APPLICATION OF KANBAN SYSTEM FOR MANAGING INVENTORY

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Abstract: *Lean manufacturing it is a comprehensive set of techniques that, when combined and matured, will allow you to reduce and then eliminate the waste from a company. Lean manufacturing is more than a set of tools and techniques and has been widely adopted by many production companies. Lean manufacturing is a culture in which all employees continuously look for ways to improve processes. The present article intend to make a briefly presentation of Kanban system and how a company can use this tool for managing the inventory. This method is one of the most used methods to reduce the waste and continuous business improvement.*

Key words: *Kanban, lean manufacturing, inventory, rules, sign board.*

1. Introduction

Lean manufacturing is a performance based process used in manufacturing organizations to increase competitive advantage. The basics of lean manufacturing employ continuous improvement processes to focus on the elimination of waste or nonvalue added steps within an organization.

Lean Manufacturing is a term popularized by Womack, Jones and Roos to describe a method for production based on the Toyota Production System (TPS). Within the organization, four prominent gentlemen are credited with developing the system: Sakichi Toyoda, who founded the Toyoda Group in 1902, Kiichiro Toyoda, son of Sakichi Toyoda, who headed the automobile manufacturing operation between 1936 and 1950, Eiji Toyoda and Taiichi Ohno, the Father of the Kanban System.

The challenge to organizations utilizing lean manufacturing is to create a culture that will create and sustain long-term commitment from top management through the entire workforce. This principles have been applied successfully worldwide in the auto industry and are being increasingly employed in many others industrial sectors [1].

In the 1970s, it became clear to a select few that the Japanese, most notably Toyota, had found a better way to manufacture cars, which caused a number of very interesting things to happen. First, and most notably, the majority of the manufacturing world went into a huge case of denial. This was heard as "that will work in Japan, but not here" and a variety of other statements that could politely be said to have lacked insight. From that

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small group came a series of efforts to try to capture parts of the Toyota Production System that were serving Toyota so well. The piece that seemed the most appealing was the JIT concept. It was rapidly popularized as an inventory reduction effort, which in fact is only a part of what it really is. JIT practitioners came out of the woodwork and many companies went about implementing kanban and slashing inventories to reduce the high cost of producing and managing the inventory. Some of the companies start to use the "zero inventory" slogan and slashed inventory with such fervor it was as if they were pursuing the Holy Grail of manufacturing. Many early efforts at imitating Lean production focused on the Just in Time (JIT) concept of inventory reduction [2].

In this article, we presented why many of these efforts failed, why a company have inventory, why they need inventory, and the reasons why a company strive to reduce inventory. Moreover, we presented the kanban concept and the six rules of kanban management.

2. Description of the Kanban System

2.1. Basics

Inventory costs a lot of money and companies try to solve this problem. First, there are the raw materials and operating expense it costs to produce it. Next, a company must handle it, which means that they need more people and machines like forklifts. Usually moving the material around, more than once before it gets to its desired location.

This in turn requires space and transportation and neither are free. Next, we must keep track of it, which means people, computer programs, and reports galore, almost all of which are filled with errors. The company should try to fix these

errors. The way it should be fix the errors is to use things like cycle counts which then take more people, more time, more computers, and worst of all more reports and more meetings. In addition, we must care for this inventory to make sure it does not get damaged. And finally, we must ship it before it becomes absolute. All of these liabilities of inventory are obvious bottom-line opportunities, and yet the greatest advantage of reduced inventory is not even mentioned here. In fact, it is often not even recognized. In just a minute, the company will get to that crucial advantage which so few see and even fewer appreciate. Kanban means sign board. A kanban can be a variety of things, most commonly it is a card, but sometimes it is a cart, while other times it is just a marked space. In all cases, its purpose is to facilitate flow, bring about pull, and limit inventory. It is one of the key tools in the battle to reduce overproduction. Kanban provides two major services to the Lean facility. Kanban provides two types of communication. In both cases, it gives the source, destination, part number, and quantity needed.

The kanban system is very flexible, and many types of kanban can be used. Likewise, as long as they follow the basic rules of Kanban, they can be used in a large variety of ways. However, the majority of kanban follow a standard pattern. Process improvement in a Kanban system is accomplished by the reduction of inventory, witch can be achieved by:

- reducing any of the four replenishment times or reducing the pickup volume by the customer, this is usually achieved by increasing the pickup frequency;

- reductions in any of these items will reduce cycle stock inventory;

- reducing the variation in the production rate, which allows safety stock reductions;

- reducing the variation in the customer demand, which allows buffer stock reductions.

