*i*Journals: International Journal of Software & Hardware Research in Engineering
ISSN-2347-4890
Volume 7 Issue 10 October 2019

Implementation of JIT production to kanban system in steel manufacturing plant

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Abstract

Globalization has changed the concept the quality, customer satisfaction and established new bench mark. Manufacturing firms have to adopt tools and techniques to meet the quality requirement and productivity. To compete rsuccessfully in today's global , dynamic and customer driven market place , many industries' wants to implement just in time production system. the scope of the thesis is to implement JIT concept in manufacturing unit and analyze the factor and barriers to implement JIT in Indian industries. the project consist of 3 modules . in the first module implementation first module, implementation of single card kanban system in a machine shop is presented . in the second module , case study related to implementation of kanban system in a tractor manufacturing unit and its cost analysis for gaining productivity advantage is discussed .critical elements and barriers for successful implementation of JIT concept in Indian manufacturing industries is presented in the third module .

Introduction of JIT production system

This chapter provides information about the Introduction, needs and advantages of just in time production system regarding implementing in Indian manufacturing industries.

JIT was invented by TaiichiOhno of Toyota shortly after World War II. Ohno system was developed to control the large or small volumes of a variety of products. Many people know JIT because of its alliance with Japan. If these people take a closer look at JIT, they know that it is addition of goods, general knowledge and production. Ohno and his associates came to U S to study manufacturing processes. They found that this system was much like the system that Japanese companies were using, but Japanese companies could not allow waste in their systems due to the reduction to their economy caused by World War II. After this in order to move toward improvement early TaiichiOhno gives a new, disciplined, process-oriented system, which is known's as "Toyota production system" or "just in time production system". Ohno found some points and views from the west of the world and also from the book of Henry Ford's "Today and tomorrow". The foundation of Toyota production system is Ford's production line of continuously flowing material. For surviving in today's competitive market; many manufacturers have come to realize that the traditional mass production concept is not enough to achieve their objectives. It has to be generated to the new ideas of just in time manufacturing. A research that was done at the Massachusetts institute of Technology and management of the movement from mass production towards just in time manufacturing, as define in the book "The machine that changed the world" (Womack, Jones and Ross, 1990), awoke many organization from their sleep. The research shows the huge success of Toyota at "New United Motor Manufacturing Inc" and brought out the big gap that existed between the Japanese and western automotive manufacturing firm. The ideas and views came to be adopted in the world because the Japanese manufacturing firm developed, manufactured and deliver products with half or less workers effort, capital investment, work space, tools, machines, materials, time, and overall expense.

According to Vikas Kumar (2010) in today's competitive and advanced global business surrounding, the objectives of all manufacturing firm is long term survival. A manufacturing firm survival in an improved competitive market closely based on its ability to produce highest quality goods at lowest possible cost & with shortest possible lead time. Just in time is a system that focused on manufacturing waste reduction & continuous improvement to got operational excellence. Just in time manufacturing system distances itself from the competition because no large capital are required other methods increased complexity , large overheads, automation while JIT given simplifying & stream ling

the existing manufacturing process. The basis of JIT is the concept of waste less production. It based on the deduction of waste in the whole manufacturing environment from raw material through shipping. Just in time is defined as "the production of the minimum number of different products, in the minimum possible number of products at the latest possible time, thereby deducting the requirement for inventory .JIT does not mean to produce on time, but to produce just in time. Traditional manufacturing strategy is driven by 'push system' with aimed to have huge inventory of products for consumer's requirement. Planning schedule is implemented as manufacturing authorization mechanism has push material from one location to other location. However this generate a great problem for people on the floor in dealing with huge WIP inventories, unsynchronized production processes & producing unnecessary goods. As a result, established organizations like Toyota Motor Corporation moved to the next level of manufacturing strategy by adopting the kanban system. The adoption of kanban system has improved their efficiency & flexibility of production according to consumer's requirements. The kanban system is a pull typed system focused that gives authorization to manufacturing at a required rate & specific time in order to replenish part that already consumed by customer. Nowadays many companies have faced customer pressure to produce products with high value, to deliver quality products at reasonable price. They have intense to meet these wants as a requirement to remain stay successful in today's market. The process of producing product is more efficient & effective when kanban system is implemented.

1. **Gaps Identified in Literature review**There has not been any analysis in organizational study of the manufacturing industries related to critical success factors and barriers which are hindering the JIT implementation.
2. There has not been yet applied AHP analysis to find out the priority ranking for critical successful factors for implementing just in time production system in Indian manufacturing industries.
3. In previous literature reviews no one showing the correlations between the barriers for implementing just in time production system in Indian manufacturing industries, applied ISM model in this project.
4. In previous literature reviews no one develop MICMAC analysis for showing which barriers is more critical than other barriers for implementing just in time production system in Indian manufacturing industries.

