

## Push Systems (Traditional Manufacturing)

In a push system the emphasis lies on using information about customers, suppliers and production to manage material flow. The name push system results from the way the system works:

*Materials and parts are made and after that they are sent to the place where they are needed next (which is another stage in production or inventory), thus the system is pushing material through production. This pushing however, is done according to schedule.*

The push system is relying heavily on the accuracy of the schedules, which come from the MPS. These schedules, in turn, depends on the accuracy of information about the customers demand and lead times. So for these information another system is developed: Resource Requirements Planning System (RRPS).

RRPS is all the planning that is directed at determining the amount and timing of production resources (personnel, cash, materials, production capacity) needed in the short-range planning horizon. MPS, CRP and MRP are important elements of this planning.

Push systems are used in almost every type of production, but there are more benefits in job shop environments. In these environments the push system provides comprehensive information to improve short run production and management decisions.

## Pull Systems (Lean Manufacturing)

In a Pull System everything is focused on the next stage of production and what is needed there (Customer Order Driven). That what is needed in the next stage of production is produced. The explanation of the name Pull System is: *Raw materials and parts are pulled from the back of the factory towards the front where they become finished goods.* So in a Pull system the ideal of producing at the same rate as customers are using the products is being realised.

This system is known by many names like the Toyota Production System (Toyota), Stockless Production, Action Workout (GE), the commonly accepted name is Just In Time (JIT) manufacturing.

The pull system works the opposite way as the Push system.

## Master Production Schedule

The Master Production Schedule (MPS) sets the quantity of each end item to be completed in each week of a short-range planning horizon. The MPS is in fact the mother of all schedules, and it is a plan for future production of end items, set by market forecasts, customer orders, inventory levels, and other information necessary to make correct schedules.

The MPS sets its production schedules based on Forecast, Orders and Lotsize, and it provides information on Available-To-Promise and Projected Available Balance. The ATP is a percentage of what is promised to the customer and what is realised from those promises. In fact it is the amount of "promises not kept" divided by "promises kept"

## Planning and Control

After the making of the Master production schedule, so when its determined when and how many products of each type are to be shipped to the customer, how a firm plans and controls

the inventory and the purchase of materials it is necessary to choose a way to produce the goods needed.

in this phase factory operations managers plan *production schedules* for parts and assemblies, *schedules of purchased material*, *Shop floor schedules* like machine changeovers and batch movements and *work force schedules*.

These managers choose between all things related to production and planning which parts are best suitable for their firm. They have to think about the, Pull Systems (which include the JIT philosophy), Push Systems (containing MRP) and TOC, which is about bottlenecks and inventory. But they also have to think about Quality Management and Quality Control.

## MRP

Material Requirements Planning (MRP) is a time-based priority planning technique that calculates material requirements and schedules supply to meet changing demand across all products and parts in one or more plants.

An MRP package takes into consideration: Customer Orders, Forecasts, Shop Orders, Parent part requirements, Inventory Management, Bills of Materials (BOMs), Purchasing, Receiving, Stockroom Control, Accounting and Invoicing.

Materials Requirement Planning (MRP) is based on the philosophy that each raw material, part and assembly needed in production should arrive simultaneously at the right time to produce the end items in Master Production Schedule. So inventory levels could be reduced, production capacity could increase as well as the profits. The MRP-purpose therefore is:

- Control Of Inventory (Right Parts *and* Reduction Of WIP)
- Maintain Order Priority (Keep Valid Duedates *And* Better Customer Service)
- Manage Capacity.

### Master Production Schedule

MRP-System is driven by the Master Production Schedule (So Called MPS). The MPS begins as a trial schedule. If these schedules are feasible, the schedule becomes input for the MRP-system. MRP sees this schedule as given: the system cannot check if a schedule is correct or incorrect, for example if a schedule goes beyond production capacity or not. The MPS can be updated or modified anytime a production-manager wants. As a result of these changes the MRP-input changes, as does the production output.

Outcome of the MPS is a **Bill of Material** (BOM) and an **Inventory Status File** (ISF).

A BOM is a list of materials and their quantities required to produce one unit of a product. When a firm produces 100 products, after the production of all end-items, all BOMs are put together in a so called BOM-file. This file contains a complete list of all products produced, how much material is used in which product, and the product structure. This is the relationship between (sub)-assemblies, raw materials and parts.

An inventory status file is a list of all material in inventory. Each material in inventory gets its own record. Such a record contains inventory-on-stock, materials ordered, materials-in-production, planned production and order releases. So it's a kind of map which shows how much material is present at what stage of manufacturing and where it's located in manufacturing.

How does the MRP-program work?

## **Inventory control**

Within the MRP system there are 2 inventory control approaches, which are called:

### *The 2 bin approach.*

Under this approach inventories availability is continuously checked, and if stock becomes below a certain level, which is predetermined, a fixed quantity of goods is ordered at the supplier.

### *The periodic order cycle approach.*

Here inventory is checked not on an amount-basis, but on a time-basis. Once in a predetermined and fixed time-interval inventory is checked and sufficient items are ordered to bring inventory quantity back to the predetermined level.

