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A GENERAL OVERVIEW OF THE PRODUCTION MANAGEMENT-JUST-IN TIME APPROACH: AN APPLICATION IN A BUSINESS OF AUTOMOTIVE SECTOR

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ABSTRACT

Purpose- The purpose of this study is to describe the basic-detail definition and features of this approach, to demonstrate the literature of JIT paradigm and to find the best alternative after investigating the working principles of different systems. The study was held in a factory of this company.

Methodology- The means of kanban and classical system were tested statistically in order to determine the kanban stock level and classical system differ from each other. Their variances were found and Z test was applied. The simulation was done with respect to the part x for kanban and classical system.

Findings- The comparison of the old system with the new system is presented clearly. For the proof of the comparison results, z test and sum of deviations were used together too. The z test proved that the new systems were better than the old systems and also results were found for the sum of squared deviations from the minimum stock.

Conclusion- JIT system is surely practicable in Quality management and mostly in Total Quality Management. Some other quality systems began to apply JIT in their own factories. Within the scope of this study, The JIT system supports a better environment for production. By this technique, the scrap rate, lead-time, and the inventory level decrease where efficiency and utilization of the workers and the machines increases.

Keywords: Business, quality, Just-in-Time, paradigm.
JEL Codes: Q56, E32, L10.

1. INTRODUCTION

Companies have new management strategies to provide competitive opportunities and advantages to have a brilliant prestige and to supply modern and productive production-service systems (Meredith, 1992; Wheelen and Hunger, 2004). Just-In-Time is one of these systems. This approach was started in Japan firstly. Much more far-east firms began to take-hold the components and requirements of markets in all around the worldIt is related to inventory and the main subjects of JIT manufacturing are quality, elimination of waste-disposal and simplicity (Aradhyea and Kallurkarb, 2014; Starr, 1989; Maiga and Jacobs, 2009). JIT is a tehnique for optimizing operations of production/manufacturing that consists continual decreased of waste. It handles a systems perception to improve and perform and manage a manufacturing system. This method arranges the production operation so that component and material are available when the stages of production are required. This perception is a production system with new values to develop productivity.

This approach identifies the stages of production which have subassemblies, components, raw materials, parts of products and the requirements of production, are available on the production-manufacturing department (shopfloor). The production-service system is required and this approach is punctual and does not have extra storage-stock (Dalcı and Tanis, 2006; Maiga and Jacobs, 2009). According to this topic, this study involves a view of the structure of production systems and implementation with a case study in a firm. At present time, in production and manufacturing sectors, the modifiers and significant properties in the market rivalry are the pioneer in the most of extents-points such as quality of products-goods, delivery on time, customer and employee satisfaction, customer relation, service structure after sales and income of the firm.

The application in this firm presents three production strategies: classical system, kanban system, and supermarket structure. In addition, it includes the difference of these strategies with reference to some basic points. The statistical and diagrammatic techniques are used to explain these issues-differences.

2. LITERATURE REVIEW

Just In Time (JIT) is a system of lean production used mainly in repetitive manufacturing, in which goods move through the system and tasks are completed just in time to maintain the schedule.

JIT is a manufacturing philosophy involving an integrated set of procedures/activities designed to achieve a volume of production using minimal inventories, reducing setup times, establishing goods relationships with a small number of vendors (Kong et al., 2018; Richard, 1988).

A corporate system designed to produce output within the minimum lead time and at the lowest total cost by continuously identifying and eliminating all forms of corporate waste and variance. JIT systems have important benefits that are attracting the attention of traditional companies. The main benefits are (Aradhyea and Kallurkarb, 2014; Chung et al., 2018; Dilworth,1992; Setsuo and Taiichi, 1986).

1-decreased level of in-process inventories purchased products and finished goods.

2-decreased space requirements.

3-Increased product quality and reduced scrap and rework.

4-Reduced manufacturing lead times.

5-Greater flexibility in changing the production mix.

6-Smother production flow with fewer disruption accused by problems due to quality, shorter setup times, multi-skilled workers who can help each other and substitute for others in case of absenteeism.

7-Increased productivity levels and utilization of equipment.

8-Workers participation in problem-solving

9-Pressure to build a good relationship with members.

10-Reduction in the need for certain indirect labor, such as material handlers.

The JIT approach involves the following:

(A) Reduction of setup times to achieve smaller production lot sizes.

(B) Increased use of sequential flow processes such as dedicated assembly lines and group technology cells.

(C) Increased use of multifunction workers. (D) Increased flexibility of equipment and capacity.