Advantages of JIT

When implementing just in time production system in any manufacturing industries these are the following advantages will be come.

JIT Capability	Competitive advantage derived from JIT capability
Reduction in WIP	Lower cost manufacture
	Reduced order to delivery lead time
Increased flexibility	Responsive to customer demands
Reduction in Raw materials	Lower cost manufacture
Increased quality	Higher quality products
	Lower cost manufacture
Increased productivity	Lower cost manufacture
Reduced space requirement	Lower cost manufacture
Lower overheads	Lower cost manufacture

Review of past research work

This chapter shows the different point of views by different authors on implementation of JIT production system.

If Indian manufacturing industries implemented just in time technique, they benefited with wide range of benefits obtained from it, but implementation of just in time in India is slightly difficult due to cultural differences & low literacy level. Many authors highlighted the just in production system case studies.

Singhvi [7] has presented the experience of implementation the JIT in an Indian automobile company the JIT in an Indian automobile company. The study found the employee involvement as a critical element for implementing the JIT, while large investments are not found essentials. At last, it is concluded that implementation of JIT is not so difficult in India. Its implementation could be a great opportunity for Indian industries due to its wide range of benefits.

Mahadvan [14] conducted survey on 43 Indian industries. He found the automobile industry in India has made significant improvement in implementation of elements such as multi skilling of work force, total preventive maintenance and JIT purchasing. Employee involvement and Top management commitment are prominently listed as

critical success factors.

According to Garg et al. [15], JIT requires a culture that allows the worker to become a participant in decision making and thus necessitates putting trust and responsibility in the hands of workers and supplier to become same interest group by the way of having long term relationship. In JIT environment, work culture required is marked by trust, locality, responsibility, development, motivation, authority, long-term relationship, and respect for human being. It is critical for a firm to make conscious and deliberate efforts to change the work culture for successful implementation of JIT. These changes in work culture require top management commitment, involvement and leadership, worker participation in decision making and massive education and training to the people concerned. It is also pointed that cultural factors are biased against above said rapid and massive changes because people prefer an existing inequity to known improvement.

5. **Gaps Identified in Literature review**There has not been any analysis in organizational study of the manufacturing industries related to critical success factors and barriers which are hindering the JIT implementation.
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7. In previous literature reviews no one showing the correlations between the barriers for implementing just in time production system in Indian manufacturing industries, applied ISM model in this project.
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METHODOLOGY-Data collection and discussion

For finding the objectives of the research, some data collection technique must be developed. Therefore, it is focused to use interview with open guided, structured questionnaire, paper review and direct examination of the actual working territory and the condition of the work floor. The structuredquestionnaire was send to the many manufacturing firm. The responses will take from to those who have thetechnical knowledge and some managerial skills. In general, a total number of questionnaires were sending in many manufacturing firm. Thequestionnaire survey is given in Appendix 1.Here in this project AHP analysis and ISM modeling for critical successful factors and barriers are used for implementing just in time production system in Indian manufacturing industries which is describe in next chapter.

The objective of data analysis is to examine the results of the information gained through collection of data which is provided by different industries.

4.2 Module-1: Implementation of JIT production to kanban system in steel manufacturing plant.

4.2.1 Background and objectives of steel manufacturing plant –

This plant is integrated steel plant. They have many units like blast furnace, coke oven, steel melting shop, machine shop etc. our study is based on machine shop, where many machine parts are made or repaired by workers . The most likely parts which is repaired or manufactured in machine shop are many types of gears, clutches, shafts. In machine shop many work will be done by lathe, shaper, planner, drilling machines. All types of works which is based on this type of machine will be done on machine shop.

The main objective of the machine shop is to make or repaired any types of gears and shafts, this study is focused on the manufacturing of spur gear in machine shop. In this project trying to applying kanban systems in machine shop. Applying kanban system (key tool of just in time production system) to reduce the overall manufacturing time of spur gear and increased the number of gears in a same time of shifts.

4.2.2 Major problems of machine shop –

i. Increased Overall time for manufacturing spur gear.
ii. Less numbers of spur gears produced in single shift.
iii. Level of inventories of raw material and WIP is higher.
iv. The manufacturing process is push type production system.
v. Finished product storage.