These inventory controls result from the notion that the availability of all components or (sub)-assemblies should be maintained.

## **MRP Output**

After the MRP program has done it's work it provides output. This output can be divided into two parts: **Primary Output Result** and **Secondary Output Result**.

Primary Output Contains The *Planned Order Schedule*, which is a plan of quantity of material to be ordered. Purchasers use this schedule to place orders at suppliers and departments upstream. It also contains *changes in planned orders*. As said before, when the MPS changes the input changes. and changes can be made automatically every certain time period, or when it's necessary.

Secondary output provides information about *Exception reports*, *Performance reports* and *Planning reports*. Exception reports require attention because something went wrong. Performance reports indicate how the system is operating and planning reports gives an overview on forecasted inventory activities.

## **Lot-Sizing Decisions**

After getting the net requirement, it's necessary to make a decision on how much material to order. These decisions are called lot-sizing decisions and have their **Pros** and their **Cons**. Order and produce in large lots lowers the order costs, machine costs, downtime by machine changeovers and leads to price breaks in purchasing. This does result in higher inventory costs, work-in-progress costs, larger risk when design changes.

Decisions have to contain a balance between those pros and cons. One frequently used principle is the Economic Order Quantity (EOQ). However, this principle has 2 restrictions for MRP:

The EOQ assumes that the costs-per-unit does not depend on the quantity of units ordered. In reality however suppliers offer quantity discounts for larger quantities. So EOQ can be used, but only with the knowledge that there can be quantity discounts, and they have to be programmed in the MRP-program and therefore the discounts have to be fixed discounts.

With calculating the EOQ, the assumption is that the demand for material is uniform, but in MRP and MPS the net requirement of material is supposed to be lumpy demand. This results in lower exhibit costs in other lot-sizing methods then EOQ. Those others are for example Lot-for-lot method and the period order quantity method.

# Just In Time Production (JIT)

**Just In Time (JIT):** Just In Time (JIT) is a manufacturing philosophy which leads to "Producing the necessary units, in the necessary quantities at the necessary time with the required quality." It is an approach to achieving excellence in the reduction or total elimination of waste (Non-Value Added Activities). Overproduction, Unneeded Inventory, Defective Products, Transport and Waiting Time are some examples of what can be waste according to JIT.

Just In Time (JIT) philosophy is a system focused on the factory: The smaller lot sizes, the better. And the system is focussed too on Group technology and the handling and transportation of (half)-products.

JIT producing therefor seeks to achieve the following goals:

- Zero Defects;
- Zero Set-up Time;
- Zero Inventories;
- Zero Handling;
- Zero Lead time;
- Lot Size of one.

The use of **Kanban systems** is one way to reach the goals producing in JIT seeks to achieve. Kanban is Japanese for card or signal. It is the means by which a customer instructs a supplier to send more parts. When this customer-supplier relationship is an internal relationship, then the customer is the machine or the procedure after the machine/procedure that the supplier.

## **Zero Defects**

In manufacturing, traditionally people thought that zero defects producing was not possible and not necessary. Not possible because of the fact that people thought that at some level of production it would be no longer possible to produce without defects and not necessary because although there were defects, the product did reach customer's expectation.

With the aim of JIT there will be no longer any cause of a defect and therefore all products will meet (far more) than the expectations. This is also related to a part of Quality Management.

## **Zero Set-up Time**

Reducing the set up-times leads to a more predictable production. No set-up time also leads to a shorter production time/production cycle, and less inventories.

## **Zero Inventories**

Inventories, including work-in-progress, finished goods and sub-assemblies, have to be reduced to **zero**. There will be no sub-assemblies, no work-in-progress and no finished goods.

This means a different view than in traditional manufacturing, where inventories are seen as a buffer against a fluctuating demand, or as a buffer against nonreliable suppliers. Also, in traditional manufacturing inventory was built up to make sure expensive machines were running for full capacity, because only then the hourcosts were as low as possible.

## **Zero Handling**

Zero handling in JIT means eliminating all non-value adding activities. Boothroyd and Dewhurst stated in 1983 "Design is the first stage in manufacturing and is therefore the single most important process in contributing to both manufacturing costs and labour requirements" So, zero-handling means reducing (namely by redesigning) non-value adding activities.

### **Zero lead-time**

Zero lead times is a result of the usage of small lots and increases the flexibility of the system. When there are no lead-times, the possibility to make planning which do not rely on forecasts becomes bigger and bigger.

The JIT philosophy recognises that in some markets it is impossible to have zero lead-times, but makes clear that when a firm focuses on reducing lead-times, this firm can manufacture more flexible, and is more flexible, than other manufacturers in the same market.

### **Lot Size of one**

A lot size of one makes it possible to adapt when demand is changing. If lot-size is, for example 100 and demand is changing, the firm ends up with inventory (let's say 45 pieces) and there will be the possibility that this inventory-level will only slowly decrease. This is because when demand is increasing again a new batch will be produced, which is be sold. The inventory level is too low to sell and will only be sold by chance, when someone asks a lower amount of pieces.

