in a firm to guarantee their peoples in the firm ready to cooperate with one another to accomplish their goals. The analyst has ordered Japanese society issue into two general classifications labor related and management related. This distinction among labor and management has helped Japanese managers to execute JIT effectively (Narender et al., 1995). All workers ought to be concerned and completely be a participator with the achievement of the new system and the achievement of the firm for the future; so they ought to be dealt with just as and reasonably. For the Japanese laborers, they are totally dedicated to their work and the organization. They are reliable, co-agent, adaptable and willing to work extend periods of time when required (Altman, 2000).

2.3.3 Rules of Kanban

So as to understand the JIT aim of Kanban system, the following principles (Monden, 1993) must be emulated:

Law 1: The consequent process ought to withdraw the vital items from the preceding process in the fundamental amounts at the right time. Any withdrawal without a Kanban ought to be precluded. Any withdrawal which is more prominent than the number in the

Kanban ought to be disallowed. A Kanban ought to always be connected to the physical parts or goods.

Law 2: The previous process ought to create its items in the amounts withdrawn by the next process. Production more prominent than the number in the Kanban must be disallowed. At the point when different kinds of parts are to be manufactured in the previous process, their production ought to take after the original process in which every kind of Kanban has been conveyed.

Law 3: The quantity of Kanban card ought to be minimized. Since the quantity of Kanban communicates the highest inventory of a part, it ought to be kept as little as it can. The jurisdiction to change the quantity of Kanban is designated to the chief of each one process.

Law 4: Kanban ought to be utilized to be able to adapt to a certain change in demand.

Law 5: Defect items should never be carried on to the next process.

2.3.3 Aim of Kanban System

As talked about in Toyota production system (TPS) and Kanban system materialization of Just-In-Time and Respect-for-Human system by Y. Sugimori et al. (1977), a production control system for just-in-time manufacturing and making full utilization of workers' abilities is the Kanban System. Utilizing Kanban System, workshops of Toyota have no more depended upon a computerized system. The motivations to have utilized Kanban System instead of automated system are as per the following:

i. ***Reduction of expense for information processing.***

It calls for tremendous expense to actualize a system that set scheduling for production to all the process and suppliers and its modifications and adjustments by real-time control mechanism.

ii. ***Rapid and exact securing of information.***

Using Kanban itself, managers of production lines may see such continuously changing information as capacity of production, operating rate, and labor without help of a machine. Henceforth, information of schedule corresponding to the change are precise, which urge workshops to establish obligation systems and to exercises for spontaneous changes.

iii. ***Limiting surplus limit of previous shops.***

Since a car manufacturer comprises of multistage procedures, for the most part the needs for the part gets to be dynamically more whimsical the further the procedure point is expelled from the point of the original interest for finished merchandise. Preceding courses of action get to be obliged to have surplus limit, and it is more subject to have waste of over-production.

2.3.5 Kanban as an Information System Tool.

The Toyota JIT production system is usually called as Kanban system. A Kanban system is an information system within a bigger manufacturing system. It is a methods by which JIT production can be done. Kanban along these lines controls the production of the needed parts in the vital amounts at the perfect time (M. Reda, 1987).

As stated some time recently, Kanban truly signifies "obvious record or plate". Nonetheless, as it is utilized within JIT, Kanban interprets into card. This card is principally used to flag the need to either deliver by using withdrawal Kanban (WK) or manufacture more components by using production-ordering Kanban (POK). A withdrawal Kanban indicates the amount needed at next process which are to be withdrawn from process before it, while a production-ordering Kanban requests previous procedures to deliver new parts (M. Reda, 1987). A sample of both Kanban cards is shown in Figure 2.2.

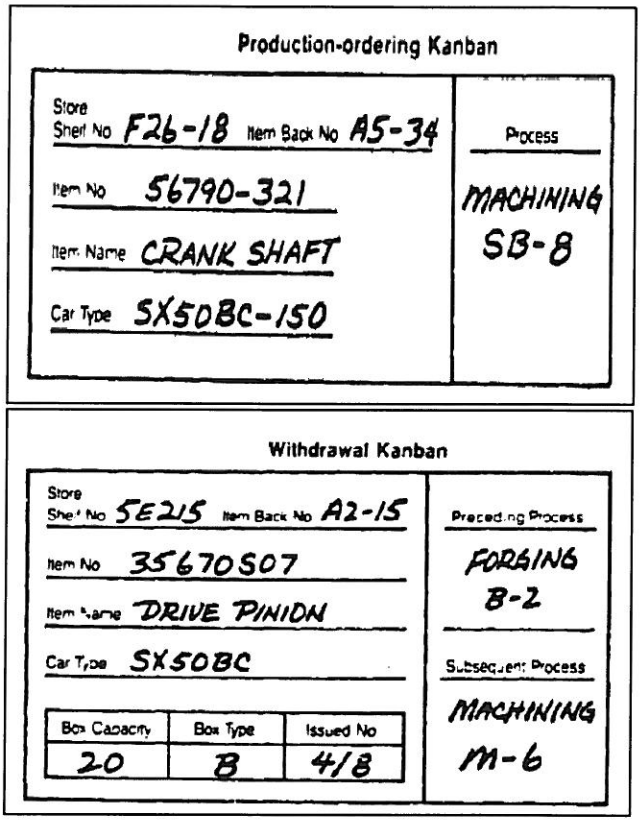

Figure 2.2: Examples of Kanban cards. (Source: M. Reda, 1987)

A Kanban system is manufacturing scheduling and inventory control system (Kumar and Panneerselvam, 2007). Kanban cards are utilized to control manufacturing stream and inventories, keeping a diminished manufacturing lead time and work-in-process in the system. Unmistakably, a Kanban is not just a physical paper or plastic card, as it can be either served by electronically or served by the container itself. (Giordano and Schiraldi, 2013)

Since it was imagined as a simple and shoddy approach to control inventory levels, numerous diverse usage of Kanban systems have been tested in manufacturing organizations everywhere throughout the world. In next passages, the most generally utilized "one or two cards" Kanban systems are explained.

i. One-card Kanban system

The "one-card" is the easiest usage of Kanban systems. This methodology is utilized when the upstream and downstream post are near to one another, so they can have the same buffer inventory. The card is called "Production Order Kanban" (POK). (Berkley, 1992 and Sharadapriyadarshini et al., 1997). The buffer stock acts either as the outbound cushion for the first (A) workstation or as the inbound cushion for the second (B) workstation. A schematic picture of a one-card system is demonstrated in Figure 2.3.