4.2.3 Data collection and analysis

4.2.3.1 Implementation Steps:-

This section shows the development of kanban system in machine shop of steel plant. Once the kanban system was adopted in manufacturing area after that evaluation of performance was carried out .Continues flow system is very

crucial for implementing kanban system. After adoption of continues flow system in production line many waste are eliminated from work floor.

To achieve the aim of the module 1, the structured method are shown below-

(a) Conducting collection of data regarding kanban.
(b) Calculate the size of kanban.
(c) Design the kanban for production line.
(d) Train everyone about kanban.
(e) Using kanban in production line.
(f) Inspect & continue the kanban.
(g) Upgrade the kanban.

Conducting collection of data regarding kanban - In this section collection of necessary data will be characterize for production process. The act of collecting data will allow taking a decision based on facts in place of desires. This data will allow calculating the quantities of kanban, to clearly define the process will need information listed below.

a) Total Number of produced parts by process.
b) Change over time-change over time is the total time required for producing last piece of product from previous production batch to the first piece of product in new production batch.
c) Downtime-downtime is the total time where production is stopped on the work floor but still this time is calculated on the working hours like lunch time.

Calculate the number of kanban – In this section calculation of kanban number will be done on the basis of present conditions, not based on future plans or wants. The basic calculations shows the utilization of requirements of production the rate of system scrap , rate of process productivity , changeover downtime & planned downtime to calculate a replenishment interval.

Kanban calculation- The main factors which are useful in kanban calculation are follows.

1) Replenishment interval- Replenishment interval is based on a function of time obtainable after considering parameters of process.
   a) Rate of production- Production rate is the rate of produced products in per day.
   b) Changeover time- Change over time is the total time required for producing last piece of product from previous production batch to the first piece of product in new production batch.
   c) Downtime (both planned & unplanned)- Downtime is the total time where production is stopped on the work floor but still this time is calculated on the working hours like lunch time.

The replenishment cycle will be calculated by the time left over for changeovers after subtracting required production run time.

2) Production requirements = avg. production order/(1- scrap of system)……equ(1)
   For calculating the adjusted production requirements, required to determine the time need for production of each and every part.

Production time= (adjusted production requirements * cycle time / part)…….equ (2)

To determine the available production time need to find how much time we have available for producing each day to produce parts.

Available time = total time in a shift – (planned & unplanned downtime)……equ (3)

Time available for changeovers = Total available time – time required for production …… equ (4)

3) Calculating the buffer- The buffers giving the required lead time to generate the replenishment interval part quantities without stocking out process or consumer. The buffers also provide the necessary time required for process activities to occur. Some buffer items are listed below.

a) Requirements for customer delivery.
b) Inner lead times.
c) Lead times of supplier.
d) Level of comfort.

4) Calculating the number of kanban containers-
Container quantity = **[**buffer quantity + replenishment interval quantity] / container size…….equ (5)

4.2.3.2 Implementing kanban system on work floor-

The aim of this project is to shows advantages through the kanban system. This project also defines how the kanban system was generated & implemented on work floor. Therefore, following are the steps for implementing kanban system.

I. Kanban flow design- The kanban flow design was based on present situation on work floor. For designing the kanban flow we took into consideration three criteria such as process distance, operation method & method to convey information from downstream to upstream.

II. Collecting relevant factors of manufacturing & consumer as a start, collection of relevant manufacturing factors was done at manufacturing site. Volume of production collection collected by demand forecasting. In steel plant the three operations & their timing will be given in to below table.

Table -4.2.3.2.1 Operation times of different machines in machine shop.

Machine	Operation	Runtime (in minute)
M1	Facing/turning	35
M2	Keyway marking	5
M3	Gear cutting	60

In machine shop, considering the three operations on a work piece. The timing of all the operations are given at table below, as well as we consider all the timing like downtime (planned & unplanned both), replenishment interval, production cycle per part, total time in a shift etc.
Calculation part- on the basis of route card
Time required for changeover per part = 45 minutes
Planned downtime = 50 minutes (i.e. lunch)

Machine	Runtime(in minutes)
M1	35
M2	5
M3	60

Unplanned downtime also included in production run considering time study done.
Production cycle per part = 35+5+60= 100 min. /part

Total time in shift = 8*60 = 480 minutes

Available time for production = (total time in a shift – planned downtime)
= 480 minutes – 50 minutes = 430 minutes
Taking 3 parts produced previously by workers/organization per shift.

Total available time for changeover = 430-(100*3) = 130 minutes

Total time required for changeover = 45*3=135 minutes

Replenishment interval = (total time required for changeovers)/(total time available for changeover)

Replenishment interval =135/130=1.03
(For smooth flow we take 2)
Table 4.3.3.2.2 shows the timing of different machines in different work centers. In implementing kanban system in machine shop the shift is like this.