Given the fact that the JIT philosophy has a wide range of goals, it's not strange that with JIT we get a view on the total manufacturing picture. Manufacturing and production design should therefore have 3 key elements: There has to be a relationship with suppliers, based on agreements and trust, to assure just in time deliveries of all purchased goods.

The possibility for products to flow through manufacturing on a family based basis.

Manufacturing problems, the product life cycle and market design should be considered at the very first stage: the product design.

## **Introduction to Kanban**

A system of continuous supply of components, parts and supplies, such that workers have what they need, where they need it, when they need it.

The word Kan means "card" in Japanese and the word "ban" means "signal". So Kanban refers to "signal cards".

What are signal cards?

### **Here's how Kanban works:**

Let's say one of the components needed to make widgets is a 42" stem-bolt and it arrives on pallets. There are 100 stem-bolts on a pallet. When the pallet is empty, the person assembling the widgets takes a card that was attached to the pallet and sends it to the stem-bolt manufacturing area. Another pallet of stem-bolts is then manufactured and sent to the widget assembler.

A new pallet of stem-bolts is not made until a card is received.

This is Kanban, in it's simplest form.

A more realistic example would probably involve at least two pallets. The widget assembler would start working from the second pallet while new stem-bolts were being made to refill the first pallet.

If this was a high volume widget manufacturing facility, each widget assembly station might empty a pallet of stem-bolts in just a few minutes, and there could be 15 or 20 widget assembly stations. Thus there would be a continual flow of cards going back to the stem-bolt manufacturing area that would cause a continual flow of pallets of stem-bolts to be sent to the widget assembly stations.

### **Kanban is Pull (Demand)**

This is called a "pull" type of production system. The number of stem-bolts that are made depends on the customer demand--in other words the number of cards received by the stem-bolt manufacturing area.

Systems other than cards may be used. For example, the empty pallets may be returned to the stem-bolt manufacturing area. Each empty pallet received indicates a need to manufacture 100 more stem-bolts. For other types of components, bins, boxes or cages might be used instead of pallets. Or components might be stored on shelves in the widget assembly area. When a shelf became empty that signals that more components need to be manufactured and the shelf refilled.

In Kanban the method of handling the components is flexible, and depends on the needs of the manufacturing process.

### **An Alternative Kanban Model**

Kanban can also operate like a supermarket. A small stock of every component needed to make a widget would be stored in a specific location with a fixed space allocation for each component. The widget assemblers come to the "supermarket" and select the components they need. As each component is removed from the shelf, a message is sent to a "regional warehouse" or component manufacturing facility, requesting that the component be replaced. The "supermarket" might then receive a daily shipment of replacement components, exactly replacing those that were used.

If we just change the term "supermarket" to "warehouse" we have our manufacturing example.

This "supermarket" model is different from the first Kanban example in that it would be used when components are manufactured in facilities that are distant from the widget assembly plant. Instead of moving around small quantities of components, larger quantities are shipped once a day to the centralized warehouse.

### **Kanban - Responsive To Customers**

Kanban results in a production system that is highly responsive to customers. In the above example, the production of widgets will vary depending on customer demand. And as the widget demand varies, so will the internal demand for widget components. Instead of trying to anticipate the future (predicting the future is difficult), Kanban reacts to the needs.

Kanban does not necessarily replace all existing material flow systems within a facility. Other systems such as Materials Requirement Planning (MRP) and Reorder Point (ROP) may remain in operation. Kanban is most beneficial when high volume/low value components are involved. For low volume and high value components, other materials management system may be a better option.

### **JIT - Just In Time / Continual Improvement**

Kanban is directly associated with Just-In-Time (JIT) delivery. However, Kanban is not another name for just-in-time delivery. It is a part of a larger JIT system. There is more to

managing a JIT system than just Kanban and there is more to Kanban than just inventory management.

For example, Kanban also involves industrial re-engineering. This means that production areas might be changed from locating machines by function, to creating "cells" of equipment and employees. The cells allow related products to be manufactured in a continuous flow.

Kanban involves employees as team members who are responsible for specific work activities. Teams and individuals are encouraged participate in continuously improving the Kanban processes and the overall production process.

Kanban is not a system indented to be used by itself. It is an intregal part of Kaizen and 5S.

### Types of Kanban signals:

#### ● Kanban Cards.



Cards are exchanged between consumer and producer of products or services. On these cards may include a indication of how much parts are needed, part number, consumer and producer location and containers are printed. It is common to see colored kanbans. The colors give an indication of the area and priority of the kanbans and its contents.

#### ● Toyota Two-Card System.

Is a two-card (Two-Bin) Kanban system. Here the *move cards* allow the movement of a standard container of parts from one workcenter to another workcenter. The *production cards* allow the production of a standard container of parts to replace the parts removed by the previous move card.

#### ● Verbal

If possible, the consumer signals that more material is needed by telling it the producer. This communication may happen by phone, email, fax, simply by shouting or by any other means (Not a perfered method).

#### ● Colored Squares.

Large subassemblies may be controlled by using colored tape. Generally, the tape is stucked on the floor. When all sections on the floor are full, the producing section stops production.