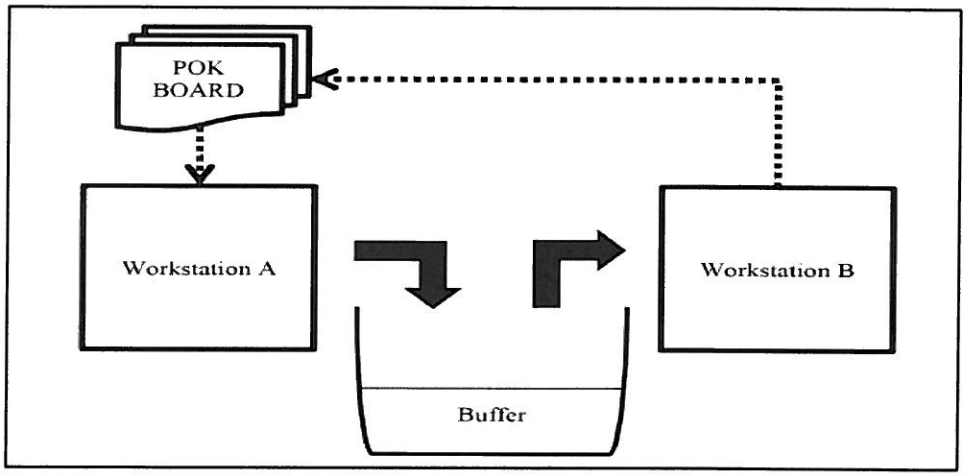

Figure 2.3: A one-card Kanban system (Source: Giordano and Schiraldi, 2013)

In this type of Kanban, every container has a POK joined, indicating the amount of a certain material in it, alongside inevitable integral information. The POK additionally speaks on behalf of production request for the Workstation A, indicating to recharge the container with the same amount. At the point when worker B withdraws a container from the buffer stock, he expels the POK from the container and posts it on a board. Thus, worker A realizes that one container with a particular part-number must be renewed to the buffer stock. (Giordano and Schiraldi, 2013)

ii. Two-card Kanban system

In the two-card system, every workstation has separate inbound and outbound cushions (Kimura and Terada, 198; and Hemamalini & Rajendran, 2000). Two separate sorts of cards are utilized, which are Production Order Kanban (POK) and Withdrawal Kanban (WK). A WK contains information on the amount of material the next station ought to withdraw. A schematic picture of a two card system is indicated in Figure 2.4.

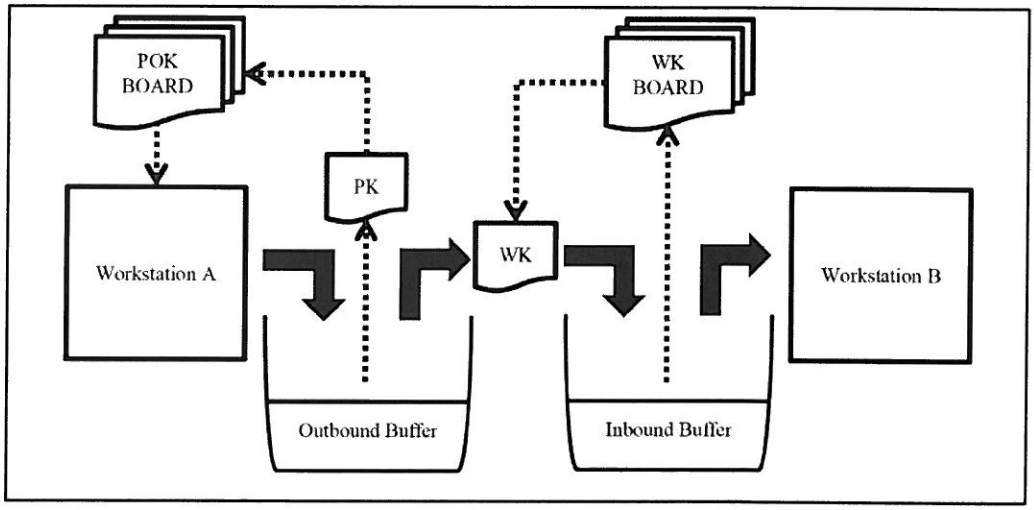

Figure 2.4: A two-card Kanban system (Source: Giordano and Schiraldi, 2013)

Every work-in-process (WIP) container in the inbound cushion stock has a WK joined, and every WIP in the outbound cushion stock has a POK. WK and POK are combined, where every part number is constantly reported both in n POK and n WK. At the point when a container is withdrawn from the inbound cradle, the B administrator posts the WK on the WK board. At that point, a stockroom worker utilizes the WK board as an order to recharge the inbound cushion: he takes the WK off the board and search for the combined POK in the outbound cradle. At that point, he moves the needed amount of the indicated material from the A outbound to the B inbound cradle, while exchanging the related POK with the WK on the container, restoring the initial circumstance. Finally, he posts the left POK on the POK board. Thus, as in the past situation, a workstation workers realizes that one container of that kind must be renewed in the outbound stock cushion. (Giordano and Schiraldi, 2013)

