Understanding KANBAN in Industries

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Abstract
KANBAN (kahn-bahn) is a Japanese word. KAN means "card" & BAN means "signal". So it stands for "card signaling" or "visual record". It is used in manufacturing to mean a visual signal that tells when it is time to get or make more of something. Kanban is a signaling system used in manufacturing environments to regulate production and movement of items in a pull system. As an information-relay device and an inventory-control mechanism, the kanban system works on the principle that each process in the production line pulls just the number and type of components the production process requires in just the right time. As a lean tool to improve the manufacturing process, the kanban system has its problems.

Keywords
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I. Introduction

A. About KANBAN

1. According to Taiichi Ohno [(February 29, 1912 -May 28, 1990), he was a prominent Japanese businessman. He is considered to be the father of the Toyota Production System] the man credited with developing Just-in-time, KANBAN is one means through which JIT is achieved.
2. KANBAN is not an inventory control system. Rather, it is a scheduling system that tells you what to produce, when to produce it, and how much to produce.
3. The need to maintain a high rate of improvements led Toyota to devise the KANBAN system. KANBAN became an effective tool to support the running of the production system as a whole. In addition, it proved to be an excellent way for promoting improvements because reducing the number of KANBAN in circulation highlighted problem areas.
4. The term KANBAN describes an embellished wooden or metal sign often representing a trademark or seal. KANBAN became an important part of the Japanese mercantile scene in the 17th century, much like the military banners had been to the samurai.
5. The KANBAN method for controlling production and material flow is based on the actual stock quantity in production. Material that is required on a regular basis is continually provided in small quantities in production. Replenishment or the production of a material is only triggered when a higher production level actually requires the material. This replenishment is triggered directly in production using previously maintained master data. The entries you have to make in the system have been reduced to a minimum, for example, the scanning of a bar code. All other actions in the system are carried out automatically in the background.
6. With KANBAN, the production process controls itself and manual posting is reduced as far as possible. The effect of this is a reduction in lead time and in stock.
7. In KANBAN, the signal for material replenishment can be triggered, for example, by the work center that requires the material (demand source) by sending a card to the work center that is responsible for manufacturing the material (supply source). This card describes which material is required, the quantity of the material required and where the material is to be delivered. The name KANBAN originally stems from these cards, which are called "kanban" in Japanese. When receiving the material, you can automatically post the goods receipt at the demand source by a further kanban signal by bar code, for example.

II. Types of KANBAN

A. Raw Material KANBAN

It is a calculation that determines the optimal amount of raw material goods to be placed in a buffer. It allows for inventory control of raw parts while assuring the raw material is available on demand.

1. General Rules

- Determine actual production lead time to produce parts.
- Analyze average demand over lead time of supplier for parts.
- Identify peak demand and frequency of demand spikes beyond average.
- Present data to supplier and get agreement from the customer to utilize KANBAN.
- Determine quantities of raw parts needed to be in KANBANs.
- Negotiate safety stock amount with supplier. Make an agreement with the supplier as to who owns any raw material in KANBANs. Make sure that any finished goods in KANBANs are properly costed and that margins reflect absorption to of those costs burdened by your company.
- Determine container to be used as for material. Determine if container should be used as signal for making parts (empty container arrives and needs to be filled) or some other KANBAN signal should be used, such as: KANBAN card, fixban, etc.
- Supplier agrees to KANBAN rules. First option: the supplier ships raw parts using established lead time+ shipping time window for delivery and parts with front end loading of parts into KANBANs. KANBANs are filled when arrived in established time window. Second option: set up a "two bin resupply process, where one KANBAN is full at the supplier waiting for you to order and that KANBAN is shipped immediately. The second KANBAN is filled during lead time and is ready when you order the next shipment.

2. Method

When a customer is unwilling to utilize a pull system with KANBANs, then one can set up one's own internal KANBAN system. The formula for that would be:

$$K = \frac{DL+SS}{CS}$$

Where:
K = KANBAN size.

 ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print)

DL = Average demand during lead time.
SS = safety stock.
CS = container size.

B. Variable Demand Raw Material

1. Determine time frequency for shipment and agreed upon normal size (might be greater than average size order) order to be shipped.
2. Determine highest level of demand for order and frequency demand is greater then agreed upon normal size.
3. Determine TAKT time for meeting that highest level of demand using standard lead time.

$$Tt = \frac{nP}{(SLt)}$$

Where:
Tt = TAKT time.
nP = Number of raw parts that can be made in determined shipping window time.
SLt = Standard lead time.

Determine if the supplier can meet the TAKT time using existing resources. If not, determine amount of lead time needed to be able to meet highest level of demand.

Agree to provide notification in lead time window prior to lead time in order for the supplier to meet highest level of demand. If the supplier agrees, keep KANBAN size at normal pull level and deal with additional demand by additional pull signal from shipping.