(E) Increased use of preventive maintenance. (F) Increased stability and consistency in the schedule.

(G) Longer term relationships with suppliers. (H) More frequent deliveries from suppliers.

(I) Improved technical support of suppliers. (J) Employee involvement programs such as quality circles.

(K) Statistical process control (SPC) (L) The stop production prerogative. (M) Cause and Effect Analysis.

Although this new philosophy affects all areas of a business, major changes take place in manufacturing management, purchasing human resources management and quality management.

2.1. Pull Versus Push

The terms push and pull are used to describe two different systems for moving work through a production process. A system of controlling materials by force of suppliers send material in reaction to a fixed schedule, without bothering whether the next operation requires them at that time. In a push system, when work is finished at a workstation, the output is pushed to the next station or in the case of the final operation, it is pushed on the final inventory. Conversely, In a pull system, control of moving the work rests with the following operation; each workstation pulls the output from the preceding station as it is needed; the output of the final operation is pulled by customer demand or the master schedule. In Pull system, A structure of controlling materials by means of applying signals to the supplier that more material is required. Thus, in a pull system, work is moved in a response to demand form the next stage in the process, whereas in a push system work, is pushed on as it is completed with no regard for whether the next station is ready for the work (Chase and Aquilano, 1998; Puchkova et al., 2006).

JIT systems use the pull approach to control the flow of work, each workstation gearing its output to demand presented by the next workstation. The traditional production uses the push approach for moving work through the system. In JIT system, there is communication backward through the system from station to station, so that work moves "just in time" for the next operations; the flow of work is thereby coordinated and accumulation of excessive inventories between the operation is avoided. If a workstation waited until it received a request from the next workstation before starting its work, the next station would have to wait for preceding station to perform its work. Therefore, by design, each workstation produces just enough output to meet the demand of the next station. This can be accomplished by having the following workstation to communicate its need for input sufficiently ahead of time to allow the preceding station to the work. The size of the buffer depends on the cycle time at the preceding workstation: if the cycle time is short, little or buffer will be needed; if the cycle time is long, a considerable amount of buffer will be needed.

Another way to describe the pull system is that workflow is dictated by 'next step demand.' There are varieties of ways in which such demand can be communicated, including a shout or wave, but by far the most commonly used device is the Kanban Card. Kanban is a Japanese term that means a signal or visible record. When a worker needs material or work form the proceeding station, he or she uses a Kanban card to communicate this (AbdulRahman et al., 2013; Bufta and Sarin, 1987; Gamberini et al., 2013; Naufal et al, 2012). The systems work this way: a Kanban card is affixed to each container. When a workstation needs to replenish its supply of parts, a worker goes to the area where these parts are stored and withdraws one container of parts. Each container holds a predetermined quantity. The worker removes the kanban card form the container and posts it in a designated spot where it will be clearly visible and the worker then moves to a lot to the workstation. The posted Kanban is then picked up by a stock person who replenishes to stock with another container and so on the downline Demand the parts trigger replenishment and parts are supplied as usage dictates. Similar withdraws and replenishment occurs all the way up and down the line form vendors to finished-goods inventories, all controlled by kanbans (Bufta and Sarin, 1987; Gamberini et al., 2013; Naufa et al., 2012). In fact, if supervisors decide the system is too loose because inventories are building up, they may decide to withdraw some Kanbans thereby tightening the systems. Conversely, if the system seems too tight, additional Kanbans may be introduced to bring the system into balance. It is apparent that the number of Kanban card in use is an important variable (Bufta and Sarin, 1987; Meredith, 1992; Naufa et al., 2012; Starr, 1989).

2.2. How to Apply JIT-Using JIT

Just In time is about inventory, but it is much more than inventories reductions program. JIT organizes the production process so that parts and subassemblies, both purchased and manufactured, are available on the shop floor when they are needed- not too soon and not too late. The central themes if Just In Time manufacturing is simplicity, quality, and elimination of waste. Waste is defined as any activity that increases cost but does not add value to the product. The manufacturing process is examined critically and carefully in an attempt to gradually remove every wasteful action. The aim is to provide the perfect process by describing all that can go wrong and, on the assumption that all problems can be solved by detailed examination and creativity, by systematically eliminating deviations from the plan (Bufta and Sarin, 1987; Hui et al., 2018; Kootanaee et al., 2013; Rohani and Zahraee, 2015)