2.3.6 Benefit of Kanban through Implementation

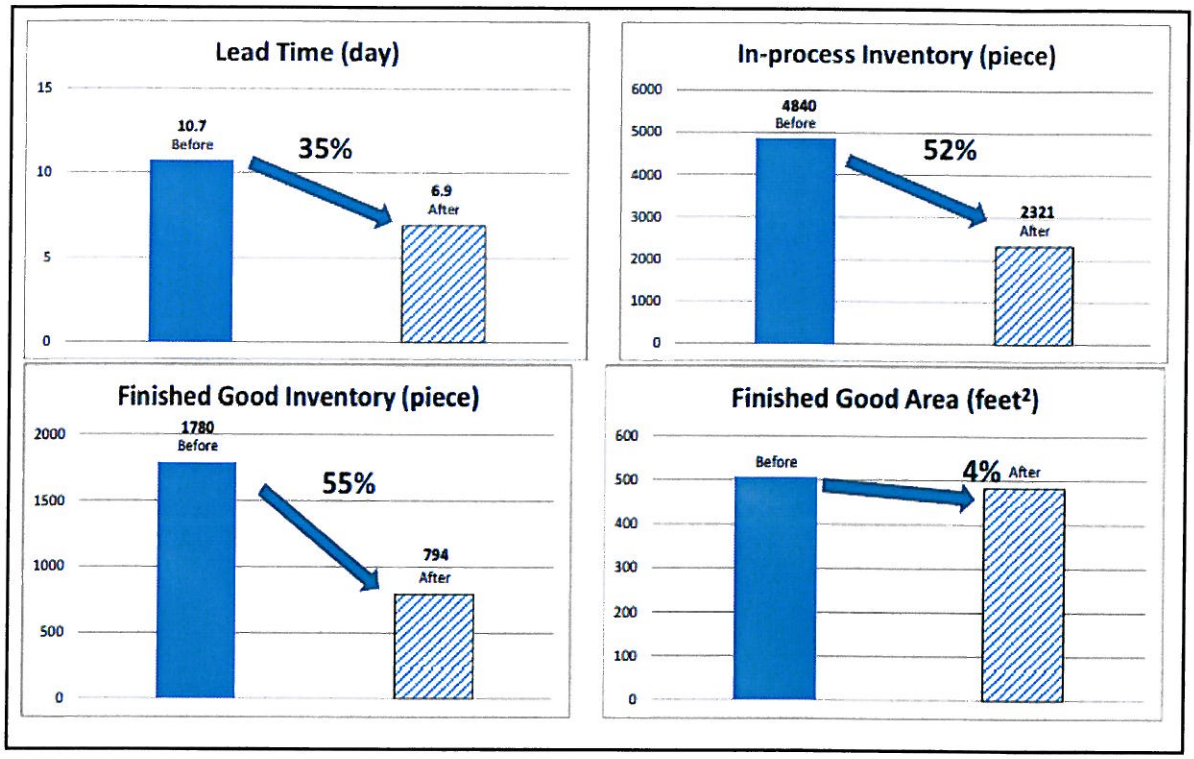

Figure 2.5: Percentage of Reduction for Lead Time, Inventory Level and Warehouse Space of Inventory.

It is demonstrated that by implementing Kanban system can truly enhance the inventory level in a manufacturing organization. A study by Ahmad Naufal Bin Adnan et al. (2013) has actualized Just-in-Time Production through Kanban system in BLM Cylinder Head Cover Company. The detailed analysis results have been assessed using lean metric parameter. Three lean measurements has been recognized which are manufacturing lead time, inventory level and space of inventory. An examination between two conditions was done to approve if the manufacturing execution had enhanced or weakened. The two conditions are previously, then after the execution of the Kanban system are indicated in Figure 2.5. From the results and discourse above, it can be seen that usage of Kanban system at manufacturing firm would enhance lead time, inventory and space usage. The change of three metrics had improved manufacturing capacity in term of efficiency of resource and lower operating cost.

2.3.7 Previous Study on Variations of Kanban System

In past decades, there're numerous studies done on modifying the Kanban system to better fit the unstable and fast changing manufacturing environment. According to Junior and Filho (2010), variations that take after the Kanban system attributes and the ones that don't. The systems that take after the original Kanban attributes are those in which no less than three of the four main original attributes are retained. Those which have just two or less original attributes are dealt with like systems that don't take after the original principle of the Kanban system.

i. Systems that follow Kanban original philosophy

Adaptive Kanban, suggested by Tardif and Maaseidvaag (2001), was produced as an option to the materials stream control in situations with shaky demand. This system comprises of determining when and what number of signals ought to be discharged for the system as an issue of the inventory level, the incoming requests, and items request. They give numerical cases and representations as an endeavor to enhance the parameters of control. Simulation outcomes about under shaky demand conditions demonstrated a decrease of postponements in conveyances contrasted with the original Kanban system. This adjustment is as basic as the original system and the attributes of pulling, decentralized control, and restricted WIP (however variable between periods) are maintained resulting in a system that takes after the rationale of the original Kanban system.

Auto-adaptive Kanban, suggested by Chaudhury and Whinston (1990), includes a structure like the Kanban system and it is adaptable to the conditions and demand of the production. It is an on-line, decentralized automatize control. It is focused around the straightforwardness of the original Kanban information need, and on other computational manufacturing innovations, for example, Computer Aided Manufacturing (CAM) and Computer Integrated Manufacturing (CIM). This system includes attributes, for example, pull production, decentralized control, and ultimate inventory level limitation, so it takes after the original rationale of the Kanban system.

Concurrent ordering system was produced in theory by Izumi and Takahashi (1993). The main contrast from the Toyota Kanban system is the releasing production and material transportation requests at the same time for all techniques focused on the genuine request of the final stage. To discharge those requests, the transportation and production signs of each stage are labeled on the final items. The incoming requests are satisfied by the final items inventory and the sign labels are ripped off, divided, and moved to all corresponding workstation avoiding a request transfer interruption if there should be an occurrence of a shortage in inventory.

Decentralized Reactive Kanban (DRK), created by Takahashi and Nakamura (1999), was suggested as an option to MFC, which concentrates on guaranteeing a decent execution of the various stage production systems and variability of demand. DRK goes for independently controlling the inventories of every workstation and in this manner, other than demand fulfillment, it keeps the average work-in-process low and decreases the mean waiting time in demand fulfillment.

Dynamically adjusting Kanban, suggested by Rees et al. (1987), embraces a dynamic modification in the quantity of Kanban card (in inventory level). Changing the quantity of Kanban card is an unequivocal factors for effective production system in an unsteady demand manufacturing system.

E-Kanban is a variation to Kanban with standout alteration, the substitution of actual cards by electronic signs. There are portrayals of E-Kanban by Ansari and Modarress (1995), Vernyi and Vinas (2005), among others. The main points of interest of this system are allowing upgrades in the supplier's relation, when the systems are utilized outside the organization, focusing on evaluating the supplier's work instantaneously guaranteeing exactness in acquiring and transmitting quantities of parts or goods. It can be utilized regardless of the gap between the productive operations, and it lessens the organization's paperwork.

Extended Kanban Control System (EKCS), suggested abstractly by Dallery and Liberopoulos (2000), is an option to Kanban systems and base stock control system since according to these creators none of these MFC systems attains a fitting harmony between fast client responsiveness and low work-in-process. In the EKCS system, the demand or request for finished items is isolated into every production stage and instantly conveyed to the process respectively. It is noticeably that the production in

every stage relies on upon the demand or request, however it is controlled by the Kanban card, which are likewise a request to convey parts to the next stages.

Flexible Kanban System (FKS), generally reviewed in writings, was created by Gupta and Al-Turki (1997). This adjusted system utilizes a calculation to dynamically manipulate and systematically the quantity of Kanban card with a specific end goal to counterbalance the blocking and starvation brought on by uncertainty (mainly identified as outcomes of demand and processing time) during a production cycle. Flexibly control and change the quantity of cards in this adjustment is a definitive element for rewarding production systems in a tight competition in the business with temperamental demand and variability in processing times.

