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Performance Improvement by Implementation of Kanban in Service Sector

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Abstract: *In current competitive scenario, the lean concepts are like solution tools for the companies, facing difficulties in making profit. Waste elimination from the process is the main focus in the industry thus creating products to the end user with less investment. The Just in Time is a technique, focusing on providing a guide way to the industries to reach minimum inventory stage. A case study conducted in a temple, where waiting period of pilgrims are more on pilgrimage day. The sole effect of this paper is to identify the problems in the present darshan system and replace it with Temple - Pull - Kanban system. A kanban board is developed to schedule the darshan system in accordance with arrival of pilgrims. On arrival, pilgrims are grouped into batches of predesigned capacity. A token containing, identity number, his/her photo, date with expected time is provided for each pilgrim. The approach selected for analysis and representation of such system was the simulation with Arena software. The experimental results shows that the waiting period of pilgrim reduced tremendously by using temple pull kanban system.*

Keywords *- Kanban, Pull, Temple,Waiting period*

I. Introduction

The Just in Time (JIT) concept was discovered by Japanese industry and it was followed by western industries also. JIT manufacturing is a concept mainly focuses to reduce inventories involved in the manufacturing by providing right quantity of materials at right time in right condition.

The idea of eliminating of "waste", typical of lean thinking, is the key objective of present manufacturing industries or service sectors. The continuous flow with less inventory is an ideal situation: every operation is performed only if necessary and when required by the next station in order to avoid the over production and to minimize inventory. In order to assist this, the production system is no longer pushed by upstream station, but it is pulled by the end users and it gives signal backward from the downstream area, up to the first upstream station. Therefore it is talk about pull production, whose aim is to create a continuous flow, where each lot must pass from one station to the next one without waiting time. It is hardly possible to achieve a production system with continuous flow without inventory and therefore, according to principles of lean, it prefers to separate out each process.

The traditional manufacturing unit or service model is no longer suitable to the context in which service providers are gradually subjected to various competitive pressures. The philosophy of elimination of "waste", a typical lean thinking, is the main objective of creating a continuous process flow in service industry. The continuous flow is a perfect situation. Every single service station operation is performed only if necessary and if requested by the next service station in order to avoid the waste in terms of overproduction. In order to enable this, now a days, the production flow is no longer pushed by upstream station, but it is pulled by the customer and it proceeds backward from the downstream area, up to the first upstream station. Therefore one talks about pull production system, whose aim is to create a continuous flow without waste, where each lot must pass from one station to the next one without waiting time. It is not possible to achieve a continuous flow of production continuously and therefore, according to the lean principles, it prefers to separate out few processes with a service industry.

This study is about a new approach to reduce waiting period of pilgrims at Ganapati temple, Pakhalpur, an important pilgrimage center in India. This center is located at the bank of holy river chandrabhaga and is very near to Pandharpur, the largest pilgrimage centre in India. It is considered to be the abode of Lord Ganesha. This center attracts a large number of visitors from all over the country irrespective of their caste, religion, belief, social status and professional affiliation. The main objectives of any pilgrim are to take darshan of principal deity i.e. Lord Ganesha.

This temple is situated about 7 kilometres away from Pandharpur. Pakhalpur is a pilgrimage center where pilgrims visit all over year but mostly it is a periodical pilgrimage center. The pilgrims are coming in number of batches. As this temple is situated in a village, such a huge traffic generates tremendous stress on the temple management. Being tradition bound institute; certain modifications on procedure, layout is not acceptable. The visitors, exposed to modern society norms, who came to the temple, expect a better service quality, and

shorter waiting time. Thus, the challenge is to balance the tradition, operational efficiency and increasing pilgrim expectations.

It is the necessity to find new creative and innovative models which is able to manage changes. This need is the governing reason throughout the literature and also by media in the recent years. This new requirement of the service industries is the motivation point of this study, which aims to apply the basic of lean thinking for the upgrading of a service system which has as its first priority to meet customer requirements as fast as possible. The system studied is a single stage service System. It consists of a single service station, which serves different products with the same service. A kanban board is to be developed to collect and manage the products. These types of systems were studied through a specific and depth literature search. A simulation model is used for implementation purpose. The service system was simulated using the Arena 8.0 software. Considering the past case studies and the outputs from literature, many authors suggested that the way of applying Lean, is totally dependent on environment. [1, 2]

Removing waste is very important to provide higher quality service or product. Increase in efficiency with continuous improvement in production process is known as lean philosophy. [3, 4, 5] This objective can be achieved by determination of waste during manufacturing a product or service. [6]The waiting period of pilgrims was reduced by 7.5 hours using a software based on just in time system.[7] Lean philosophy was originated in Japan. It was adopted as an alternative for mass production and batching for increasing efficiency with higher quality and speed. Many researchers have studied Lean system numerously and continuous development was observed through literature. [8]

II. Problem Formulation

The First, In case of assembly line, the storage area between two stations holding products contained in strictly necessary quantity of raw material. The downstream station assembles only the requested amount by the end users and then it sends a request to the upstream station in the form of a kanban.