If you cannot provide prior lead time notification, determine how much additional material would be needed to meet highest level of demand. Determine how much material can be built in production window between pull signals from you the supplier ship date. Subtract the amount that can be built from total quantity needed and use that as KANBAN size. Make the difference as a safety stock. Make an agreement with the supplier as to who will own safety stock.

KANBAN size = Amount possible to make during production lead time.

Safety stock = Highest demand – Amount made during order to ship lead time.

C. In Process KANBAN

It is calculation that determines the optimal size of a production process queue (KANBAN).

It allow for production process control using KANBANs.

General rule:

1. Select the process or sub process to implement KANBAN process control.
2. Determine KANBAN locations. KANBAN locations are determined by evaluating the rhythm of the process or sub process and determining where controlled queues are needed. Rhythm can be calculated by determining the longest cycle time (in minutes) of all operations in the process or sub process. The overall rhythm should be balanced against that longest operation. KANBANs can be used to achieve balance in a process.
3. Determine the KANBAN size. This is done by using an average customer demand (usually monthly) divided by the number of operation minutes during that same period times the process rhythm (time).

$$K = \frac{p}{u * T}$$

Where:
K = KANBAN size in units.
P = units shipped per month.
U = number of monthly production minutes available.
T = process rhythm (time).

D. Finished Goods KANBAN

It calculation that determines the optimal amount of finished goods to be placed in a buffer (KANBAN). It allows for inventory control of finished goods while assuring the customer receives material on demand.

1. General Rules

- Determines actual production lead time to produce parts.
- Analyze average demand over lead time of customer for parts.
- Identify peak demand and frequency of demand spikes beyond average.
- Present data to customer and get agreement from the customer to utilize KANBAN.
- Negotiate safety stock amounts with customer. Get agreement from customer to purchase any material in finished good KANBANs. If not make sure that any finished goods in KANBANs are properly costed and that margins reflect absorption of those costs.
- Determine container to be used as for material. Determine if container should be used as signal for making parts (empty container arrives and needs to be filled) or some other KANBAN signal should be used, such as KANBAN cards, fixban, etc.
- Customer agrees to KANBAN rules. First, customer orders shipment using established lead time + shipping time for delivery and parts are built and shipped to customer when filled. Or, alternately, set up a "two bin resupply process, where one KANBAN is full waiting for customer order to ship and that KANBAN is shipped immediately. Second KANBAN is filled during lead time and have ready for when customer orders a shipment.

III. Product With Variable Order Size

- Determines time frequency for shipments and agreed upon normal size (might be greater than average size order) order to be shipped.
- Determine highest level of demand for order and frequency demand is greater than agreed upon normal size.
- Determine TAKT time for meeting that highest level of demand using standard lead time.

$$Tt = \frac{nP}{(SLt)}$$

Where:
Tt = TAKT time.
nP = Number of raw parts that can be made in determined shipping window time.
SLt = Standard lead time.

Determines if TAKT time can be reached using existing resources. If not, determine amount of lead time needed to be able to meet highest level of demand.

Have customer agree to provide notification in window prior to lead time in order to meet highest level of demand. If customer agrees, keep KANBAN size at normal pull level and deal with additional demand by additional pull signals from shipping.

If customer cannot provide prior lead time notification determine how much additional material would be needed to meet highest level of demand. Determine how much material can be built in production window between pull signal from customer and ship date. Subtract the amount that can be built from total quantity needed and use that as KAN BAN size. Make the difference as safety stock. Get agreement from customer that they will purchase all safety stock.
KANBAN size = Amount possible to make during production lead time.
Safety stock = Highest Demand – amount made during order to ship lead time.

IV. Advantages of KANBAN

A. Improvement in Production

The main advantage of the Kanban system lies in its innate ability to drive down costs and waste by improving the flow of production. Many of the scheduling advantages of the Kanban system spring from naturally from the core elements of lean and just in time manufacturing strategies. These strengths become more pronounced when the flow of production is reduced to small batches to accommodate product variations. With a Kanban system in place, managers and supervisors see the benefits of the Kanban system in:

1. Better Managed Inventory Levels

Too much inventory can result in cash flow problems by adding overhead expenses for storage, insurance, and security. On the flip side, too little inventory can damage the reputation of the business for being unreliable, resulting in lost sales and dissatisfied customers. The Kanban system combined with good inventory practices smooths out inventory levels and eliminates carrying costs.

2. Smoother Manufacturing Flow

Because the Kanban system focuses on current conditions, production levels are calculated to take into account downtime, scrap, and changeover time of equipment to ensure that the production schedule is met.

3. Overproduction Elimination

As a demand pull system, Kanban is less likely to result in overproduction because of the need to create buffer inventory to address unexpected delays resulting from quality problems with suppliers or minor disruptions in the transportation network.