Generalized Kanban Control System (GKCS) was suggested hypothetically by Buzacott (1989) and Zipkin (1989). This system includes the maintenance of cushions to take care of the demand spontaneously, and the utilization of Kanban signal to approve the production and to reduce WIP level. A hindrance of this system is the need of a definition and management of two control parameters for every stage, which are the cushion and number of production request signal. The main contrasts from the original Kanban is that in the GKCS the requests work independently from the Kanban signal, and even though when there are no parts in the workstation inventory, the signal request is conveyed to stage before if the Kanban signal is accessible.

Generic Kanban System (GKS) was developed in 1994 by Chang and Yih (1994a). GKS was made because of the need of a just-in-time system for non-monotonous manufacturing situations. The distinction in GKS, and the purpose behind its name, is identified with using generic signal, which don't fit in with a certain part, and subsequently can be ascribed to any parts in a workstation. This system obliges a waiting time since there is no intermediary WIP between workstations. There are signal that if uprooted don't initiate the production of new parts consequently, instead they sit tight for another order. The GKS acts like a push system, however it is more adaptable and powerful as to the location of the bottleneck. Simulation results demonstrated that the GKS is superior to the Kanban system in dynamic situations.

ii. Systems that doesn't follow the original Kanban philosophy

Bar-coding Kanban, exhibited through a case study conducted in a Canadian organization, was suggested by Landry et al. (1997). The main explanation behind its modification was the need to enhance the flow coordination of the procured materials of the organization. This modification utilizes essentially the material requirement planning (MRP) and bar coding cards. The main advantages implementing this system is highlighted by the researcher, which are reduced WIP, increased adaptability in supply, and more responsive to demand fluctuation. In this adjustment, just limited quantity of WIP (during each period) is maintained in connection to the original Kanban system. The conditions overcome by the utilization of bar-coding Kanban are parts variability and unsteady demand.

CPM Kanban System, exhibited by Abdul-Nour et al. (1998), is a management of project methodology adapted to equip just-in-time manufacturing (JIT) in a little profitable organization. CPM is the popular Critical Path Method. Kanban system is utilized between the beneficial divisions and the final gathering. In these division, production is pushed. The system was enforced using a Computer Aided Design (CAD) system to conceptualize the final goods and utilized the CPM methodology to perform the work to be done by the production divisions and to recognize the important task.

Customized Type 5 and Customized Type 10 systems are aftereffects of a critical commitment of Gaury, Kleijnen, and Pierreval in 2001 (Gaury et al., 2001) to a customized pull systems. This system comprises mainly of three steps, which are utilize a generic model that has numerous sorts of pull control, reenact the application of this strategy using the productive system parameter in which the modified pulled MFC is to be enforced and obtain the aimed parameter value. While the arrangement proposed by the Customized Type 5 is exceptionally extraordinary, yet this is an adjustment of Kanban system rationale. This system has decentralized control and restricted WIP at some stages, which makes it a non-adherent of the original rationale. What's more, the Customized Type 5 can be utilized successfully in a situation with variability in processing times. Customized Type 10 is an alternate case of high-peculiarity, yet it still is an adjustment of the Kanban system rationale. The control is decentralized and there is constrained WIP. Also, this system can be utilized successfully in situation with some variability in processing times with low reliability of the machines and bottlenecks.

Fake Pull Control System (FPCS) is a pragmatic adjustment of the Kanban system for a particular little volume and high-value manufacturing firm created by Hendrick (1988). The FPCS is an approach to work Kanban allowing the system to push the materials when the original Kanban conditions are not fit to the current situation.

Hybrid push or pull is a Markov judgment methodology created by Hodgson and Wang (1991a) and Hodgson and Wang, (1991b). This system is focused around the integration of push and pull manufacturing method. The creators displayed a four and a five-stage production system with parallel and serial production stages to be controlled by this variation. The early production stages push the production the other stages pull, resulting in average system expenses lowered. This is an adjustment that is more straightforward than other crossover variations like synchro MRP and potentially to be used in production systems with moderately demand instability.

Virtual Kanban (VK) is a variation proposed hypothetically by Takeda et al. (2000), which can be implemented to multi-stage production systems and profoundly custom goods. The highlight for this variation is the signal transferring to the upstream process, which responds to the bottleneck process, such as at the point when a machine breaks down or there is a shortage of raw materials, no sign is exchanged to the point of reference workstations. The VK execution was assessed by simulation, which indicated declining inventory levels, lessened lead times, and increased dependability in deliverance dates. The VK is suitable for circumstances of high mixture of parts, flimsy demand and complex productive streams.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The development of research design is one of the crucial part of this research. Choosing the type of research and the approach to carry out this research is very important because this it will decide whether this it will reach the objective of this research or not. The main purpose of a research design is to guarantee that the data collected allow us to adequately address the research issue as clearly as possible. Research design is the initial stage of developing the path of where this research will be lead to. Choosing the research type, the approach of research, method of sampling and data collection as well as the method of analyzing the data is decided and presented to give us the insight about how this research will be conducted in the future.

3.2 RESEARCH DESIGN

3.2.1 Type of Research

Qualitative research will be the method of research in this study. Qualitative research is methods that do not involve measurement or statistic which were usually been used in philosophy, sociology, and history for centuries. Denzin, Norman K. & Lincoln and Yvonna S. (2005) defines qualitative research as an approach of study utilized in numerous distinctive scholarly disciplines, generally in the social sciences, additionally in business and further settings. Qualitative research frequently classifies data in some pattern as the essential premise for organizing and reporting the findings.

To put it into another word, qualitative research produce information just on the specific case considered and any other general conclusions are just suggestions.

The purpose of employing qualitative research is because this paper objective is to study the Traditional Kanban System (TKS) in order to identify any operational issues that exist in the system at a manufacturing firm. This type of research does not focus of statistical nor experimental, which is more flexible in nature and not bound to reach its objective only by numbers.