#### ● Container -Kanbans.

When the empty container returns to the supplying operation, this is a signal for the need to produce more items. Of course the container needs to have proper markings (number or color) to show which material it needs or the priority. This system is illustrated in the "Toyota Production Kanban System".

#### ● Packaging.

There is a close relationship between the Kanban and the two-bin system of stock control. Parts are generally stored in two boxes by part-number. As one box is empty, it will be

replaced by a full box. This system works fine for low volume inventory commonly known as class C and D items.

**The rules for Kanban systems** seem very are simple, but they are actually very strict:

- **Operation** - the consuming process should withdraw the necessary products/units from the supplying process in the necessary point in time using a Kanban signal.
- **Kanban Cards** - if used, always accompany containers from the supplier until removed from the Kanban staging area, thus ensuring visual control.
- **Each Container** must have a Kanban card, indicating part-number and description, consumer and producer location and quantity.
- **The Parts** should always be pulled by the succeeding process (Consumer).
- **No Parts** are produced without a Kanban signal.
- **No Defective** parts may be sent to the consuming process.
- **The Producer** can only produce the quantities withdrawn by the consuming process.
- **The Number of Kanbans** should be properly calculated, minimized, monitored and reduced.

**JIT, MRP, TOC Matrix**

	<b>JIT</b>	<b>MRP</b>	<b>TOC</b>
<b>Situation</b>			
<b>System</b>	Pull-System	Push-System	Push-System downstream from constraint, and Pull-system upstream the constraint
<b>Capacity Scheduling</b>	---	Infinite Scheduling	Finite Scheduling
<b>Environment Assumption</b>	Stable	---	Stable
<b>Reaction Changes</b> <b>On</b>	Very Sensitive	Quick Reaction Because Of Infinite Scheduling	Sensitive
<b>Transferbatch</b>	Focus Is On A Batchsize of 1	Set To The Process Batch Size	Optimized To Maximize Throughput
<b>Improvement</b>	Set-Up Improvement Everywhere	Changes The Scheduling	Set-Up Times Change When Throughput Can Be Improved
<b>Focus On</b>	Quality	Customer Services And Due Dates	Bottlenecks.
<b>Inventory Status</b>	Reducing Inventory To ZERO	Inventory Can Be A Problem, But The Less Is Better	With No Bottlenecks, There Will Be No Inventory
<b>Production Pace</b>	Set By Master Production Schedule	Set By Master Production Schedule	Set By The Beat/Rate Of The Customer

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# **Kanban - an Integrated JIT System**

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## 1-0 INTRODUCTION

Japanese are good at manufacturing. Just ask any global producers of automobiles, copiers, or personal electronics what happened in the 1980s. They will probably tell you how the Japanese captured a large share of the global-market by creating world-class standards in design, materials, and management. What is often overlooked is the attempt to understand how the Japanese industry succeeds at the services that support the manufacturing process (Krajewski et al, 1987: 40). Within the production field, the Kanban process is the most significant of these services.

The concept of time-based management is nothing new for managers outside of Japan and has been in practice for many years. However, the Kanban process involves more than just in time deliveries and inventory control. Briggs (1993: 29) notes that Kanban process components are the most 'exportable' of Japanese techniques, but the complete process itself has not yet been successfully adopted outside Japan.

## 1-1 THE ORGANIZATION OF THIS REPORT

This report will focus on the interlinked components and features which constitute the Japanese Kanban process of time-based management. In addition, it will examine the potential for the successful implementation of the process into Australian manufacturing firms. Experience from the adoption of Kanban theories in North American manufacturers will serve as the foundation on which the Australian case is built upon.

## 2-0 THE JAPANESE KANBAN PROCESS- MORE THAN INTERNAL 'JUST IN TIME PRODUCTION' TECHNIQUES

Most Japanese manufacturing companies view the making of a product as continuous-from design, manufacture, and distribution to sales and customer service. For many Japanese companies the heart of this process is the Kanban, a Japanese term for "visual record", which directly or indirectly drives much of the manufacturing organization. It was originally developed at Toyota in the 1950s as a way of managing material flow on the assembly line (Perelman, 1994: 85). Over the past three decades the Kanban process, which Bernstein (1984: 48) identifies as "a highly efficient and effective factory production system", has developed into an optimum manufacturing environment leading to global competitiveness.

The Japanese Kanban process of production is sometimes incorrectly described as a simple just-in-time management technique, a concept which attempts to maintain minimum inventory. The Japanese Kanban process involves more than fine tuning production and supplier scheduling systems, where inventories are minimized by supplying these when needed in production and work in progress is closely monitored. It also encourages; Industrial re-engineering, such as a 'module and cellular production' system, and, Japanese human resources management, where team members are responsible for specific work elements and employees are encouraged to effectively participate in continuously improving Kanban processes within the Kaizen concept (Stainer, 1995: 11).

