# CHAPTER FIVE

# JUST- IN- TIME (JIT) & LEAN PRODUCTION

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## Learning objectives:

**By the end of this chapter, students will be able to:**

1- Define the meaning of Just in Time and its benefits.

2- Explain the Requirements of implementing Just in Time.

3- Discuss the Origins and History of JIT.

4- Define Importance of JIT.

5- State the Elements involved in JIT.

6- Explain the Advantages & Disadvantages of Just-In-Time Systems.

7- Discuss the Benefits of Just-in-Time Inventory.

## 1. What is Just in Time?:

Just in Time (JIT), is a management philosophy that calls to produce what the customer wants, when they want it, in the quantities requested, where they want it, without it being delayed in inventory.

So instead of building large stocks of what you think the customer might want, you only make exactly what the customer actually asks for when they ask for it. This allows you to concentrate your resources on only fulfilling what you are going to be paid for rather than building for stock.

Within a Just in Time manufacturing system, each process will only produce what the next process in sequence is calling for.

Taiichi Ohno was tasked by Eiji Toyota to make production more efficient through implementing these ideas and pull production with just in time concepts was developed. It took more than 15 years for Toyota to perfect their ideas and it was not introduced into western manufacturing until the end of the 1970's.

With a JIT system each process pulls from the preceding process and that process will then work to replenish those shelves.

- **How does JIT differ from traditional manufacturing?**

In traditional manufacturing we try to predict what the customer will want, and we will create a forecast (or guess) against which we will produce our products. We will also try to produce those products in large batches as the belief is that will make machines and processes more efficient, especially if those machines require a long time to setup. This will typically result in long lead times through our processes, huge amounts of Work in Process (WIP) stocks and also large quantities of finished goods stocks that have not yet been ordered by our customers. This is what many now call "Just in Case" manufacturing.

If the customer does order something that is not in our current stocks they will either have to wait many weeks or even months for the product to be manufactured or work will be hurried through the system by progress chasers causing a huge amount of disruption to the production schedule.

These systems are often run by Manufacturing Resource Planning (MRP2) programs that will try to schedule each and every process within

the facility. These software packages will seek to control every step and everything requires careful and often complex planning.

A Just in Time system on the other hand will seek to use simple visual tools known as Kanbans to pull production through the processes according to what the customer actually takes. It massively reduces the amount of stock held and will reduce lead times by a significant amount, often from weeks to just a few hours or days.

## 2. The benefits of a JIT system

The following are some of the many benefits that you could gain through the implementation of just in time:

- **Reduction in the order to payment timeline**: Many businesses will suffer with cash flow problems as they will often have to purchase large amounts of raw materials prior to manufacturing and subsequent payment by the customer. Often this gap is many months. Through implementing JIT you are able to considerably reduce that time period.
- **Reduction in Inventory costs**: one of the main aims with any JIT implementation is to improve stock turns and the amount of stock

being held. Personal experience has seen reductions of more than 90% stock in some industries. Along with the reduction in the stock come many other associated benefits.

- **Reduction in space required**: by removing large amounts of stock from the system and moving processes closer together we will often see a significant reduction in the amount of floor space being used. Results from 100's of projects run within companies in the UK through the Manufacturing Advisory Service saw average reductions of 33% for simple 5 day implementation projects.
- **Reduction in handling equipment and other costs**: if you don't have to move large batches there is less need for complex machinery to move them and all of the associated labor and training.
- **Lead time reductions**: one of the most significantly impacted areas is that of the time it takes for products to flow through the process. Instead of weeks or months most JIT implementations result in lead times of hours or a few days.

- **Reduced planning complexity**: the use of simple pull systems such as Kanban, even with your suppliers, can significantly reduce the need for any form of complex planning. With many implementations the only planning is the final shipping process.
- **Improved Quality**: the removal of large batch manufacturing and reduction in handling often results in significant quality improvements; often in the region of 25% or more.
- **Productivity increases**: to achieve JIT there are many hurdles that must be overcome with regards to how the process will flow. These will often result in productivity improvements of 25% upwards.
- **Problems are highlighted quicker**: often this is cited as being a negative aspect of JIT in that any problems will often have an immediate impact on your whole production process. However this is the perfect way to ensure that problems are highlighted and solved immediately when they occur.

- **Employee empowerment**: one requirement of JIT as with most other aspects of Lean manufacturing is that employees are heavily involved in the design and application of your system.