3.2.2 Approach of Study

Case study will be used in this research, in order to obtain the desired data and input from targeted subject or sample. A case study is an inside and out investigation of a specific research issue as opposed to a sweeping statistical study. It is frequently used to tight down an exceptionally wide field of examination into one or a couple of effectively researchable illustrations. The case study research design is likewise helpful for testing whether a particular hypothesis and model really applies to phenomena in this present reality. It is a helpful outline when very little is thought around a phenomenon (Anastas and Jeane W, 2003). Not all study is outfitted to sampling subjects out of vast population. The case study is a kind of spellbinding research in which a top to bottom investigation of a group, event, community or institution is directed. The quality of the case study methodology is its profundity, as opposed to its expansiveness. The investigator tries to find all the variables that are vital in the history or advancement of his subject

Runyan (1982) stated that case study as the presentation and interpretation of definite information around a single subject whether an occasion, a society or individual life. Thus case study is very suitable in order to collect information about the operational issues that exist in a Traditional Kanban System (TKS) in order to address the issues properly in the recommendation of chapter five.

3.2.3 Type of Data

Primary data is the kind of information that will be gathered all through this examination. Primary data are those which are gathered first timer and are essentially given in the manifestation of raw information and originals in character. These sorts of information need the utilization of statistical methodology as a mean for analysis and interpretation. The suitability of primary data in this research is according to the method of data collection, which is in-depth interview of a production manager of a manufacturing firm. With the cooperation of the interviewee, this type of data is expected to be accurate and reliable because it doesn't have any influence of second or third informant. This type of data is suitable for a case study which needed an intensive investigation about the specific study, primarily focused on the operational issues of TKS in a manufacturing firm.

Secondary data, which has been gathered by somebody and have been statistically analyzed, might be possible to be utilized as a part of this study. This is because the interviewee may or may not show the interviewer the past performance's record of the firm's manufacturing system, and in this case study, the performance of TKS. However, even though the secondary data may be private and confidential, the research done by researchers in the past decades about TKS can be employed in this study, just in case the data collected are not sufficient to achieve the objective, or the data collected are not valid. The literature will also be reviewed to answer second research question, because I've no expertise in Kanban system. Thus by reviewing the literature, it will help me gain insight about what to be can be done to address the operational issues properly.

3.3 DATA COLLECTION

3.3.1 Population and Sampling

Data collection is critical in a study, as the information is intended to help a finer understanding of a hypothetical structure (Bernard 2002). It then gets pretty basic to select the way of obtaining information and from whom the information will be procured should be done with good judgment, particularly since there are no analysis

can compensate for falsely gathered information (Bernard et al. 1986). A population is the whole group to which we wanted to sum up our results. A sample is a subset of the population that we will do our study on.

Population

A "population" comprises of every subjects you need to study. A population contains all the conceivable cases, for example, persons, objects, occasions that constitute a population. Sampling is the practice of selecting a group of subjects for a study, the individuals selected is a representative of the bigger group from which they were chosen. This representative allotment of a population is known as a sample. In this research, the population under study consist of manufacturing firms that employ Traditional Kanban System (TKS), from that produce any type of product in their own plant. It is hard to recognize the identify the manufacturing firm that still implement the original, unmodified Traditional Kanban System (TKS) thus the population of study is very broad and include any firm in the in manufacturing business. The population may be later be modified if there're any justification or information that allow the population to be changed.

Sample

Sampling is the process of selecting a group of subjects for a study in such a way that the individuals represent the larger group from which they were selected. This representative portion of a population is called a sample.

Non-probability sampling will be incorporated in this research. Non-probability sampling serve as a sampling methods that help specialists to choose units from a populace that they are interested in studying. On the whole, these units outline the sample that the researchers investigates. The main character of a non-probability sampling procedures is that sample are chosen depending on the subjective judgment of the person conducting the research.

Non-probability sampling is used with the purpose of including the manufacturing firm that actually implement the Traditional Kanban System (TKS). And because sample selection is time-consuming and expensive, as a student, non-

probability is the best choice. Non-probability sampling is usually utilized on the grounds that the method used to choose units to be included in a sample are much less complicated, faster and less expensive when contrasted and probability sampling.

While the method of sampling selected is purposive sampling. Purposive sampling is a method in choosing the informant for the data collection which are utilized universally. The purposive sampling method, likewise called judgment sampling, is the intentional decision of an informant because of the qualities or information the informant has. It is a non-arbitrary method that does not need underlying hypotheses or a set number of informants. Basically, the researcher chooses what needs to be known and sets out to find individuals who can and are willing to give the information based on his or her knowledge or experience. (Bernard 2002, Lewis & Sheppard 2006).

Purposive sampling is widely utilized when one's objective is to include participant who serve as an expansive scope of points of view. Purposive sampling may additionally be utilized when a researcher wishes to include just individuals who meet extremely limited or particular criteria. Purposive sampling is used with the purpose of collecting useful data from an expert, specifically sample the have in-depth knowledge about Traditional Kanban System (TKS), which not widely known and popular among in the manufacturing world nowadays, such as line manager of a manufacturing firm.

3.3.2 Instrument Development

As stated before, the method of data collection will be in-depth interview of expert. In-depth interviewing is a technique for qualitative research in which the person conducting the study asks open-ended inquiries orally and records the respondent's replies. Interviewing is ordinarily done visiting the respondent personally, yet can likewise be carried out by means of phone-call. In-depth interviews are unique in relation to survey interviews in that they are less organized an in addition to it is more adaptable and continuous. The technique are not rigid and are regularly not prepared before the interview takes place. In-depth, qualitative interviews are good method to be used in evaluating the performance and identifying operational issues of TKS in light of the fact that it is an open-ended, discovery-oriented method technique, which permits the interviewer to profoundly investigate the respondent's feelings and viewpoints on a

subject. This results in rich foundation information that can shape further inquiries pertinent to the theme.

Although in-depth in flexible and usually, the questions are not prepared in advance, this research will be more purposive, thus question will be prepared in advance to avoid waste of time. Basically, all in-depth interview include 3 steps which are, thematizing, designing and lastly, conducting the interview.

Thematizing is defining the purpose of the interview. Before the interview, the researcher must determine what information is required. In this stage, everything that required to be answered by the interviewee is listed including the conceptual framework developed earlier on Chapter 1. This is for easier design of question.

Designing is where the question are structured based on the theme of the interview decided earlier on. This is very important part of instrument development because this is where the interviewer will construct the question in a purpose to fully utilize the interviewee in order to answer all the question.

Last one is conducting the interview. Before the interview, the targeted sample will be informed earlier to let the interviewee be ready for the interview. The theme, time, and duration of interview is also informed. What will be done in the session will be elaborated more in the next topic.