## 2-1 THE KANBAN

The Japanese refer to Kanban as a simple parts-movement system that depends on cards and boxes/containers to take parts from one work station to another on a production line. Kanban stands for Kan- card, Ban- signal. The essence of the Kanban concept is that a supplier or the

warehouse should only deliver components to the production line as and when they are needed, so that there is no storage in the production area. Within this system, workstations located along production lines only produce/deliver desired components when they receive a card and an empty container, indicating that more parts will be needed in production. In case of line interruptions, each work-station will only produce enough components to fill the container and then stop (Roos, 1992: 112). In addition, Kanban limits the amount of inventory in the process by acting as an authorization to produce more inventory. Since Kanban is a chain process in which orders flow from one process to another, the production or delivery of components are pulled to the production line. In contrast to the traditional forecast oriented method where parts are pushed to the line (Roos, 1992: 113).

The Kanban method described here appears to be very simple. However, this "visual record" procedure is only a sub-process in the Japanese Kanban management system.

### 2-1-1 SIMPLE VERSUS INTEGRATED KANBAN PROCESSES

The Kanban process utilizes two different kinds of cards - transport Kanban and production Kanban. Both of the cards do not have to be used simultaneously in a production process.

The transport Kanban contains information from where the part/component originated and its destination. When only this card is used, it is known as a simple Kanban process. In this system components are ordered and produced according to a daily schedule. Roos (1992: 113) describes this system as "ordering a box when it is the only one left on line".

The production Kanban, on the other hand, outlines to what extent and when work has to be accomplished by a specific station on the production line (Roos, 1992: 113). Together with the transport Kanban, it is known as an integrated Kanban process. This system is often used between the corporation and its suppliers. Here, the corporation's transport Kanban is the card which regulates the supplier's production Kanban. The same amount of components are produced as used in production and the maximum stock level is determined by the number of cards that are in circulation. The number of cards in circulation can be determined by an algebraic formula (refer appendix 1).

### 2-1-2 EXAMPLE

In the case of many manufacturing plants, the supplier is the warehouse and the customer is the assembly line. In this case, one box of components goes to the correct station at the assembly line at a time. When the box is empty, an operator takes it back to the warehouse, and this automatically triggers the delivery of the next box of components. Since only the transport Kanban is used, this example represents the application of the simple Kanban system.

Toyota of Japan has taken the example discussed above one step further. Here, certain components are directly supplied from suppliers to the production line. Stock levels are therefore kept low and factory overhead can be reduced. The supplier's work stations are regulated by the production Kanban, which in turn is regulated by the transportation Kanban from Toyota's production lines. The transport Kanban is simultaneously used internally between the warehouse and the production lines. This is an excellent example of the integrated Kanban system.

### 2-1-3 ADVANTAGES OF THE KANBAN PROCESS

Roos (1992: 115) notes the following advantages of Kanban over the traditional push system:

- 1 A simple and understandable process
- 2 Provides quick and precise information

- 3 Low costs associated with the transfer of information
- 4 Provides quick response to changes
- 5 Limit of over-capacity in processes
- 6 Avoids overproduction
- 7 Is minimizing waste
- 8 Control can be maintained
- 9 Delegates responsibility to line workers

He further indicates that "Kanban represents an efficient tool to continuously rationalize the production process and find the source of problems" (Roos (1992: 115). Since the circulation of Kanban will stop if there is a production problem on line, it is easy to both spot and correct the problem instantaneously.

## 2-2 THE KANBAN PROCESS- MORE THAN INVENTORY CONTROL

To managers outside of Japan, Kanban may look only like a pure production method having little or nothing to do with the surrounding environment. This is a fallacy. Instead, the concept takes form on the shop floor, in close interaction between the work force and management, and more importantly, involves both internal and external customers. Kupanhy (1995: 62) identifies Kanban as a production system which draws many of its elements from two primary sources: industrial re-engineering, and work force (Japanese) Kanban management.

## 2-3 INDUSTRIAL RE-ENGINEERING AND KANBAN

Industrial re engineering which goes hand in hand with Kanban consists of elements such as:

- 1 Modular/cell production. Flow-of-products-oriented layout of processes and machines layout.
- 2 U-shaped production/processing lines
- 3 Total preventive maintenance
- 4 Mass production of mixed models

The interrelationship between the Kanban concept and industrial re-engineering is clear.

Modular/cell manufacturing, which is sometimes referred to as group technology involves organizing machinery so that related products can be manufactured in a continuous flow (Kupanhy, 1995: 62). Here, products flow smoothly from start to finish, parts do not sit waiting to be worked on, and forklift trucks do not travel kilometers to move parts and materials from one part of the plant to another. This can be contrasted to a typical production system, where machines are grouped by function and products move from function to function from one end of a facility to another and back again. This results in long waiting times between procedures. Kanban will not work effectively without efficient logistics systems and process-oriented plant layouts. Kanban controlled production and the Kanban itself must be able to flow smoothly between processes (Kupanhy, 1995: 63). Modular/cell manufacturing can be realized by U-shaped processing lines, which integrate the manufacturing process into a continuous flow and increase supply accessibility to the lines. It would be impossible to join different processes to form a U-line if processes are not integrated. In addition, Total Preventive Maintenance, which prevents machines from breaking down or malfunctioning during the production time, also contributes to the efficiency of Kanban.

