Reflexive Production System: Use of Kanban

A common challenge faced by the apparel industry on the shop floor is the production of goods over demand and production of goods.

by Anand Deshpande 15-April-2016

Anand Deshpande, Founder & CEO, Admaa Consulting, illustrates the concept of a Pull System, Application of Kanban and Supermarkets between Cutting and Sewing, and Setting up of Supermarket between Cutting Room and Sewing Floor.

A common challenge faced by the apparel industry on the shop floor is the production of goods over demand, and production of goods earlier than required. The 'lean' term that we used to describe this manifestation is 'Overproduction', which can be avoided by using Kanban (Production and Withdrawal) cards with Supermarkets. Kanban ensures that the entire production system becomes reflexive and follows the principles of a Pull System.

The ultimate manifestation of a delay in production is airlifting the shipment or receiving the buyer's debit note, and these often drive the operation scheduling in factories. Figuring out the scheduling accounts for several things. The major factors that lead factories to overproduce are:

- Fear of labor absenteeism.
- Variability and dependency that exist in the system.
- Ignorance of frequent changeovers.
- Absence of production feedback loop, especially from downstream operations.
- Poor planning and scheduling.
- Capacity imbalances in the production system.
- Capacity utilization when order pipeline has dried up.
- Sales forecasts are way off the mark.
- Instability in the production system.
- Longer set-up times between product changeovers.
- Shortage of skilled operators.
- Machine breakdowns/repair delay.

The concepts of Kanban find relevance in these scenarios to help build Reflexive Production Systems. Imagine Kanban to be a series of links in a cycle chain. Any force exerted at the end of the chain is felt by the first link in the chain. Kanban ensures that a feedback mechanism is created on the production floor and only what is required by the customer is produced.

Figure A: Pull System

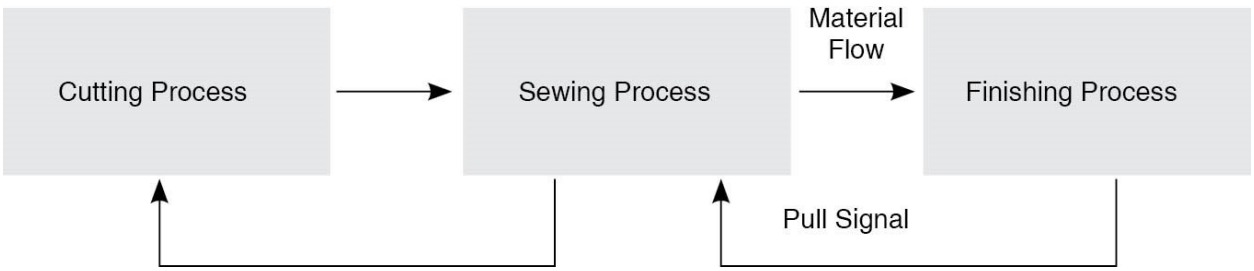

Figure A: Pull System

Figure A is a simple illustration of a Pull System in an apparel production plant. A signal is generated by the actual consumption at the downstream process (at Finishing). The last process downstream received is the consumption from the customer. Therefore, the customer exerts 'pull' on the entire production system in this way. The Pull Signal keeps moving up, based on the actual consumption, till it reaches the upstream process (i.e. cutting). In a Kanban System, the 'pull' exerted by the downstream customer is manifested visually to the supplying upstream process.

A Pull System has many advantages. While it schedules work based on information from inside the system, it also establishes prior limit on the Work in Progress in the system and authorizes the work to upstream processes based on Kanban Cards.
Application of Kanban System between cutting and sewing departments in an apparel factory