3.3.3 Process of Data Collection

In-Depth Interview

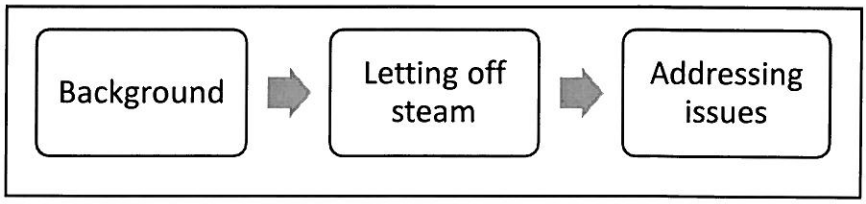

Figure 3.1: In-Depth Interview Process Flow

Figure 3.1 explains the process flow of an in-depth interview. The usual question in an in-depth interview is about the background of the subject under a study or topic under discussion. As of this part, researcher obtain the subjects' background information, for example, the respondent experience in TKS or his or her everyday activities that relates to managing TKS. This is the stage where most of the research

question will be answered, which is about the performance and operational issues of Traditional Kanban system incorporated by the company the respondent work. This is the warm-up session, to gain insight about what this interview session is attempting to complete and achieve in the end.

Letting off steam means that letting the interviewee shares with us the general knowledge, opinion and others about the topic At this point, it is appropriate to ask general inquiries which permit the member or the interview session to 'let off steam'. Regularly members have in their mind a set of key points that they need to let you know about the subject under study and may let you gain bigger picture about what is going on in the firm, which in return will benefit your study.

Addressing issues is the part where the "un-answered" question is addressed. This is to avoid the main purpose of the interview is not achieved. This is the where the importance of designing of question play it role.

The interview will be recorded by voice-recorder to avoid missing of important data. Notes will also be taken to jot down any relevant answer to the question. The voice recording then will be used as primary data in this study. The period of collecting data will be 1 hour 30 minutes to 2 hours.

3.4 DATA ANALYSIS

There're no software or specific method to analyses the data collected in this research. But most common way of analyzing interview's data is using Daily Interpretive Analysis (DIA). The goals of the DIA is to collect and analyze the information that was gathered during the interview. Specifically, toward the end of each day of interviewing, it is crucial for an analyst to audit the notes and the tapes and to compose a report that condenses and interprets the information and data obtained.

The objective of this research can be achieved if and only if the interview session can collect the required data such as performance review of the TKS, which will then be used identify operational issues of TKS of implemented in the sample's workplace.

Data collected in form of voice recording and notes will later be analyzed to find the required information to allow the researcher to come out with operational issues of TKS in a particular manufacturing firm.

In addition, as stated before, secondary data will be used in this research to achieve the second objective. Thus, research done by experts about TKS or variation of Kanban will then be analyzed properly, to find it relationship with the operational issues. Upon finding the relationship, the modified system of Kanban will be used as recommendation for improvement to address the operational issues that exist in the targeted manufacturing firm.

CHAPTER 4

FINDING AND DISCUSSION

4.1 INTRODUCTION

This chapter presents about the analysis of data and the summary of the findings from the data collection stage. The data collected in this chapter are based on secondary data, which are collected through the literature review of previously done research on Kanban-based manufacturing system. This is because the targeted sample which is the manufacturing firm that employ Traditional Kanban System (TKS) was failed to be identified due to the system feasibility issues in nowadays manufacturing environment. Thus, this bring me to use the secondary data, in order to answer the first research question about the operational issues of TKS in a manufacturing firm.

In this chapter, the data analysis is done on the possible operational issues or disadvantages that are widely discussed by the experts that may occur if the manufacturing system follow solely on the original or in other word, Traditional Kanban System (TKS) that is primarily developed and implemented by Toyota Motor Company. The data are presented and discussed in connection that may address the primary issues in the research question.

4.2 FINDINGS

4.2.1 Operational Issues of Traditional Kanban System (TKS) In a Manufacturing Firm through Literature Review

i. Lost Signboard

While the literal meaning of "Kanban" is "signpost," it is referred to as a "card" or a tag which is attached to containers of parts during production (Uszoy, 1990). Kanban is a tangible control tool that serves the purpose of transmitting the message to produce and move parts in the Just-in-Time environment (Spearman 1990). Numerous producers implemented replenishment systems based on pull system to deal with their raw material flow and work-in-process stock using Kanban cards. Ordinarily, Kanban cards are bits of laminated card fixed on the front of bins or other stockpiling containers. Operator or clients of a specific material take and transport the cards in along the workstations and stockpiling zones to cue workstation upstream that now is the ideal time to send more parts and the accurate amounts required.

Drickhamer (2005) stated that the use of physical cards works well within the factory. Unfortunately, in a real situation, some manufacturers extends their process to outside of the factory, for example, to the suppliers or customers. The physical cards, often lost during its travel to another workstation, whether inside or out of the factory. The workers often misplaced the cards or purposely throw the cards into the garbage. This issue creates problem for the process. Drickhamer (2005) also stated that a lost Kanban cards may lead to other problems for example, material shortage, waiting, additional expense, and in the end, a bad level of service.

ii. Limited Numbers of Kanban Cards

As stated before, in Kanban system, production of new parts is only good to go if there're production Kanban (PK) cards that authorize the production. According to Gupta et al. (1999), predetermined number of Kanban card can prompt to either

blocking or starving of workstations. The blocking of a workstation happens when all its production Kanban are affixed to full containers in its yield buffer. Equivalently, the starving of a workstations happens when at least one production Kanban is in the production Kanban's crate waiting for an empty box while the machine at that workstation is not in use.

There're numbers of possible reason that leads to blocking or starving. One of it is the stochastic behaviour of the process, which is mainly because of the variable processing time and demand. This, in turn, hinders the stream of production which can have an antagonistic impact on the performance superiority, for example, the time taken to complete an order and throughput. The quantity of Kanban in traditional Kanban system is rigid (cannot be change at will) and never increases or declines disregard of the system condition. Yet, due to the blocking or starving, operator or line manager sometime attempt to decisively increase the quantity of Kanban card at each station and thus increase the throughput of the system. This is not the best option since the main theory of Just-In-Time (JIT) is to have less inventories (WIP) and the time in system, while the change in quantity of the kanban will increase the work-in-procedure (WIP) and the time in system.

iii. *Developed for Perfect Manufacturing Environment*

Traditional Kanban system works best in production situations with stable request and lead times (Hall, 1983). Sadly, when an organization encounters wide varieties in supply and unstable demands, long haul average are frequently poor guess of the current operating conditions. Tardif and Maaseidvaag (2001) stated that, numerous organizations occasionally modify their pull control mechanism to suit current operating situation by studying the latest demand patterns and lead time projection and adding or decreasing the quantity of cards at some production stages. Some organizations essentially toss in extra cards or reduce the cards when they feel the requirement for higher or lower inventories. Yet, this is carried out in an impromptu style, typically ill-timed to be truly useful, and regularly brings about higher operating expenses.