Toyoda Gosei Co. advisor Taiichi Ohno, architect of the Toyota Kanban system believes that the real benefits of Kanban probably will not be realized until the auto industry moves into a mixed production mode in which modular production methods are employed (Schreffler, 1987: 74).

### 3-0 JAPANESE KANBAN PROCESS MANAGEMENT

In addition to the industrial re-engineering concept of Kanban based management, the Kanban process indirectly focuses on the human factors of production. It involves; multi-machine manning working structure, standard operations, quality control circles, suggestions systems, and continuous improvement/Kaizen. All these concepts provide for the supportive environment necessary to implement the complete Kanban process. The secret of the Kanban's success is its requirement that each part of an organization be totally interdependent (Morris, 1992: 20).

Japanese-management-related elements of Kanban are methods that are either imported directly from or highly conditioned by Japanese management (Kupanyh 1995: 63). Included in that category are the following techniques which are interlinked:

- Breaking of administrative barriers (BAB) as achieved by the Kanban
- Team-Work, Quality Circles and Autonomation (decision by worker to stop the line)
- Continuous improvement
- Housekeeping

### 3-1 KANBAN FOCUSES ON THE INDIVIDUAL WITHIN THE TEAMWORK CONCEPT

The Kanban places great emphasis on the individual within the team framework. Workers frequently have a great deal of input about the product they manufacture, and most companies using the Kanban provide lifetime employment (Eaton, 1995: 27). People who work in a factory using the Kanban are very important. Management and workers believe that productivity and quality comes from people rather than systems.

The Quality Circle (QC) concept is a crucial component of the Kanban system. QCs provide for dynamic centers where employees are able to discuss and find solutions to various problems within the team's boundaries of production (Eaton, 1995: 28). Within this framework, the Kanban process is run by workers who make a large percentage of the decisions traditionally made by supervisors and quality control inspectors. Morris (1995: 21) notes that it is often the people who are producing the product or supplying the service who are in the best position to make positive changes. In addition, modular and cellular production concepts increase the scope of the team's work. Such industrial re-engineering concepts encourages modular organization of work, where members of a team are responsible for the completion of any one stage in the production process (Briggs, 1992: 28). This further encourages multi-skilling which is achieved via job-rotation and on the job training procedures.

Traditional companies believe quality is costly, defects are caused by workers, and the minimum level of quality that can satisfy the customer is enough. Companies practicing the Kanban believe quality leads to lower costs, that systems cause most defects, and that quality can be improved within the Kaizen framework (Bernstein, 1984: 48).

The simplicity of the Kanban system supports Stoddard's argument that "It's organization, not hardware that needs to be changed. People want a high-tech solution, some wonderful magic bullet." (quoted in Cook, 1984: 66) Kanban is not a magic bullet, it is rather an organizational shift towards decentralization of responsibility.

### 3-2 KANBAN AND KAIZEN

Kaizen is the Japanese term for continuous improvement. "It is both a rigorous, scientific method using statistical quality control (SQC) and an adaptive framework of organizational values and beliefs that keep workers and management alike focused on zero defects." (Morris, 1995: 21) It is a philosophy of never being satisfied with what was accomplished last week or last year.

The Kaizen cycle has four steps:

- 1 Establish a plan to change whatever needs to be improved.
- 2 Carrying out changes on a small scale.
- 3 Observe the results,
- 4 Evaluate both the results and the process and determine what has been learned.

The link between Kaizen and the Kanban process is clear. Quality Circles within the team framework decentralize responsibility for improving processes. It is the teams responsibility to improve current systems and procedures, including the Kanban. Kanban, like any other management theory will improve with time, and it is the primary responsibility of the individual worker within the team to continuously improve it within the Kaizen model.

### 3-3 HOUSEKEEPING AND KANBAN

In order to facilitate the logistic process of quickly moving material to numerous work stations on the production line, a clean and well organized environment is required. Roos (1992: 83) notes that such a workplace increases safety, employee well-being, and productivity. In addition to the duties directly related to working on the line, team members should be responsible for keeping their stations neat and clean and keeping tools in good condition. Production down time is often dedicated to housekeeping activities.

More importantly, the factory layout should encourage and ease the housekeeping process, which Toyota refers to as Siiton (Ettlie, 1994: 14). All movable items, such as material boxes should have dedicated positions on line indicated by symbols or lines on the ground. Kanban cards should be kept on in-going and outgoing racks.

### 3-4 THE IMPORTANCE OF THE KEIRETSU

(Morgan et al. 1991) notes that the Keiretsu system ensures loyal suppliers and customers. Naturally, this is a crucial component to the Kanban process. Long-term relationships, technology transfer, and fixed production schedules increases dependence between suppliers and major manufactures, but also enhances mutual trust. In such an environment, stock levels can be kept at minimum and Kanban can work at its optimum performance.

The savings realized through Kanban, however, are not necessarily passed on to (Japanese) suppliers. In fact, the suppliers encounter much of the cost for ensuring on-time delivery of precise quantities of components and materials. Yet few of these companies care to discuss the system's negatives. Their reluctance seems to be motivated by fear. Fear of doing or saying anything that might disrupt the close relationships they have developed with their customers (Cook 1984: 6).