Figure B: Kanban System between Cutting and Sewing

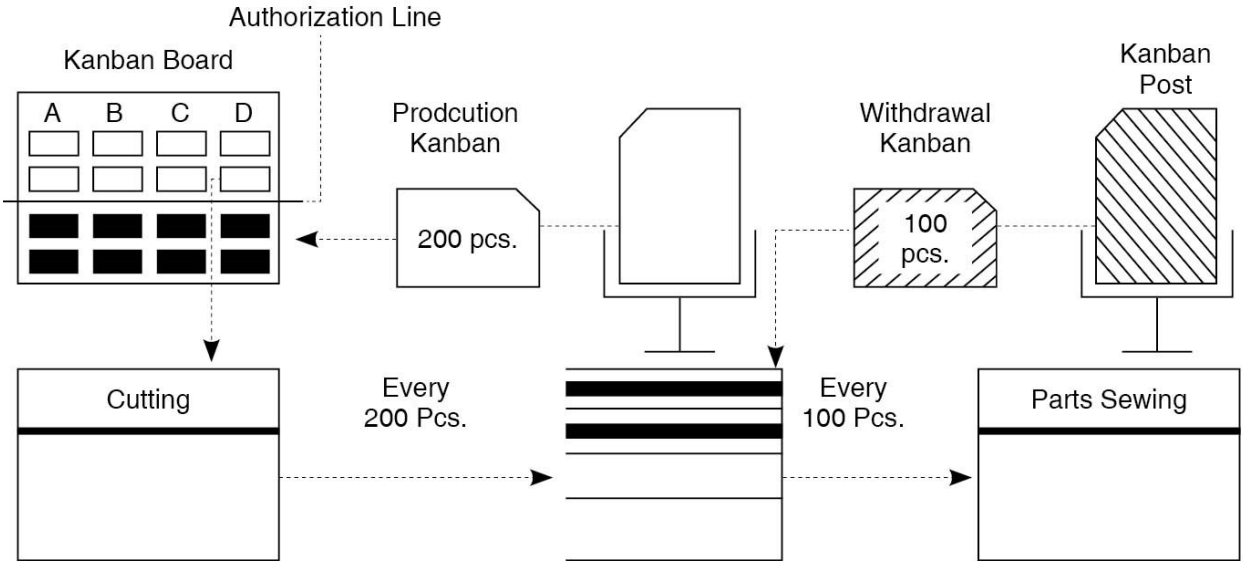

Figure B: Kanban System between Cutting and Sewing

Figure B is an illustration of a Kanban System that could be created between cutting and sewing departments. The cutting works on batch production principles whereas sewing nowadays uses single piece flow or unit production system.

Let us understand some terms that have been used in the illustration…

Supermarket: A Supermarket is an area identified in the factory that stocks goods in the finished form (ready for shipping) or in WIP (Work in Progress) form. In a typical apparel factory, a Supermarket Area could exist between cutting and parts sewing, parts sewing & assembly, assembly & finishing and also in the finished goods warehouse.

Supermarket ties the consuming process and the supplying process in a Pull System. The withdrawal of the inventory from the Supermarket is authorized by a Pull Signal (e.g. a Withdrawal Kanban Card). The inventory in the Supermarket Area is kept in trolleys or bins.

Kanban Cards: Inventory for the items authorized by these cards is kept in the Supermarkets. These cards are recycled through the production system continuously.
A Kanban Card typically has the following information displayed on it:

- Material, part number, etc.
- External and internal supplying processes.
- Consuming process (could be sewing if parts are stitched in sewing or finishing if parts are consumed in finishing).
- Container Quantity ('container' here refers to a trolley or a bin, and the 'quantity' refers to the amount of stock that should be stored in the trolley or bin).
- Supermarket Address (Supermarkets have a designated address like A1, H2, etc.)
- Card Serial Number.
- An illustration of the part (a typical component drawing).

The base 'Colour' of the Kanban Card could be white or red. It is a choice that management makes. These cards are attached to standard containers and are placed into a clear plastic sleeve firmly attached to each container. Container quantity for all cut panels from cutting could be 200 pieces. This, again depends on the order quantity and cutting machine capacity or type of cutting (manual or automatic) being practiced on the floor.

Withdrawal Kanban Card authorizes the consuming process to withdraw the inventory from the Supermarket. Once the stock is used in the consuming process, the Withdrawal Kanban Card accompanying the container is removed from it and kept in the Kanban Post. In the same vein, the production Kanban Card that accompanies stock kept in the Supermarket Area is kept in the Kanban Post once the stock is taken out for consumption.
Production Kanban Card authorizes the supplying process to produce the required amount, which is stored in the Supermarket Area.

Kanban board is a visual display board: The production Kanban Cards are accumulated in the board after removing them from empty containers (trolleys or bins) no sooner they are withdrawn by the consuming process from the Supermarket. The accumulation of cards continues till a predetermined number of cards are achieved as defined by the common authorization line. In Figure B, the common authorization line is achieved after two cards (each card bears a production quantity of 100 pieces).

A robust Kanban board design is adaptable, scalable, and communicates visually and at the minimum has the following key information:

- Locations to position the Kanban Cards in either rows or columns, by product (A, B, C, or D) as they are returned from the consuming process.
- A visual indicator, known as the authorization line, of when replenishment is authorized and necessary.
- FIFO tracking to show which product is to be processed first in cutting and then next one as well based on FIFO priority.
- The common authorization line in Kanban board functions in the following manner (Refer Figure B):
- Product is consumed from Supermarket by the consuming process (Sewing). When the consuming process empties a container, the card and container are removed from the Supermarket Area. The card is then removed from the container (trolley or bin). Thereafter, the empty container is staged in proximity to the Kanban board, which could be placed in a designated area in cutting.
- The Kanban Card is placed on the Kanban board at the lowest location available for given product (A, B, C or D). This process repeats until enough Kanban Cards representing a specific product accumulate to reach the authorization line on the Kanban board.
- Immediately upon the authorization line being reached, all the Kanban Cards for all those part numbers are removed and individually placed in transparent sleeves attached to empty containers (trolleys or bins). The empty containers with the attached Kanban Cards are delivered to the supplying process (cutting). This action authorizes replenishment by the supplying process.
- Once the containers (trolleys or bins) are filled again with the completed product, the containers with the attached card are returned to their specific Supermarket location. As the line stock at the part sewing process is depleted, product is removed from the Supermarket and delivered to the consuming process by a withdrawal Kanban Card. The process repeats itself.
- The Kanban System works in the following manner (Refer Fig. B):
- Parts sewing operator uses parts kept next to assembly line, removes the Withdrawal Kanban Card that accompanies the container (trolley or bin) and places it in the Kanban post.
- Operator takes the Withdrawal Kanban Card to the Supermarket to fetch items. He picks up the 100 pieces of cut panels and deposits the Production Kanban Card that came along with them into the Kanban Post.
- The Production Kanban Card is then moved to the Kanban board.
- As soon as two cards accumulate on the production board (in the case of order D), the two production cards are issued to cutting machines authorizing production of the same.
- As soon as they are produced, 200 pieces (two Kanban Cards – 100 pieces per card) are transported to the Supermarket and stored in the location (trolley or bin).

The principles of Kanban are as follows:

- The downstream process (consuming process) will only consume what is needed.
- The supplying process will only produce if Kanban System authorizes it to produce.
- Defective products will not be sent downstream processes.

- Kanban should reflect changes in demand as demands keep fluctuating.
- The number of Kanban must reduce in time as they only are reflection of waste.
- The rules are non-negotiable.

Let us consider the Case of installing a Supermarket between Cutting and Sewing processes. Supermarket ties the consuming and the supplying process in a Kanban Pull System by keeping a buffer inventory allowed for replenishment by a pull signal. If we did not have a Supermarket, a Kanban Card at supplying process would mean immediate replenishment, which is difficult in a typical apparel-manufacturing environment because of variability and dependency. Hence the need for 'Supermarkets'.

In case of the above example, sewing parts assembly will withdraw cut panels from the Supermarket, and the cutting will replenish the Supermarket when signaled to do so by the Kanban board. The signal provided by the Kanban board can be in the form or a production card or merely an indicator light or an indicator flap. A green flap would mean no replenishment required, whereas a red flap would mean replenishment required immediately.

The best choice of position of the Supermarket depends on the following factors:

- The number of supplying workstations vs. the number of consuming workstations.
- Travel distance.
- Availability of space.
- Transport mechanism is currently available.

In the apparel industry, it makes sense to have one Supermarket between cutting and sewing parts, a pairing Supermarket between sewing parts and sewing assembly, a WIP Supermarket between finishing and sewing.

Once the Supermarket and Kanban board are institutionalized, we can move on to decide the inventory to be kept between departments in the Supermarket.

The inventory or buffer to be kept in the Supermarket largely depends on the variability and dependency that exists between the two processes on either side of the Supermarket. The rationale is to ensure that you neither starve nor block the bottleneck. In most cases, sewing parts (i.e. Front, Sleeve, and Lining) is a bottleneck in the industry. The reason being that sewing assembly, traditionally, has relatively shorter cycle times and hence more capacity.

Keeping a day's inventory in the Supermarket between cutting and sewing parts is recommended because:

- Any breakdown in the cutting could be repaired under four hours, therefore with one day inventory in the Supermarket, supply to the sewing parts will still be alright. If the meantime to repair a breakdown in cutting is 1½ days, then the inventory level can be kept at 2 days initially. Simultaneously the factory should start working on improving the breakdown maintenance efficiency and then reduce the inventory to one day.
- Cutting has more capacity than sewing parts as sewing section could experience wandering bottlenecks because of skill dependency. If a skilled operator in the sewing

parts is absent, the line is slowed down because the slowest operation on the line defines the speed of the line. The speed of the flow of product through the bottleneck also determines the cost of the product.

- Since we work on a Pull System, we observe that flow in sewing parts is often interrupted because of variability in inputs leading to operator skill dependency and breakdowns. Therefore, mostly one day inventory is fine.
- Also, by keeping less inventory in the Supermarket, the production system becomes more responsive and agile. The moment the cutting maintenance team knows that inventory between cutting and sewing parts is slashed, they look for addressing problems quicker and therefore meantime to repair also reduces.