Simple techniques such as kanban Cards, used to present when a manufacturing work center has run out of a component and needs to replenished ensure that parts and assemblies are made only when they are needed. This practice gives people on the shop floor control of the movement of components and eliminates unnecessary inventory Many impacts of production must work together effectively. Master production scheduling production and material planning, procurement, shop-floor design, production engineering and labor relations are some of the factırs that must change for a JIT approach to succeed. JIT is not a series of techniques or methods; it is an approach to manufacturing that emphasizes solving the root problems that cause a lack of productivity. It is a philosophy that creates an atmosphere of continuous improvement in all aspects of the enterprise (Inmana et al., 2011; Naufal et al., 2012; Bufta and Sarin, 1987; AbdulRahman et al., 2013)

2.3. Converting to a JIT System

The success of JIT system in Japan has attracted keen interest among US manufactures. A number of well-known firms have converted a portion of their operations to JIT systems. In order to increase the probability of successful conversion, companies should adopt a carefully planned approach that includes the following elements (Bufta and Sarin, 1987; Dilworth, 1992; Richard, 1988; Setsuo and Taiichi, 1986).

1-make sure top management is committed to the conversion and that they know what will be required. Make sure that management is involved in the process. And make sure that management knows what it will cost and how long it will take to complete the conversion and what results can be expected.

2- Study the operation carefully; decide which parts will need the most effort to convert.

3- Obtain the support and the cooperation of workers. Prepare training programs that include sessions in setups, maintenance of equipment, cross training for multiple tasks, cooperation, and problem-solving. Make sure workers fully informed on what JIT is and why it is desirable. Reassure workers that their jobs are esquire.

4-Begin by trying to reduce setup times why maintaining the current system. Enlist the aid of workers in identifying and eliminating existing problems (bottleneck, poor quality and etc.)

5-Gradually convert operations, beginning at the end of the process and working backward at each stage, make sure the conversion has been relatively successful before moving on. Do not begin to reduce inventories until major problems have resolved.

6-Convert suppliers to JIT as one of the last steps. Be prepared to work closely with them. Start by narrowing the list of vendors, identifying those who are willing to embrace the JIT philosophy give preference to vendors who have long-term track records of beginning reliably. Try to use vendors located nearby if quick response time is important to establish long-term commitments with vendors insist on high standards of quality and adherence to strict delivery schedules.

7-Be prepared to encounter obstacles to conversion.

JIT can apply (often with a different emphasis) to low-volume and short-run manufacturing processes. It must be pointed out, however, that the emphasis of JIT is not on mass production, but on the reduction of waste. JIT techniques are intended to provide substantial improvements in manufacturing productivity by reduction of lead times, setup times and lot sizes; by preventive maintenance and by the more intelligent use of the talents and experience of production personnel circles (Chase and Aquilano, 1998; Chung et al., 2018; Dilworth, 1992; Hui et al., 2018; Setsuo and Taiichi, 1986; Richard, 1988; Naufal et al. 2012). JIT strongly emphasizes the participation of the workforce in all levels of decision making and the creation of an atmosphere of teamwork and joint achievement within the plaint. Some more publicized aspects are the uniforms worn by all personnel, the offices of senior managers adjacent to the shop floor and the use of quality circles (Chase and Aquilano, 1998; Chung et al., 2018; Dilworth, 1992; Hui et al., 2018; 1986; Richard, 1988; Setsuo and Taiichi, 1986; Naufal et al. 2012).

3. DATA AND METHODOLOGY

The system in ABC Auto Establishment (X firm) continues with KAIZEN principles. Kaizen means, continuous improvement. The system has been implemented in Japan and it refers to the Japanese name: Kaizen (continuous improvement). The JIT system is applied in the program of Kaizen and it is named as both Supermarket and Kanban (Meredith, 1992; Naufa et al., 2012; Starr, 1989). Two of the JIT systems are now applied in this factory but there are some differences between them. We aimed to find the best alternative after investigating the working principles of two systems and the classical system. The study was held in the factory of this company.

3.1. Simple Explanations of Two Sytems on ABC Auto Establishment

Generally, the logic structure behind the two systems is same. One can easily say that supermarket and Kanban systems are originating from JIT production System. In ABC Auto Establishment, these two systems are separately applied because of the position of the two assembly locations. Kanban cards are used for a factory of this company and automatically inclosed into the system. In this system, cards are used and the production is performed according to the numbers on the card. Supermarket system is also a kind of JIT system in which the production progress in the card. But these cards are only applied on the shelves of the market. Spiderman contains the shelves and delivers the instructions to the production department of that item.