## 3. Requirements for implementing Just in Time:


**Figure 1. JIT requirements**

Just in Time is just one of the pillars of a lean manufacturing system and as such it cannot be implemented in isolation and without a firm foundation on which to build. Trying to reduce batch sizes without tackling setup times for instance cannot be done. The following are some of the things that must be implemented for JIT to be able to work:

- **Reliable Equipment and Machines**; if your machinery is always breaking down or giving you quality problems then it will frequently manifest in big issues with any JIT flow. The

implementation of Total Productive Maintenance is required to ensure that you can rely on your equipment and to minimize the impact that any failures have on your processes.

- **Well-designed work cells**; poor layout, unclear flow, and a host of other issues can all be cleared up by the implementation of 5S within your production. This simple and very easy to implement lean tool will make a significant improvement in your efficiencies all by itself.
- **Quality Improvements**; an empowered workforce that is tasked with tackling their own quality problems with all of the support that they need is another vital part of any lean and JIT implementation. Setting up kaizen or quality improvement teams and using quality tools to identify and solve problems is vital.
- **Standardized Operations**; only if you know how each operation is going to be performed can you be sure what the reliable outcome will be. Defining standard ways of working for all operations will help to ensure that your processes are reliable and predictable.

- **Pull Production**; Just in time does not push raw materials in at the front end to create inventory (push production), it seeks to pull production through the process according to customer demand. It achieves this by setting up "supermarkets" between different processes from which products are taken or by the use of Kanbans which are signals (flags) to tell the previous process what needs to be made.
- **Single piece Flow**; the ideal situation is one in which you will produce a single product as ordered by the customer. This for some industries is not immediately possible but should always be your end goal. To achieve this you will need to work on reducing batch sizes significantly through the use of Single Minute Exchange of Die (SMED) which seeks to significantly reduce the time taken for any setup. It will also often require the use of smaller dedicated machines and processes rather than all singing all dancing mega machines.
- **Flow at the beat of the customer**; the demand of your customer is often referred to as your Takt time. You need to ensure that your

cells and processes are organized, balanced and planned to achieve the pull of the customer. This is achieved through Heijunker and Yamazumi charts.

## 4. The origins and history of JIT

JIT is generally accepted as being a concept invented by Taiichi Ohno of Toyota; after World War2 resources were very scarce in Japan so using them to create something that the customer did not actually want right now was not a good idea.

On a visit to the US the management team of Toyota were inspired by, of all things, how they saw a supermarket (Piggly Wiggly) handle their inventory. Only what was removed from the shelves by the customers was actually replenished and ordered from suppliers. In this way shelves never became empty, nor did they end up overflowing with excessive inventory.

JIT approach has the capacity, when adequately applied to the organization, to improve the competitiveness of the organization in the market significantly by minimizing wastes and improving production efficiency and the product quality.

## 5. Importance of JIT:

The main focus of JIT is to identify and correct the obstacles in the production process. It shows the hidden problems of inventory. Just In Time method prevents a company from using excessive inventory and smoothens production operations if a specific task takes longer than expected or a defective part is discovered in the system. This is also one of the main reason why the companies (which are opted for JIT) invest in preventive maintenance; when a part/equipment breaks down, the entire production process stops.

The prime objective of JIT is to increase the inventory turnover and reduce the holding and all connected cost. This concept was made applicable again by the Japanese firms, placing an order for the material, the same day for the production of the product. Thus, the Just In Time approach eliminates the requirement to carry voluminous inventories and incur heavy carrying other related costs to the manufacturer.

In order to avail the benefits of JIT system, there should be an optimum synchronization between the manufacturing cycle and delivery of material. Just in Times requires a good understanding of the supplier and

the manufacturer in terms of the quantity and delivery of the material. In the event of any misunderstanding between the manufacturer and supplier of the material, the entire production process may come to a halt. One example of JIT system is a car manufacturer, a manufacturer of the cars operates with bare minimum inventory levels, as there is a strong reliance on the supply chain to deliver the parts required to manufacture cars.

The parts required in the manufacturing of cars do not arrive before or after they are needed; rather, they arrive only when they are needed. Successful JIT implementation wholly depends on how the manufacturer manages its suppliers. A lot of pressure is exerted on them, as the supplier of the materials have to be ready with an ample quality material, as the need arises.

**Continuous improvement:**

- Attacking fundamental problems and anything that does not add value to the product.
- Devising systems to identify production and allied problems.