In case of service industries, the waiting period as well as waiting experience is matters more. The real reason why one is not prepared to wait too long is that the average assignments per week have increased. It can be concluded that customers are cautious about their time, waits seem more wasteful than ever. A particular service industry having more waiting period than expected from the customers, need improvement, as it is indication of poor quality of service.

No one likes to wait for long time. There are chances of leaving the queue, if waiting period is more than expected and this in turn results in pilgrims' dissatisfaction. The waiting period has major impact on pilgrims' satisfaction. The period pilgrims spending on waiting, has impact on his/her satisfaction. Researchers have demonstrated that satisfaction of pilgrims is affected not just by actual waiting time but also by their expectations for the waiting. As a result, one of the issues in management of queue is not only the actual amount of time the pilgrim has to wait, but also their perceptions of that wait also. The prime goal is to maximize the level of pilgrim satisfaction with the service provided in minimum time.

In the case considered, it is a temple. We can assume temple as a service station, where pilgrims visits regularly. They make a queue for darshan in the area provided by the temple management. Lastly by first in first serve method, they will take darshan. Now we can consider pilgrim as a job and darshan as a service so this can be treated as a service industry problem. The temple has a storage area between arrival and service stations for queuing pilgrims strictly with necessary quantity. Presently all the pilgrims joins the queue and by first in first serve law, the individual pilgrim takes darshan. It was observed that maximum waiting period was 30 minutes. All the pilgrims were standing for 30 minutes in the same queue.

The kanban is a technique of materials handling that allows the perfect synchronization between what is required from downstream station (i.e. an assembly line) and the production started upstream from the production system. The Japanese word kanban means, "visual record" and shows a card that accompanies the single container of materials or parts. The kanban is not essentially a physical card, as it can be either electronic or may be represented by the container itself. The temple managed by kanban is called Temple Pull Kanban, and it is the aim of this study. The kanban board consists of many columns as there are groups of pilgrims and each group is divided into 3 different columns like "To Do", "In Process", "Done" as shown in fig 1.

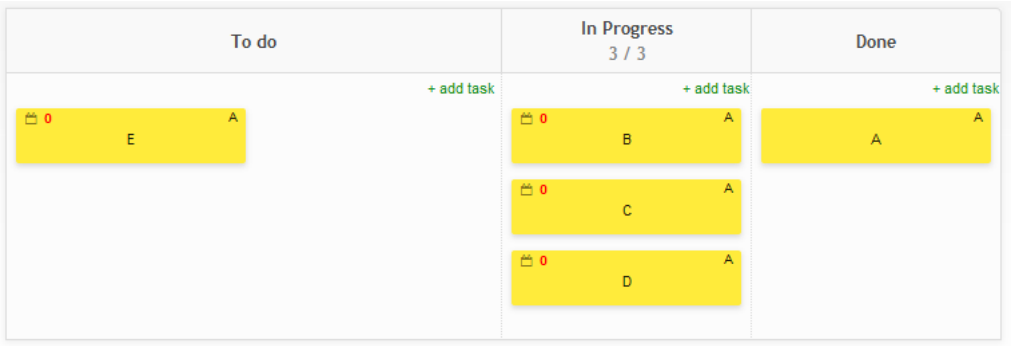

Fig -1 Kanban Board

This research paper focuses on optimal size of the kanban board to reduce waiting period of pilgrim.

III. Kanban System

The Kanban is a type of JIT technique, which was initiated to optimize inventory levels in the production cell and supply of raw materials. Graves et al. states that kanban is defined as a flow control mechanism in production line, which channelize the predesigned quantity and time of the manufacturing as well as delivery of required products or services. It is a special pull approach which gives consent to produce at a required rate, in order to optimize inventory of raw material and finished product according to forecast. It uses visual cards/ bins, which provide information to regulate the flow of inventory and materials. Kanban was introduced to accomplish specific needs of a company for inventory optimization. In precise, its aim is to introduce stability and predictability with less inventories, hence being responsive to market changes.

The application of kanban in manufacturing has acknowledged much consideration with many examples of accomplishment in improving productivity. JIT with Kanban system has beenwidely used in manufacturing as well as it has been expanded to other industries, such as software production, decision making processes and knowledge development. The literature reveals that there are major advantages to implementing the kanban system, including optimization of inventory holding; perfection of flow of material, elimination of overproduction and minimization of obsolete inventory.

Besides the effective operation of kanban systems, there are relatively few papers unfolding its variations. The production and market conditions may not be identical for all organizations. Therefore, some limitations have been reported such as it is not adequate in circumstances with unstable demand, great variety of items and long setup time.