Process variability can be caused by many issues. One of the issues is discussed Gupta et al. (1999). They addressed the effect of material handling system failure at a

random time of a day in a JIT environment. Their research reveal that sudden material handling system breakdown failure shows significant awful impact on the average time in system and the average time to complete an order. They also point out that traditional Kanban system also affected by the repairing duration of the material handling system. Lengthy material handling system repair or maintenance times cause a higher average time in the system, increase time to complete customer order, more overtime shift in production, underutilized buffers and underutilized station during normal production hour.

Research by Dasgupta (1998) also reveal that unstable demand in traditional Kanban system degrades the performance of the system that are developed based on assumption that demands are known and stable. Accoding to Dasgupta (1998), it is apparent that non-stationary demand lower the performance of a Kanban system through the delay of a demand to be filled, the backlog queue size, the service level, and the average flow-time of parts through the system. And as stated before, managers often stack up the downstream cells with more Kanban (or buffer stock). A high number of Kanban toward downstream provides a 'cushion' against the fluctuations of arriving demand. This enables the Kanban system to respond to high fluctuations relatively mildly and to maintain the production rate in a steady fashion. As the effects of adding more Kanban in the downstream stations of a Just-In-Time (JIT) line, the process entail more inventory. This fact completely deny the first and foremost desirable objective of a Just-In-Time (JIT) system, which is zero inventory.

4.2.2 Summary of the Operational Issues of Traditional Kanban System (TKS)

According to Junior and Filho, there're four main categories to classify the issues of the original Kanban system. The categories are summarized in Table 4.1.

Table 4.1: The Issues of Original Kanban System.

Disadvantages	Explanation
Increased Complexity	The system has element that make it more intricate to be practiced and utilized.
Increase in Movement of Workers And Container	The system has element that cause extra movement at the factory and may require the worker to be away from their workstations.
Likeability Of Delaying Demand Transmission	The system has element that can slow down the conveyance of demand information to upstream stages,

	causing inferiority in system response.
Increased Average Inventory Level	The system has element that may cause an increase in average level of inventory.

Source: Junior & Filho (2010), Variations of the Kanban System: Literature Review and Classification

In the research conducted by Junior and Filho (2010), the have classified the disadvantages of traditional Kanban system (TKS) in four categories. But how they decided to come up with the categories of disadvantages were not explained in the research. I have assume that they're classifying the disadvantages based on literature review analysis and observation as well as logic.

Based on the disadvantages of TKS explained earlier, I have enough reason to believe that the categories are true. The first category, complexity increase can be explained by the nature of the Kanban system that are develop under assumption that the manufacturing environment are stable without any variability in demand and supply, process and machine reliability. Traditional Kanban system works best in production environments with steady demand and lead times (Hall, 1983). The traditional Kanban system have the probability to increase the complexity to control the system if the manufacturing process experience unstable process with high variability in time and demand constraint. If, for example, the factory experience an unexpected and unknown demand, the manager must adjust the quantity of Kanban. But adjusting the quantity of Kanban is not simple. This is what I assume to be the reason why the TKS tends to increase the complexity.

Junior and Filho (2010) reveal that the system has element that cause extra movement at the factory and may require the worker to be away from their workstations. An increase in movement of workers and containers can be explained by the manual process of information sharing through the TKS. The manual system of TKS require the workers to transfer the Kanban card manually between workstation inside the factory in order to deliver information to the next process upstream that new parts are needed. This will increase the rate of movement of the workers and the container, which in turn will increase the traffic inside the plant.

The system has element that can slow down the conveyance of demand information to upstream stages, causing inferiority in system response. (Junior and Filho, 2010). This weakness addressed in this category is the effect of the rules of Kanban system that only allows the production of new part if there're production

Kanban card exist in a particular workstation. Through the literature, there's a main reason that can slow down the conveyance of demand information caused by lost Kanban card. When the production Kanban card didn't reach the upstream workstation, the demand is delayed, thus in turn caused the delay in demand fulfilment.

The TKS is classified as a system that has element that may cause an increase in average level of inventory (Junior and Filho, 2010). The explanation for this is the traditional Kanban system sometimes relies on buffer stock, in order to maintain the process in a steady fashion. Theoretically, TKS was not developed to face unstable demand. Unstable demand can lower the performance of TKS waiting time of a demand to be filled, the backlog queue size, the service level, and the average flow-time of parts through the system (Dasgupta, 1998). To avoid this, manager use buffer stock when they face fluctuating demand that enable TKS to respond to it better. More buffer stock means more in-process inventory. And more inventory can contribute to more average inventory level in the process.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter will explain about the summary of the research, the recommendation of improvement to address the operational issues in Traditional Kanban System (TKS) and also to discuss the limitation throughout this research. I hope this chapter will help peoples from the industry to gain some insight about what they're dealing with when they intend to implement Kanban system in the factory.

5.2 DISCUSSION OF FINDING

Recommendation of Improvement to Address the Operational Issues That Exist In Traditional Kanban System (TKS) of a Manufacturing Firm

Throughout the literature review, I manage to gain knowledge about some operational issues that exist in a manufacturing system that employ traditional Kanban system (TKS). So as to accomplish the point of the second target and additionally to answer the second research question about how can the operational issues that exist in the Traditional Kanban System (TKS) implemented in a manufacturing firm be addressed, I believe it is appropriate for me to address those issues by referring to previous research done by numerous researchers, which I have reason to believe that they have better knowledge about Kanban system. I intend to address those operational

issues by suggesting improvement through implementation of variation of Kanban system. Because of the complexity in using the Kanban system in its original idea in such diverse circumstances, variation (or adjustments) to the Kanban system (unique in relation to the "original Kanban") were made to adjust appropriately to organizations' particular situation (Junior and Filho, 2010). However, only variation that follows Kanban original logic will be considered as an improvement method to address the operational issues.

This research strongly recommend the manufacturing firm to implement Electronic Kanban system to address the issue of lost signboard or Kanban card, which are normally made of a laminated paper. Electronic Kanban is a variation to original Kanban with one and only change which is the substitution of physical card with electronic signaling. Ansari and Modarress (1995) and Vernyi and Vinas (2005) discuss the possibilities and benefit from the implementation of E-Kanban.