4. Reduced Risk of Inventory Obsolescence

Many products have a shelf life or product lifecycle that can expire unless the product reaches the consumer in a timely manner. In these changing economic times, brand loyalty has faded and can no longer save a company that does not deliver its goods on time.

B. Responsiveness to Demand

Manufacturing is more than just about the mechanics of production and a series of calculations to determine changeover, lead time, and downtime for equipment to derive an ideal production schedule. Production is foremost driven by customer demand which can run in a various patterns from predictable to sporadic, from increasing to declining, and from seasonal to non seasonal. One of the biggest advantages of the Kanban System is that it improves the responsiveness to changes in demand. In this way, the Kanban system is similar to a smart traffic light with its ability to sense when the traffic, or in this case the demand, is building up. When the pent up demand reaches a predetermined level, the system sends the appropriate signal -- the traffic light changes to green or, in the factory, production is sped up.

C. Empowerment

Another advantage of the Kanban system is that it places control in the hands of the operators who are in the best position to oversee production. People on the front lines have the most knowledge about the daily operations and have a pulse on the real-time flow of the work. Also, shifting accountability for monitoring the daily runs frees up the time of supervisors to focus on long term planning needs. Empowerment is an effective managerial tool because it reinforces education and training; increases mutual respect among employees, generates enthusiasm and dedication to a common goal; lowers absenteeism, and increases productivity. Another by-product of empowerment is conquering resistance to change because employees participate directly in the decision making process.

D. Quality Control and Self-Discipline

A final advantage of the Kanban system is found in the fabric of its purpose to promote an environment devoted to quality improvement. Because the Kanban system uses small lot sizes at various points in the production, quality control issues can be more easily pinpointed at the source. Also, the Kanban system eliminates excess inventory which tends to mask quality problems by remaining undetected for longer periods of time. Thus, the need for buffer inventory to resolve quality problems is reduced, and this system becomes self-perpetuating as inventory reduction leads to further quality improvement results.

E. A Final Tally of the Advantages of the Kanban System

In adding up the advantages of the Kanban system, managers should recognize that the system's strengths lie in creating a more orderly and highly visual accountability system. The visual signals not only aid in improving production flow and responsiveness to customer demand but also in shifting workers' focus on quality improvement and team work through empowerment and self-monitoring activities

V. Disadvantages of KANBAN

A. Less Effective in Shared-Resource Situations

Infrequent orders may render the kanban process ineffective. For instance, if your upward production line made many parts, your requests to make more parts required by the downstream line will require a buffer to ensure that the downstream line does not run out. This is because each production line requires a separate signaling card.

B. Product Mix or Demand Changes May Cause Problems

The kanban system assumes stable, repetitive production plans. The kanban concept implies that the warehouse or the supplier should deliver components to the production line as and when they are needed. Fluctuations in demand and products may affect the functioning of the kanban system. Therefore, the system is less suited to industries where product volumes and mixes fluctuate.

 ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print)

C. The Kanban System Does Not Eliminate

Variability The kanban system may produce poor-quality items that need to be reworked or scrapped if production is disrupted with lengthy and unpredictable down times. Kanban is structured like a traffic signal, to manage the flow of traffic to meet customer needs by signaling when to start, stop or slow down production. Any variability or unpredictability will affect the functioning of the system, making it send confused, mixed and wrong signals with regard to the optimal production levels.

D. Production Flow Problems

Kanban is not suited for manufacturing environments with poor-quality products, short production runs, a multitude of product types and highly variable product demands. The Kanban system requires planned weekly and monthly production schedules coupled with day-today flexibility. This may not be possible in a manufacturing environment with multiple product types; variable production demands and long production runs, thus reducing the overall efficiency of the production line.

E. Quality Miscues

The kanban system brings quality levels of inventory close to zero. In cases of high uncertainty and disruptions in the transportation network, inventory buffers are needed to guard poor quality from the internal processes and also from the suppliers. This delays your production process.

VI. Conclussion

1. It is not an inventory control system by itself, Rather, it is a scheduling system.
2. Tells a firm what to produce, when to produce it, and how much to produce.
3. It is its very nature that makes it a suitable element in implementing JIT.
4. Kanban is used as an indicator of demand that it immediately signals to the whole of the supply chain.
5. the Kanban scheduling system makes it possible for a business to be reactive to customer needs instead of trying to draw estimated forecasts.

Referances

[1] A. Rahman, Chattopadhyay, Simon Wah,"KANBAN applied to reduce WIP in chipper assembly for lawn mower industries",Queensland University of Technology.
[2] The Application of Kanban to the Management of Construction Work Packages, [Online] Available: http://www.ennova.com.au
[3] Bhuvnaesh Khuller,"A comparison of traditional and extended information kanban control systems using dedicated and shared KANBANS".
[4] M. P. Groover,"Automation in Production System".
[5] John M Gross, Kenneth R. Mclnnis,"KANBAN made simple".
[6] Martand Telsang Industrial Engineering and Production Management".