### 4-0 THE APPLICABILITY OF THE JAPANESE JIT PROCESS IN AUSTRALIA

As mentioned, the Kanban process is believed to be the most 'exportable' of all Japanese management theories (Briggs, 1992: 29). On the contrary, Taiichi Ohno, who set-up the Toyota Kanban system more than three decades ago, believes that Kanban may not be right for everybody in any nation (Schreffler, 1987: 74). Many factors have to be taken into

consideration, including firm size, cultural differences, and the external dimension of a nation's business environment. This section will closely examine the applicability of implementing typical 'Japanese style' Kanban in Australian firms.

#### 4-1 EXTERNAL CONCERNS

The external business environment in Australia is very different from that of Japan. This is caused by a range of external forces, however, the Industrial Relation's structure, and geographic concerns are most applicable in this discussion.

##### 4-1-1 INDUSTRIAL RELATIONS

The Industrial Relation's structure in Australia has been dominated by the adversarial relationship between the major unions, the state, and employers. In-house unions are not very common and Enterprise Bargaining has only recently been introduced. The Kanban process requires team-work and multi-skilling of employees. Presently, Demarcation barriers make it difficult for employers to introduce multi-skilling, job rotation practices, as well as the team-work concept. Furthermore, low morale at the work-place undermined by the adversarial relationship between workers and management impacts negatively upon "housekeeping" and related activities.

Perhaps more importantly, frequent industrial disputes make the integrated Kanban process very vulnerable. If a Supplier cannot guarantee on-time delivery of components, the corporation has to carry higher stock-levels to reduce the risk unscheduled production interruptions. High inventory levels translates into higher costs. However, the use of the simple Kanban process can still increase the efficiency and accuracy of the internal logistics process (Roos, 1992: 80).

##### 4-1-2 GEOGRAPHIC LIMITATIONS

Roos (1992: 17) identifies one of the factors behind the Japanese success story as geographic proximity and that suppliers are often clustered around the major corporations. This significantly reduces logistics barriers and costs. The success of Integrated Kanban in Japan can be attributed to the proximity of main assembly plants to parts suppliers, "a characteristic of almost all Japanese industry due to the smallness of the nation" (Schreffler, 1987: 74).

Australia, on the other hand, has suppliers scattered all over the nation. This logistics barrier seriously undermines the effective implementation of an integrated Kanban process. Long lead-times of supplies and economies of scale factors in distribution increases the need for large safety stock levels. In-house manufacturing of components, as employed by several Japanese multinationals in Australia, represents an excellent way to employ a somewhat modified integrated Kanban system in this nation.

#### 4-2 LIMITED APPLICATION TO SMALL FIRMS

Most Australian manufacturing firms are relatively small in comparison with their global competitors. Taiichi Ohno notes that small and medium-sized firms may find the prospect of running delivery trucks 10 or 15 times each day cost prohibitive (Schreffler, 1987: 74). Furthermore, manufacturers that do not have to make immediate changes in their production plans probably are wise not to adopt it (Sandras et al, 1990: 53). Furthermore, In the absence of an Australian Keiretsu concept, it is difficult for small firms to develop favorable relationships with suppliers. An integrated Kanban system is therefore extremely difficult to achieve.

A simple Kanban system, on the other hand, can reduce costs by smoothing the production process and thereby reduce excess inventories. It can also enhance quality and reduce work in

process. Significant savings, however, can only be achieved by implementing an integrated Kanban process (Cook, 1984: 67). Likewise, Kanban works best in a large scale mixed-production environment. Most small companies specialize in a very narrow product range on a small scale.

#### 4-3 CULTURAL DIFFERENCES

Cultural barriers may hinder the implementation of Kanban. Briggs notes that "the success of module production is dependent on a social organization the production process intended to make workers feel 'obligated' to contribute to the economic performance of the enterprise" (1992: 28). The Japanese positive attitude towards labor, reflected by longer hours worked per week and shorter vacations do not exist to the same extent in the 'western' world (Japanese industrial workers average 42 hours per week, while workers in Germany and in the USA average 38.3) (Briggs, 1992: 28).

One of the biggest problems encountered by Toyota in Kentucky, USA was the concept of Kaizen in improving Kanban processes. Since people liked things the way they were, change was not comfortable. Employees found it very difficult to understand why Toyota wanted to keep changing, moving machines and racks continually. They asked, "Don't you guys know how to do this? I thought you were experts! Aren't we done yet?" (Purchasing, 1992: 63). In fact, a couple of employees even left, not caring for all the change.

Within the concept of Kanban teamwork, Graham (1995: 35), observed workers at the Subaru-Isuzu Automotive plant in Tennessee. Graham encountered that under non disruptive conditions, it was a matter of pride for a team member to complete his or her share of the work. However, evidence of resistance emerged in various individual and collective forms. Individual resistance was expressed through silent protest when workers refused to participate in company rituals. For instance, team members protested unfair company policies by refusing to participate in team meetings (Graham, 1995: 37). At the team and group levels, resistance took the form of direct confrontation when workers refused management requests. Some collective resistance was also expressed through jokes and humor, team members making light of kaizen. When the line stopped, a team member might say, "I guess they kaizened that!" (Graham, 1995: 39). Sabotage even occurred when workers discovered how to stop the assembly line without management tracing their location. These signs of resistance clearly demonstrate lack of commitment to the company, which may seriously undermine the success of implementing the Kanban process (Graham, 1995: 41).