The inventory between sewing parts and sewing assembly however can be limited to1-2 hours as:

- Pairing becomes more real time.
- Container clearance is easier as maintaining FIFO (first-in-first-out) becomes easier with lesser stock.
- Production lines become more flexible and can accommodate any other product at short notice.
- The entire system becomes more reflexive.
- Quality improves naturally as lesser stock lead to improved process efficiency.
- Defects can be detected sooner and by keeping only 1-2 hours of stock can reduce excess rework.

Some FAQs for setting up a Kanban system

Can electronic data processing or barcode scanner be used?
A. Yes it can be. It depends on how inventory is being managed on the production floor.

How to determine the number of Kanban Cards to be used?
A. To arrive at the exact number of Kanban Cards to be used, the following equation by James Vatalaro is useful.

Number of Kanban Cards = {Average Daily Demand x (Order frequency + Lead time + Safety time)}/Container quantity

To apply the equation, let us consider creating a Kanban System between cutting and parts sewing (first process):

Let the Average Daily Demand be 500 pieces of jackets.

Order Frequency = 1 day (i.e. produced daily).

Lead Time = 6 hours (time to refill the Supermarket, i.e. time to start laying until it is bundled and kept in the Supermarket) = 0.75 day (converting hours into days by dividing the number by 8, i.e. 6/8 = 0.75).

Safety time = 4 hours (time that is factored in for breakdowns, quality losses, etc.) = 0.5 days.

Working time = One shift = 8 hours.

Container quantity = 250 pieces (one container as trolley holds 250 pieces).

Replacing the value of all the variables in the equation we get:

Number of Kanban Cards = {500 x (1+0.75+0.5)}/250 = 4.5 cards rounded off to 5.

Thus, the number of Kanban Cards required is 5, which actually means that if the trolley is 250 pieces, there would be five trolleys recirculating between cutting and parts sewing. There is no specific rule to round up or round down. In the above numerical, one could round down to 4 cards as well. The only risk here is that safety available is reduced in a practical sense.

Can containers be used instead of Kanban Cards; can they function as Kanban Card?
A. Yes, there could be a system wherein an empty container is taken to the supermarket and a full container is picked. However, the operator must know which container to pick.

How is the Authorization Line ascertained?
A. While the best estimates come with experience, to begin with a quantity equivalent to the batch size of the upstream supplying process (in this case cutting) can be set as the Authorization Line.

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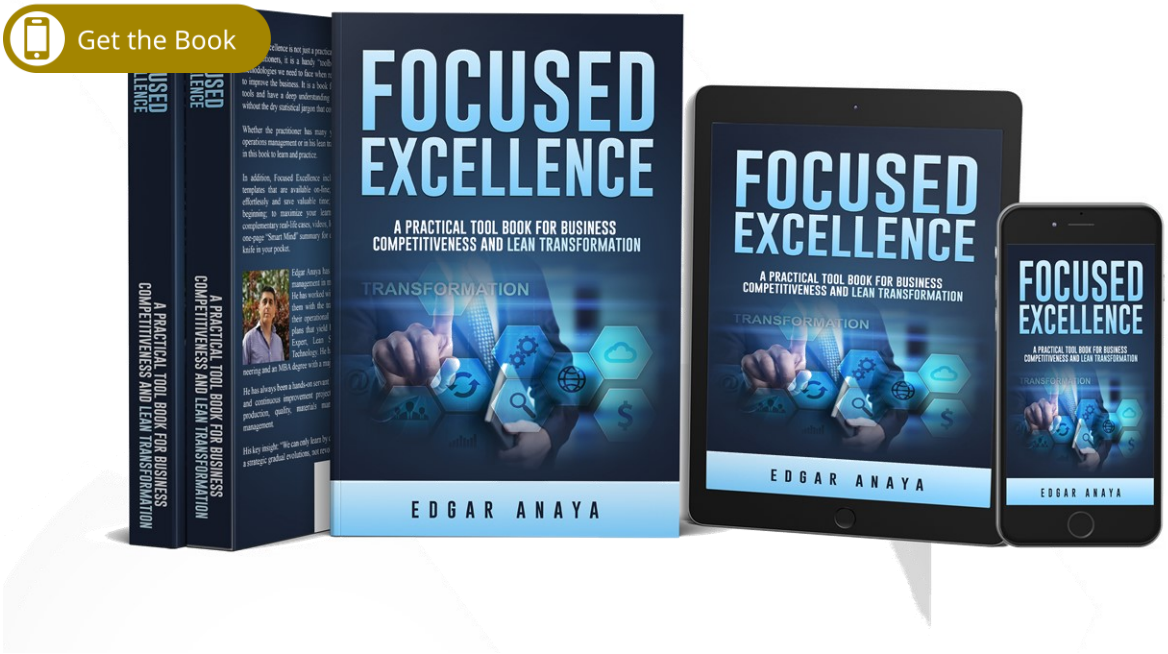

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