- **Simplicity:** Simple systems are simple & easy to understand, easily manageable and the chances of going wrong are very low.
- **A product:** oriented layout for less time spent on materials and parts movement.
- Quality control at source to ensure every worker is solely responsible for the quality of their own produced output.

**Eliminating waste:** There are seven types of waste:

- Waste from product defects.
- Waste of time.
- Transportation waste.
- Inventory waste.
- Waste from overproduction.
- Processing waste.

Waste minimization is one of the primary objectives of Just In Time system. This needs effective inventory management throughout the whole supply chain. Initially, a manufacturing entity will seek to reduce inventory and enhance operations within its own organization. In an attempt to reduce waste attributed to ineffective inventory management,

SIX principles in relation to JIT have been stated by Schniededans and they are:

- Reduce buffer inventory.
- Try for zero inventory.
- Search for reliable suppliers.
- Reduce lot size and increase the frequency of orders.
- Reduce purchasing cost.
- Improve material handling.

## 6. Advantages & disadvantages of Just-In-Time systems:

- **Advantages of Adopting Just-In-Time include:**
- Just-in-time approach keeps stock holding costs to a minimum level. The released capacity results in better utilization of space and bears a favorable impact on the insurance premiums and rent that would otherwise be needed to be made.
- The just-in-time approach helps to eliminate waste. Chances of expired or out of date products; do not arise at all.
- As under this management method, only essential stocks which are required for to manufacturing are obtained, thus less working

capital is required. Under this approach, a minimum re-ordering level is set, and only when that level is reached, order for fresh stocks are made and thus this becomes a boon to inventory management too.

- Due to the above-mentioned low level of stocks held, the ROI (Return on Investment? of the organizations be high in general.
- As this approach works on a demand-pull basis, all goods produced would be sold, and thus it includes changes in demand with unanticipated ease. This makes JIT appealing today, where the market demand is fickle and somewhat volatile.
- JIT emphasizes the 'right-first-time' concept, so that rework costs and the cost of inspection is minimized.
- By following JIT greater efficiency and High-quality products can be derived.
- Better relationships are fostered along the production chain under a JIT system.
- Higher customer satisfaction due to continuous communication with the customer.

- Just In Time adoption result in the elimination of overproduction.
- **Disadvantages of Adopting JIT Systems:**
- JIT approach states ZERO tolerance for mistakes, making re-work difficult in practice, as inventory is kept to a minimum level.
- A successful application of JIT requires a high reliance on suppliers, whose performance is outside the purview of the manufacturer.
- Due to no buffers in JIT, production line idling and downtime can occur which would have an unfavorable effect on the production process and also on the finances.
- Chances are quite high of not meeting an unexpected increase in orders as there will be no excess inventory of finished goods.
- Transaction costs would be comparatively high depending upon the frequency of transactions.
- JIT may have certain negative effects on the environment due to the frequent deliveries as the same would result in higher use and cost of transportation, which in turn would consume more fossil fuels.

## 7. The Benefits of Just-in-Time inventory:

Just-in-time (JIT) inventory is a stratagem that manufacturers utilize to increase efficiency and decrease waste by receiving goods only as they are needed in the manufacturing process, thereby reducing the cost of inventory. Importantly, manufacturers must forecast their requirements accurately.

JIT avoids the waste associated with overproduction, waiting for material and holding excess inventory. The original concept was created by the founder of Toyota. Just-in-Time means that a manufacturer makes only what is needed, only when it is needed, and only in the amount that is needed.