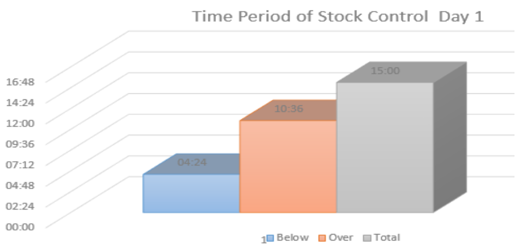
(i) Supermarket system: There are shelves in the storehouse and on each shelf there remains cards due to types of components for the assembly or production of the buses. The responsible labor named spiderman looks the shelves in every day and if the level of the parts is below the safety limit, the spiderman tells to the production department that they should produce more (Dilworth, 1992; Chase and Aquilano, 1998; Richard, 1988; Setsuo and Taiichi, 1986).

(ii) Kanban system: Kanban is a card that approves the movement of components from a supplying work center to the next work center. When a part is required, the work center carries the Kanban card to the supplying work center which then supports a batch of the item. The shelves and the storehouse are same as Supermarket but the main difference for the Kanban equipments or components is that there is no requirement for such a person named Spiderman. The system automatically rejoins to the changes made in the warehouse (Chase and Aquilano, 1998; Dilworth, 1992; Naufal et al., 2012; Richard, 1988; Setsuo and Taiichi, 1986).

4. FINDINGS AND DISCUSSIONS

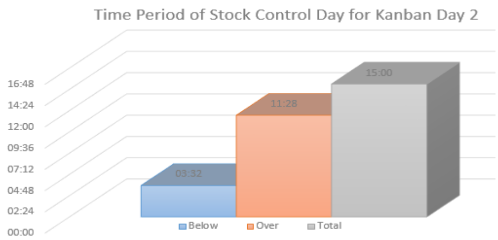
For the Kanban system, the ABC Auto Establishment (x firm) engineers have determined a minimum stock limit when making the firm's stock fluctuation calculations. The stock fluctuation for the first day of the simulation can be seen in the figure 1. X firm engineers are using a two or three days leveled Kanban system in which the produced amount is consumed.

Figure 1: Kanban System Stock Control



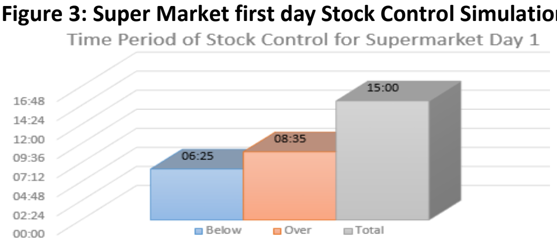
In this study, the calculations are made and solved about the Time Period of Stock Control, in which the time limits are calculated for the below the minimum stock and over the minimum stock times. It can be seen from the figure, the total time is 15 minutes and over the stock limit time is 10 minutes and 36 seconds in figure 1.

Figure 2: Kanban Second Day Stock Control



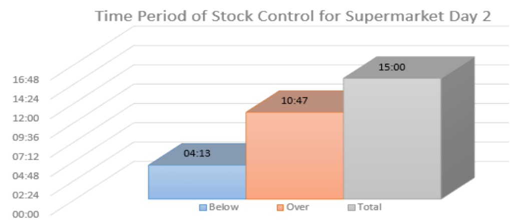
The second day's over/below ratio was calculated etwa as 4, the same ratio for the first day was approximately 3. The cause for such a big discrepancy is certainly the not-yet-used on-hand inventory that the system structure drives from day one to day two in figure 2. A faster production structure might be useful overwhelmed this weak point, by this faster production structure the below the minimum stock level time can be lowered.

Figure 3: Super Market first day Stock Control Simulation



The figure 3 represents that being below and above the stock limits have difference values. Each of them shows a time for one shift which is 8,5 hours.

Figure 4: Supermarket System second day stock Control



For the second day of Supermarket system, the time being below the limit is approximately one-third of the total production time of 15 hours in figure 4. After combining the total production data of the first and the second days,the variation from the minimum stock is not very much and this decreases the expenditure of holding inventory.

Figure 5: Supermarket System two days stock Control

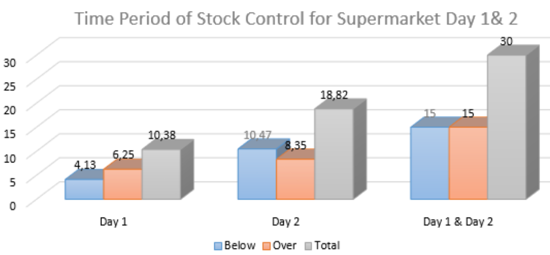


Figure 5 demonstrates that the time being below and above the minimum limits is approximately equal and totally the above times are a bit greater than the below times.