Electronic Kanban which sometimes alluded to as E-Kanban, is a signaling system that is a mix up of cutting edge technology to trigger the flow of materials within a manufacturing or production plant. Electronic Kanban contrasts from traditional Kanban where utilizes technology innovation to supplant traditional components, for example, Kanban cards with barcoded cards and electronic messages (Gupta et al, 1999). An electronic signal is used to signal that a Kanban representing an exact quantity of parts has just been drawn or consumed. The signal goes directly to the upstream supplier, internal or external, where a new order is automatically processed for a replacement of the same item in the desired quantity, to be delivered within an agreed upon time span. Blending E-Kanban systems into ERP systems permits the ability of real-time demand indication over the supply network and enhanced clarity. Information pulled from E-Kanban systems can be utilized to improve inventory levels by better tracking supplier lead and restocking times as well as eliminates lost physical cards (Mertins and Lewandrowski, 1999).

By implementing E-Kanban, this research believe that the operational issues categorized by Junior and Filho (2010) as workers and container moving increase and likeability of transmitting demand delay can be solved through improved visibility of the signal card, no lost Kanban card, automated transmission of the demand upstream and downstream and physical card which means long term cost-saving on paperwork. Although E-Kanban can be helpful, the manufacturing firm must analyzed cost benefit

of this system and return on investment before implementing E-Kanban because the system will impose additional investment on the information technology system.

Next, to address the issues of limited quantity of Kanban cards and the nature of the traditional Kanban system (TKS) which was developed under assumption of a stable manufacturing environment, this research suggest that the manufacturing firm employs Flexible Kanban System (FKS).

FKS is intended to tackle a portion of the operational issues in TKS. FKS is powerful and its execution is better than TKS in spite of processing time fluctuations (Gupta et al. 1995). According to Gupta et al. (1995), FKS maintains a minimum quantity of base level Kanban designated to every workstation. Under FKS strategy, additional Kanban are added just when required to enhance the performance of the system and taken out when they are not required or when its existence will bring only reduce system performance. The additional Kanban are included when there are advantages of their existence, for example, decreased blocking and starvation, enhanced throughput exceeds the expenses of increased WIP and also operating expenses. The time at which Kanban are added is alluded to as to as the release threshold and the time at which they are removed is the capture threshold. The challenging factor is to define the quantity of base Kanban, the quantity of additional Kanban, the release and capture thresholds, the technique for putting in and taking out the Kanban, and the timing of putting in and taking out the additional Kanban.

5.3 RESEARCH LIMITATION

Throughout this research, there're several limitation that have caused me rely completely on literature research related to Kanban system, Just-In-Time (JIT) and variation of Kanban system.

First of all, Traditional Kanban System (TKS) is not popular among manufacturing firm in Malaysia. Most companies that follow JIT production philosophy is implementing modified Kanban system which is more relevant in nowadays manufacturing environment.

Next is because of the privacy issues of the performance of their production system. Most companies has a policy of privacy on their production system and they only share the knowledge internally to avoid the risk of losing competitive advantages.

After going through literature review, this research also face limitation on the amount of information needed to achieve the objective. There're no research that focus primarily on the weakness of Kanban system. Thus, this research is short on information of other weakness that may play an important part of this research. This limitation also deny my intention of using the statistical process of analysing the data such as Ishikawa Fishbone Diagram in order to decide on the main reason of the operational issues that exist in TKS.

5.4 RECOMMENDATION FOR FUTURE RESEARCH

For future research regarding Traditional Kanban System (TKS), it is strongly recommended that the researcher carry on with the objective to measure the performance of the system using more sophisticated method to better prove whether the TKS is unable to tackle problems existed in nowadays manufacturing environment such as variability in processing times and demand instability. This way, the evidence will be more concrete rather than relying primarily on assumption and theory.

In addition, it is recommended that future researchers may as well focus on the feasibility of Kanban system in a Small Medium Enterprises (SME) which is not under automobile industry. This is because there're lack of resource regarding the implementation of TKS in industry other that automobile manufacturers. This can help the managers or owner of SME in Malaysia to gain more insight about this powerful system, thus increase the productivity in their business as well as increasing the economy of Malaysian.

Other than that, I also recommend future researchers to do in-depth investigation on the variation of Kanban system as proposed by numerous researchers and the study should focus on the feasibility and the method of implementing the variation in existing Kanban system of an organization. Theoretically, their proposed suggestion is quite hard to be implemented without enough implementation method and references.

5.5 CONCLUSION

Traditional Kanban System (TKS) is a tool developed under the philosophy of Just-In-Time (JIT) production to control the production through visible signal card to start the production. Although Kanban's performance level is optimum under manufacturing condition with constant processing time and smooth demand, but once implemented in nowadays market condition, TKS performance is degraded by the uncertainties in process and unstable, fast-changing demand.

Information system plays an important part in manufacturing environment. Without proper transfer of information through the supply chain of suppliers and buyers, the competitive advantages cannot be manipulated. Traditional Kanban System (TKS) that uses manual transfer of information through the line and between buyer and supplier aren't efficient in nowadays fast-moving industry.

In-addition, without the conscience about the modification needed to be done on the traditional Kanban system (TKS), the manufacturing firm that still employs TKS, is facing the risk of lower performance in the manufacturing line, thus lowering the possibilities of more competitive advantages, cost saving and deny the probability of better revenue and profit.

Lastly, the advantages of Kanban system in JIT manufacturing environment can be fully manipulated if there're proper modification to the original system, without changing the original logic of the Kanban system.

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APPENDICES

GANTT CHART FINAL YEAR PROJECT 1

		SEMESTER 1													
		WEEK													
NO	ACTIVITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	RESEARCH TITLE RELEASED														
2	SUPERVISOR APPROVAL														
3	WEEKLY MEETING WITH SUPERVISOR														
4	RESEARCH STUDY														
5	PREPARATION OF THE PROPOSAL														
6	COMPLETE THE PROPOSAL														
7	SUMMISSION OF THE PROPOSAL														
8	PREPARATION OF SLIDE PRESENTATION														
9	PROPOSAL PRESENTATION														

GANTT CHART FINAL YEAR PROJECT 2

		SEMESTER 1													
		WEEK													
NO	ACTIVITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	RESEARCH TITLE RELEASED														
2	SUPERVISOR APPROVAL														
3	WEEKLY MEETING WITH SUPERVISOR														
4	RESEARCH STUDY														
5	PREPARATION OF THE PROPOSAL														
6	COMPLETE THE THESIS														
7	SUMMISSION OF THE DRAFT														
8	PREPARATION OF SLIDE PRESENTATION														
9	PRESENTATION														