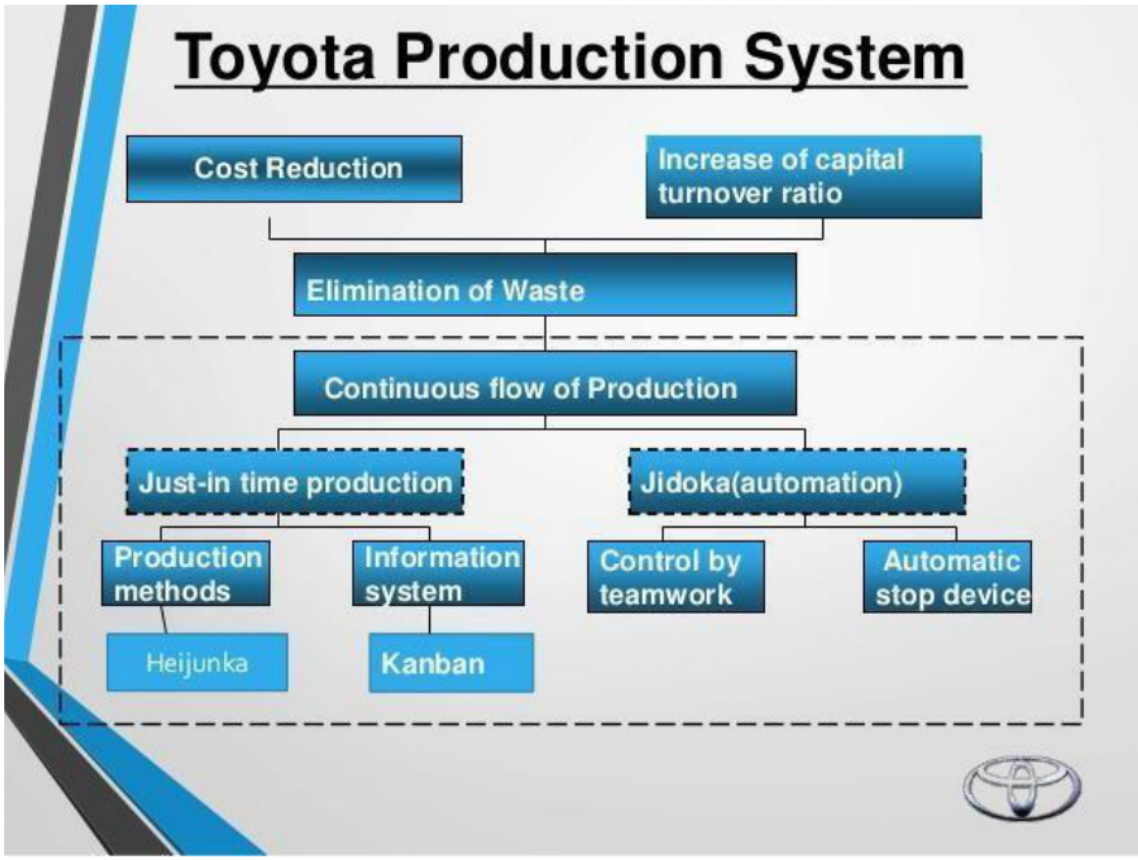


**Figure 2: Toyota Production System**

Many manufacturers have tried to imitate Toyota without understanding the underlying concept or motivation, which might have led to the failure of those projects. The concept behind Toyota's system is to work intelligently and eliminate waste so that only minimal inventory is needed.

Toyota's founder used the American supermarket as his model for what he was trying to achieve in the factory. When shopping for groceries, a customer takes what s/he wants from the shelf and purchases them. The store restocks the shelf with enough new product to fill up the shelf space. In a manufacturing situation, a worker would go to an inventory storage location and remove the quantity of material needed for production. The inventory storage location would then replenish just the amount of the material taken.

The just-in-time inventory model lets manufacturers reduce their overhead expenses while always ensuring that parts are available to manufacture their products. This allows a company's customers to be better served, while, at the same time, lowering the cost of doing business.

Warehousing excess inventory can be very expensive. Reducing the amount of inventory can reduce carrying costs. Companies that employ the just-in-time inventory model may be able to reduce the number of warehouses they own, or even allow them to eliminate those warehouses altogether.

An efficient supply chain can deliver lower costs throughout the manufacturing process, and those lower costs can then be passed on to the customer, making the company's products more affordable. This helps the company acquire a larger market share and outpace its competitors.

By using the JIT model, a manufacturer has a better level of control over its entire manufacturing process, thereby, making it easier to respond quickly when the needs of customers change. For example, a manufacturer that uses the just-in-time inventory model can quickly increase production of an in-demand product, while reducing production on products that are slowing down. The company will need to cut prices on any unsold inventory just to clear it out, which reduces the perceived value of the manufacturer’s other products. The just-in-time inventory model reduces this waste.

One example of JIT are fast-food restaurants, which use just-in-time inventory to serve their customers daily during breakfast, lunch and dinner. Fast food restaurants have cheese, burger patties and all the

fixings in a refrigerator, but they don't start assembling and cooking their cheeseburgers until a customer places an order.

Another example is the self-publishing industry. Authors might forgo the traditional approach to publishing their works and self-publish. Self-published authors can take advantage of just-in-time inventory by working with a printer that offers print-on-demand services. Print-on-demand companies don't print the books until an order is placed.