Table-4.2.3.2.2 Schedule for one shift (480 minutes) in machine shop

Part no.	M1-in	M1-out	M2-in	M2-out	M3-in	M3-out
1	10	45	62	67	82	142
2	55	90	107	112	127	187
3	100	135	152	157	172	232
4	151	188	203	208	313	375
5	198	235	250	255		
6	245	282	328	333		
7	292	329				
8	339	376				

In the above table all in & out times are in minutes. In above table see that there are 4 parts are completely made in one shift after implementing the kanban system.

The following results were obtained while implementing kanban in machine shop of steel plant.

I. As per of the consideration there were 3 shifts in day in machine shop which included an 8.00 hours per shift, on implementing kanban 40 minutes of extra spare time is left per shift for production on purpose. On other way, 40 minute per shift is well saved by kanban system for more work.
II. Up to 3parts/shift is being produced by the worker there is a shift of 8.00 hours. By the implementation of kanban with an extra time reserved for 40 minutes an extra part can be well made by worker there.
III. As an extra part can be well made, there is much more increase in the inventory level of the production for the organization which in turn increase the production level much more on annual terms.
IV. Scrap obtaining from machining process for every part is very well accomplished by the kanban system thus descends the scrap & control the scrap management.

With an effective conclusive result a time span of 14 hours/week is well being saved by implementing kanban system in the machine shop.
This module presented a case study of implementation of kanban system on a production area. The study shows that kanban system is very important for the success of just in time production & provides a smooth flow of manufacturing parts throughout production system. For implementing kanban system Systematic techniques and full commitment will be required. The implementation of kanban shows that reduction in lead time, in process and finished product inventory and quality of products also be improved.

Therefore, its shows that implementing kanban system improves the quality of the final products and reduced all types of inventories generated in production site.

RESULT AND DISCUSSIONS

According to project, in Module 1 when implementing kanban system (key tool of just in time production system) in machine shop of steel manufacturing plant getting following results.

I. As per of the consideration there were 3 shifts in day in machine shop of a steel plant which included an 8.00 hours per shift, on implementing kanban 40 minutes of extra spare time is left per shift for production on purpose. On other way, 40 minute per shift is well saved by kanban system for more work.
II. Up to 3 parts/shift is being produced by the worker there is a shift of 8.00 hours. By the implementation of kanban. With an extra time reserved for 40 minutes an extra part can be well made by worker there.
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IV. Scrap obtaining from machining process for every part is very well accomplished by the kanban system thus descends the scrap & control the scrap management.
V. With an effective conclusive result a time span of 14 hours/week is well being saved by implementing kanban system in the machine shop of steel plant.

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Therefore, its shows that implementing kanban system improves the quality of the final products and reduced all types of inventories generated in production site.

CONCLUSIONS

1. This project shows the changes in Indian industries after implementing just in time manufacturing system. The important goal of this study was to find out the benefits of JIT production system, critical successful factors for implementing JIT production system in Indian industries and the barriers for implementing JIT production system with a focus on major tool of JIT which is Kanban system.
2. The results of this study shows that, the execution of just in time production system in Indian manufacturing industries is not an easy task ,its required many efforts from employee and management side, but when organization implementing JIT ,they have many profits like increased in productivity, quality improvement, reduction in inventories, reduction in total production time etc.
3. In this project, implemented kanban system in steel manufacturing plant and tractor assembly plant .After implementing this found some changes in both of industries which is described in results.This project presented a case study of execution of kanban system on a production area. The study shows that kanban system is very important for the success of just in time production & provides a smooth flow of manufacturing parts throughout production system. For implementing kanban system Systematic techniques & full commitment will be required. The implementation of kanban shows that reduction in lead time, in process & finished product inventory &.quality of products also be improved.
4. This study shows the critical elements & barriers for successful execution of just in time in Indian manufacturing firm. In this study, categorized the barriers for implementing JIT in organization in various phases like operational, cultural, financial, technological etc. Successful execution of JIT in Indian manufacturing industries can be found by bringing out successful cultural changes & management commitment. It can be shown from the study that successful JIT execution need to implement initiatives successfully, so as to improve organizations maintenance performance, productivity, reduce costs, unnecessary downtime, and utilization of resources. In this project also shows a priority ranking of critical successful factors for implementing just in time production system by AHP analysis and also gave correlations between barriers for implementing JIT production system in Indian industries.

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