The Comparison of the Old System with the New System:

-Product variety is higher –Flexibility is higher – Lead time is much smaller because of the less production –Utilization of the Workcenters are higher –Utilization of the Employee are higher –If a change occurs in the part, the system is able to overcome that problem -Scrap rate is low. – Reliability of the Machines are higher - # of employee needed for production is less than before -Operations are done with computer-based rather than manual. -Area of the warehouse is much smaller because of the less manufacturing. -Utilization of the suppliers are higher

(1) The Evaluation of the Stock Fluctuations with Z test

We want to conclude that if a system works with smaller inventory level then it is a better system. The means of Kanban and Classical System was tested statistically in order to determine of the Kanban Stock level and Classical System differs from each other. Their variances were found and Z test was applied. Table 1 shows the results.

μ_1: The mean of stock limit in Kanban System

μ_2: The mean of stock limit in Classical System

H_o: $\mu_1 - \mu_2 = 0$ H_a: $\mu_1 - \mu_2 \neq 0$

S_1^2= The variance of Kanban System (4207.74)

S_2^2= The variance of Classical System (54069.583)

Table 1: The Z test Evaluation of Kanban and Classical System

Z test : Two Sample for Means		
	Kanban	Classical
Mean	91, 111	265, 24675
Known Variance	4207, 74	54069, 583
Observations	90	87
Hypotheszed Mean Difference	0	
Z	-6,290	
P (Z <= z) one tail	1, 59536E-10	
z Critical one-tail	1, 6448	
P (Z <= z) two tail	3,19E-10	
z Critical two-tail	1, 928561082	

As seen above the z value in table 2 is below the limit of -1,95 and this shows that the stock limit of Supermarket is below the limit of Classical System. The Supermarket system can be said to be better.

(2) The Z test Evaluation of Supermarket and Classical System

The z test of Supermarket and Classical System were also done to prove that Supermarket is better than the Classical System. The z test of Supermarket and Classical System were also applied to prove that Supermarket is better than the Classical System.

$\mu 1$: The mean of stock limit in Supermarket System

$\mu 2$: The mean of stock limit in Classical System

Ho: $\mu 1 - \mu 2 = 0$ Ha: $\mu 1 - \mu 2 \neq 0$

S_1^2= The variance of Supermarket System (493.61)

S_2^2= The variance of Classical System (3384.98)

Table 2: The Z test Evaluation of Supermarket and Classical System

Z test : Two Sample for Means		
	Supermarket	Classical
Mean	61. 1	159. 31034
Known Variance	493.61	3384.98
Observations	108	87
Hypotheszed Mean Difference	0	
Z	-1,893	
P (Z <= z) one tail	0	
z Critical one-tail	1, 6448	
P (Z <= z) two tail	0	
z Critical two-tail	1, 92996	

As seen above the z value in table 2 is below the limit of -1,95 and this shows that the stock limit of Supermarket is below the limit of Classical System. The Supermarket system can be said to be better.

5.CONCLUSION

Just In Time is considered as one of the best production planning and inventory control approach for today's management. The system was used by Japan Factories after Second World War and showed an increase in efficiency. The most important advantage of Jit system is to minimize the stock cost of the material (Maigaand Jacobs, 2009; Richard, 1988; Setsuo and Taiichi, 1986). The aim is reaching the zero stock level (but this can be seen as impossible in today's life). If you minimize the stock levels of each department the cost of each inventory level decreases because of the relations between departments.

JIT system is certainly applicable in Quality management and mostly in Total Quality Management. Some other quality systems began to apply JIT in their own factories. The JIT system provides a better environment for production. By this technique, the scrap rate, lead-time, and the inventory level decrease where efficiency and utilization of the workers and the machines increases (Dilworth, 1992; Kong et al., 2018; Iqbal et al., 2018).

As we approved above the classical systems were working with much inventory levels where the newly implemented systems are mostly with smaller levels. The distribution of the stock becomes more uneven as the time passes in classical systems where the Kanban and Supermarket Systems work with more evenly distributed inventory. This makes the calculations, forecasts, and cash flow more convenient to use. For the proof of the comparison results, we also used z test and the sum of deviations together. The z test proved that the new systems were better than the old systems and also we have found satisfactory results for the sum of squared deviations from the minimum stock.

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