By reducing inventory, JIT frees up resources to employ them elsewhere in the company. A retail store—using JIT—can renovate its warehouse space, providing additional retail floor space without expanding the store itself.

A manufacturer can convert part of its warehouse into manufacturing space, increasing production. JIT also allows the workforce to focus on primary tasks, from making goods to interacting with customers rather than stocking material.

With JIT, manufacturers will know when employees are needed at different stations of assembly to meet the demand of those stages of manufacturing. A more flexible workforce can focus on quality

production with lower defect rates, which lower costs and increase customer satisfaction.

To make JIT workable, management must rethink the entire work flow of the company, from the intake of raw materials to the final finished product. At the same time, supply-chain relationships might require multiple suppliers, closer locations, and suppliers that can provide materials with minimal notice.

One negative is the problem that smaller orders will be needed for JIT. Therefore, new negotiations may be needed because of minimum order requirements. Even if a slightly higher price is paid, the cost difference could be offset by the low cost of inventory.

An entirely different mindset will be needed throughout the company. The complete workforce must understand the entire JIT process and shift to where they are needed, as work flow recedes and surges to meet customer demand swings. This will take a sizable commitment of both time and money at first—plus allegiance—to stay the course in implementing JIT. If not, the system will never gain traction within the company.

Lean manufacturing and JIT are often mistaken for the same thing, but they are different concepts. Just-in-time manufacturing is focused on efficiency, while lean manufacturing is centered on using efficiency to add value for the customer. JIT can be utilized on its own, or as one step in the lean manufacturing process.

## 8. Is JIT push or pull?

- **Push-Pull Manufacturing**

"Push type" means Make to Stock in which the production is not based on actual demand. "Pull type" means Make to Order in which the production is based on actual demand. In supply chain management, it is important to carry out processes halfway between push type and pull type or by a combination of push type and pull type. Supply Chain Management (SCM) is to create a solution i.e. "supply" for a goal or issue, i.e. "demand". Supply chain models of "Push type" and "Pull type" are opposite in terms of a demand and supply relationship. "Push type" is represented by "Make to Stock" (MTS) in which the production is not based on actual demand and "Pull type" is represented by "Make To Order" (MTO) in which the production is based on actual demand.

One of the major reasons why supply chain management currently receives so much attention is that information technology enables the shifting of a production and sales business model from "Push type" to "Pull type". Pull-type supply chain management is based on the demand side such as Just-in-Time (JIT) and CRP (Continuous Replenishment Program) or actual demand assigned to later processes. Therefore, unlike the Push-type method it is not Make to Stock, which is based on demand forecast. While inventory is kept to a minimum, products can be supplied with short lead times and at high speed. At the point where "Pull type" starts to supply operations triggered by actual demand, it is like an elevator. An elevator starts when a button is pressed even if there is only one passenger. On the other hand, the "Push type" can be considered as an escalator. An escalator continues to supply (push) regardless of whether there is actual demand (passenger). In addition, "Push type" corresponds to a model for trains, buses, and airplanes for which supply (push) is based on demand forecast by time period and route. There may be various forms between "Push type" and "Pull type" depending on inventory forms of materials, work in progress (WIP), and finished items

and how to deal with the actual demand in supply chain management. In the case of sushi, there are boxed sushi sold in a shop, sushi ordered at the counter in a sushi restaurant, and sushi for which an order starts from purchasing live fishes. The place and form which fish for sushi are held in varies from downstream to upstream in a supply chain. An extreme example of a pull-type supply chain sushi restaurant that is unconcerned about lead times is the one that goes fishing when an order is received.


**Figure 3. lean Manufacturing**

Lean manufacturing takes the idea of JIT and looks at it from the perspective of customer value. In the lean manufacturing process, a company must consider what aspects of the product add real value. The

first tenet of lean manufacturing is that every step in the production process must add something of value.

The manufacturing process is then redesigned to remove activities that don't add value. Transporting parts from a distant warehouse to the manufacturing plant would not add value. Switching to JIT would reduce transportation and warehousing costs, making the product more affordable. The JIT process adds value by increasing efficiency.

The most important benefit of JIT is the elimination of raw material, inventory and product storage costs. Traditionally, raw materials and inventory of finished goods were considered assets. This notion has changed because of JIT and now inventory is considered as waste or dead investment, incurring additional costs.