The kanban system it is a powerfull tool for reducing the waste during production because first it is direct communications to produce material, in other words, to supply and the customer [3].

It is the pull signal to produce. Once the product is withdrawn by the customer, at that moment the kanban tells us exactly what the customer is using, and hence what the customer will need later. This kanban is sent as fast as possible to the production line. In essence, the kanban system is doing the "talking" to the production system, telling it to produce because some product has been removed. This system easily bypasses all the accounting and planning systems that tend to not only delay this signal but also add variability along the way. The kanban system is dealing real time with the realities of what is happening on the line. Second, kanban creates an absolute limit on total inventory. Since each kanban represents a certain amount of stock, and the number of kanban are strictly controlled and limited, this creates an upper limit on the inventory. Below is presented a formula witch is using in production to show how kanbans could flow between a customer cell and a supplier cell.

Step 1:

$$\frac{Designed\ daily\ production\ rate \times replenishment\ time}{available\ time} = Kanban\ quantity\ . \qquad (1)$$

Step 2:

$$\frac{Kanban\ quantity}{lot\ size} = number\ of\ cards. \qquad (2)$$

Lot size may be required due to weight, size, A, B, C categorization, setup times, and common resources, outside suppliers. Replenishment time that is less than one shift would result in a two-bin system. Replenishment time that is greater than one shift would result in a card system.

For example:

Step 1:
$$\frac{90\ pieces \times 15\ hours}{7.5\ hours} = 180\ pieces,$$
$$"A"\ parts = 1/2\ day\ demand,\ or\ 45\ pieces. \qquad (3)$$

Step 2: $$180\ pieces \div 45\ pieces = 4\ cards\ . \qquad (4)$$

Every Kanban system should have the minimum identification requirements, witch are: part number, part description, part quantity, point of supply, point of consumption, "one of… cards" (e.g., 1 of 3; 2 of 3; 3 of 3).

The determination of Kanbans is an important step in the cell design process because Kanbans are the limiting factor for inventory levels (raw material, WIP, finished goods) and are the control element on lead-times. These operational aspects (inventory and lead-time) have a major influence on continuous improvement within a cellular operation. In Figure 1 is presented an example of a Kanban card.

Fig. 1. *Example of a Kanban card*

2.2. Kanban Circulation

The kanban contains information that serves as a work order. It is an automatic directional device which gives information concerning what to produce, when to produce, in what quantity, by what means and how to transport it. The kanban system was created to do the following: engage in standard operation at any time, give directions based on the actual conditions existing in the workplace and prevent a deluge of paper which cannot serve as future source materials. Another kanban function is to move with the actual material.

If the actual material and kanban can consistently move together, the following become possible: no overproduction will occur, priority in production becomes obvious (when the kanban for one item piles up, that is the item that must be produced first), and control of actual material becomes easier. The shape of the kanban is not fixed. Depending on the processes they are made of iron, they can be in size or triangular in shape. The important consideration is how it's best to transmit the requisite information accurately [4].

The six rules of the Kanban — Table 1

Rule no.	Rule	Function
1	Later process goes to earlier process and picks up the number of items indicated by the *kanban*.	Creates pull, provide pick up or transportation information. The replenishment concept is formatted here.
2	Earlier processes produce items in a quantity and sequence indicated by the *kanban*.	Provides production information and prevents overproduction.
3	No items are made or transported without a *kanban*.	Prevents overproduction and excessive transportation.
4	Always attach a *kanban* to the goods.	Serves as a work order.
5	Defective products are not sent to the subsequent process.	Prevents defective parts from advancing: identifies defective process.
6	Reducing the number of *kanban* increases their sensitivity.	Inventory reduction reduces waste and makes the system more sensitive.

The kanban system is very flexible, and many types of kanban can be used. Likewise, as long as they follow the basic rules of Kanban, they can be used in a large variety of ways. However, the majority of kanban follow a standard pattern. Let's follow a kanban as it is circulated. Since Lean thinking usually works best if we start at the customer and work backwards, let's do just that. Since Rule 3 says that the product has kanban attached. When the customer comes for his pickup, the kanban are removed and placed in a kanban post. From here, the kanban are picked up, normally by a materials handler, and transported to Planning, or ideally they go directly to the heijunka box in front of the production line. If they go to planning, they generally do little with the Kanban, but they like to stay in the loop. From planning, the kanban are sent to the front of the production line per the information on the kanban. The kanban are then placed in the heijunka box, a load leveling tool. From here, the production workers withdraw the kanban from the box in sequential order, and the process then produces the product in the quantity listed on the kanban.