Yet another major cultural difference that may have negative impact on implementing the Kanban process in Australia is the adversary relationship between employees and management. Australia is a nation where people work because they are forced to. On the contrary, Japan is a country where workers often refer to their company as uchi-home. Here, "Lifetime" employment at the same large firm has been a national ideal and a reality for about one fifth of the work force (Schonberger, 1993: 37).

#### 5-0 'IMITATING YOU COMPETITOR MAY BE COMPETITIVE SUICIDE'

Stainer (1995: 7) warns 'western' managers that, "by imitating yesterday's Japanese model, they are missing today's challenge." The same phenomenon may apply to imitating the Kanban process. Once you have achieved a sensible balance of just-in-time arrivals, others will catch up, and no further gains are possible in that dimension. In addition, you are forced to further develop and 'fit' Kanban to the organization.

The simplicity of Kanban alone, work in favor of it. Simple Kanban, which can be internally implemented everywhere has the potential of increasing manufacturing efficiencies. Naturally, obstacles triggered by cultural differences and logistics barriers have to be

overcome for a successful implementation. The Integrated Kanban, on the contrary, is more complicated to implement successfully. In the case of Australia, the absence of the Kieretsu, poor Industrial Relations, the adverse relationship between management and workers, and geographic factors seriously undermine the potential for such an implementation. However, several Japanese subsidiaries in Australia have employed in-house production of components, in order to fit the somewhat modified integrated Kanban process into the Australian environment.

## **Lean Manufacturing (Just in Time)**

Just-In-Time (JIT) manufacturing is a system of *enforced problem solving*. Managers have the choice between putting a huge effort in finding and solving causes of production problems, or they can learn to live with an intolerable level of interruptions in production. As everybody knows, the situation in which one has to put huge efforts (money and personnel) is highly undesirable, and therefore the system is called enforced.

### **Lean Manufacturing Philosophy:**

- Customers can have what they want, when they want it without a penalty.
- Improvement is always possible and necessary.
- Customers are the reason for existence, and they must always have a perfect product or service.
- All buffers are wasteful and need to be eliminated.
- A career consists of solving more difficult problems in a multi-skilled, cross-functional team environment.

### **Lean Manufacturing Strategy:**

- Know your customer and their needs, identify value-added activities and functions.
- Focus all the businesses' processes around the value stream of activities.
- Align your company to the needs of your customers.
- Activities that take time, resources and space but do not to the customer's requirement, are non-value added and must be reduced or eliminated.
- Establish performance measurements in all aspects of the value stream.

### **Aspect Of Importance In Just In Time Manufacturing:**

- People.

Here I think of Total Employee Improvement with Quality Circles, Selfdirected Workteams and Kaizen teams. But you must also include Job Enlargement/Job Enrichment. Job Enrichment provides job-rotation, a flexible workforce and cross-training.

- Quality.

Quality within JIT-manufacturing is necessary and must be inherent in the process. Without high quality standards, JIT will fail. Here I think about JIDOKA (Quality at the source), POKA YOKE (Error proofing) and the Plan Do Check Action, with its Statistical Process Control.

- Techniques.



The JIT-technique is a "Pull System", based on not producing units until they are needed. The well known Kanban Card is used as a signal to produce. More of the techniques used by JIT are on the JIT-producing page.

#### ●Integration.

JIT integration can be found in 4 points of a Lean Manufacturing firm. The Accounting side, Engineering side, Customer side and Supplier side. The accounting side of JIT has concern for WIP, utilization and overhead allocation and on the engineering side of JIT focus is on simultaneously and participative design of products and processes. More of this is described on the JIT Producing-page.

**Just In Time Has Influence In:**Ordering, Scheduling and Producing sides of a manufacturing firm. JIT producing contains the well known Kanban System. This influence in the manufacturing firm is depending on employees, suppliers or customers. They are the ones on which the JIT-principle is relying. This results in a well known Quote: "**It's the people that make JIT work.**"

Manufacturers put a large element of training in the JIT to reach to following goals:

●*Mutual Trust And Teamwork*. This is an important factor in the JIT-principle. When managers and workers see each other as equal, committed to the organization and it's success, they are more willing to cooperate with each other in order to find the problems and solve these problems.

●*Empowerment Of The Workers*. A firm which empowers it's workers, gives her workers the authority to solve problems on their own. When this is done, workers have the authority to stop production to solve problems, instead of first waiting for guidance from above. The objective of worker empowerment is having workers involved in problem solving at the shop floor level.

#### References:

**William Patrick Hendrickson** - <http://members.aol.com/williamfla/homepage.html>

Free Online Business & School Tutorials – <http://www.graphicproducts.com/tutorials/>

Management Systems Consulting, Inc. - [http://www.msc-inc.net/Index\\_Main.htm](http://www.msc-inc.net/Index_Main.htm)