The kanban has just served to be a production work order and is infinitely superior to any MRP type system to trigger production. The worker then attaches the kanban to the products made and they are placed in the designated spot, ready for

pickup. On his normal circulation, the materials handler picks up the products, with kanban attached. The kanban tell him exactly where to deliver the products, normally this is the storehouse, which completes the cycle.

The Kanban have moved a distance and have consumed time by:
  - Transportation to, and time in, planning;
  - Transportation time to and time spent waiting in the queue, the heijunka box;
  - Time spent in the production line;
  - Time used to deliver the finished goods.

Process improvement in a kanban system is accomplished by the reduction of inventory. The reduction of inventory and hence the reduction of kanban can be achieved by:
  - reducing any of the four replenishment times or reducing the pickup volume by the customer, this is usually achieved by increasing the pickup frequency;
  - reductions in any of these items will reduce cycle stock inventory;
  - reducing the variation in the production rate, which allows safety stock reductions;
  - reducing the variation in the customer demand, which allows buffer stock reductions.

3. How Can the Kanban System Help the Company?

Think for a moment about a perfect stockless (almost) manufacturing system. It would have a cell where all the necessary processing steps are connected with zero inventory between stations, one-piece flow, operating with 100 percent availability and 100 percent yield, and hence the steps would operate in total synchronization. We would simply tell the operators to keep one unit of production in the finished goods inventory and if the customer came and removed a unit, then and only then would we replace it. In this system, with 100 percent on-time delivery, once the customer withdrew an item, it would signal replenishment, and in total

synchronization all stations would spring into action and another would be produced, almost instantaneously. Once a customer arrived, product was ready; however, if the customer did not withdraw a product, no production would occur. One hundred percent on-time delivery and no overproduction mean a near perfect Lean system [5].

This, of course, would only occur in a perfect therefore, non-real system. Unfortunately, we mortals need to deal with the realities of life. These realities of life include several issues. First and foremost is the issue of variability. Since perfect synchronization is not possible, 100 percent on time delivery and zero overproduction are also not possible. Through these ideals might be ones to shoot for, they are typically impossible and many times impractical. Variations always exist in rate, quality, people, machine and environments. They are inevitable and omnipresent. All of this variation creates inventory. So, to compensate for the variation, we need some buffers. This causes our total inventory to rise and Little's Law tells us our lead time will increase, which likely will cause us to hold even more inventory as finished goods.

So how do we reduce the inventory, that is, avoid overproduction of both the local (WIP) and finished goods, bringing inventory to its minimum. Either task can be done simply, by doing both simultaneously and well is the trick of a good business system. And that trick is kanban.

The essence of kanban is twofold. First, it is direct communications to produce material, in other words, to supply the customer. It is the pull signal to produce. Once the product is withdrawn by the customer, at that moment the kanban tells us exactly what the customer is using, and hence what the customer will need later. This kanban is sent as fast as possible to the production line. In essence, the kanban system is doing the "talking" to the production system, telling it to produce

because some product has been removed.

This system easily bypasses all the accounting and planning systems that tend to not only delay this signal but also add variability along the way. The kanban system is dealing real-time with the realities of what is happening on the line.

The planning systems deal with what the programmer believed should be happening. We can say with certainty, that when it comes to triggering production, with the minimum lead planning time, no planning system can come close to kanban.

In this manner, the kanban system not only assures supply to the customer, but does so with the minimum planning time [6].

4. Conclusions

In this article we presented the Kanban system as the lean manufacturing tool used for reducing the inventory from a company. Moreover, we have showed the problems what can be appear in a company because of the overproduction. To affect inventory reductions, it is important to understand that inventory is created largely due to the variation that exists in the manufacturing system and that this variation.

The Kanban lean manufacturing tool lets a company not only to save money but also allows reducing the lead time. All that finally, will make flexible and responsive as a business.

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Though a number of inventory reduction tools exist, Kanban is one of the most powerful in the House of Lean and must be applied totally, following all six rules of the kanban management in order to be really effective.

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