IV. Research Methods

A case study approach was used in this research [10]. The data was gathered from the Ganapati temple situated at Pakhalpur in Maharashtra state, India to formulate research question. Most often researchers struggle to get access to the required industries and collect the useful information. However, they deal with the situation through a combination of good relationship, effective planning, patience and hard work. This particular investigation continued for 2 months during which system was observed neatly and data were collected through observations, and scheduled semi-structured interviews with key personnel related to the particular temple. These included trusty, managers, technicians and pilgrims as well. The aim of this study was to examine the current darshan process with the waiting period, categorise the typical waste movement associated with the pilgrims, as well as to realise the benefits from a pilot kanban implementation to reduce waiting period. Hence, as a direct result of this study, a kanban system for reducing the waste in the form of waiting period was recommended.

This study focuses on the waiting period of pilgrim and especially the way the pilgrims arrived. Few problems are noted during the procedure, causing delays and unpleasantness to the pilgrims. With a vision to overcoming these issues the authors, in conjunction with the temple committee, recommended the implementation of a kanban system. Specifically, this paper represents the definition and the outcomes of a pilot temple-pull-kanban system.

The following section describes the way a pilot case study of temple-pull-kanban system has been designed within a temple to reduce waiting period of pilgrims and how the temple management can benefit from its application. Consequently, the overall objective of the case study is to understand the wastage in terms of waiting period. Also this case study used to assess how innovative approach can reduce the waiting period and improve satisfaction of the pilgrims.

V. Case Study

Before applying this inventory control system, the queuing system and pilgrims holding area needs to be clarified. When pilgrims arrive to the temple, he/she join the present queue in the area provided by temple management. There is anxiety as how many pilgrims are ahead. There is also tremendous uncertainty as when one would reach in front of deity. Finally by First Come First Serve rule, pilgrims arrive in front of the deity. The actual darshan time is about 5 to 6 seconds. The darshan time of pilgrim in front of deity cannot be increased. The number of queues also cannot be increased as only one deity is present.

The function of kanban can be explained through a Single Stage Service System that is depicted in Fig. 1. In this system, production is first initiated by the demand at final stage (the final process). In such kanban operation a withdrawal kanban, which is attached to a loaded container in a successive operation, is detached from the same container, and put into the withdrawal kanban (WK) post when the first part from the same container is to be processed. The withdrawal kanbans in the post are then collected at a fixed interval and brought to the production kanban (PK) post at the preceding operation. The quantity of parts to be filled in a kanban bin, the succeeding and preceding workstations is already displayed on the kanban.

The withdrawal kanban is then attached to the kanban bin at preceding work station in place of the production ordering kanban, permitting the worker at the same preceding work station to produce the required amount of parts. It clearly indicates that the detached production ordering kanban initiates the production of preceding work station. When the containers are filled with parts together with withdrawal kanban are brought to succeeding work station for processing. This kanban runs in a cycle. It realizes a timely, smooth and waste less flow of jobs between preceding and succeeding work stations. There are K kanbans (equivalently containers) in Fig.1 and the kanban numbers are indicated with 1, 2, 3, ……,K. A kanban usually includes the information such as part number, part description, bin type, quantity per container, station location (from) and end station process (to). In production unit, kanbans have a general purpose, mainly it is not only an information transporter, but also a material transporter (or container). When it is mentioned in the supply chain system, a kanban is a physical or virtual card attached to a transporter.[8]

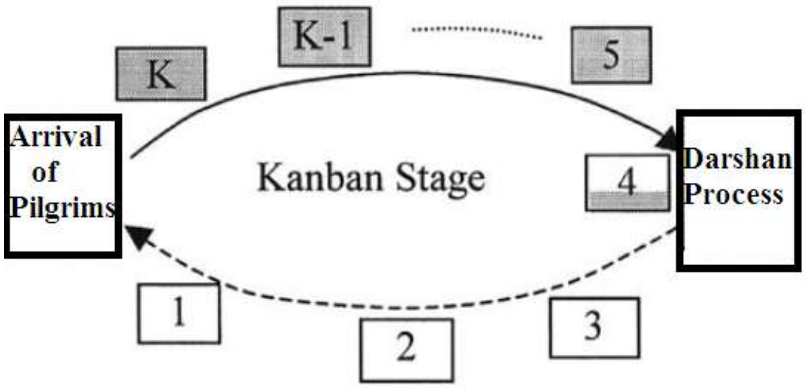

Fig 2 Temple Pull Kanban

Empty bins are indicated with clear rectangles (1, 2, 3) and the loaded bins are indicated with darker rectangles (5, K-1, K) while a partially emptied bin is indicated by partially marked rectangle (4) at darshan process where the incoming pilgrims from the downstream (arrival of pilgrims) 1 is being used. The level of raw material (Pilgrims in the queue for darshan) inventory is after arrival of Pilgrims and before darshan process and finished goods (Pilgrims who have taken darshan) are after darshan process. To deliver materials by using kanban tool, firstly, the number of batches in each stage should be calculated. Then, bearing in mind the delivering time and loading / unloading time, the numbers of kanban containers needed to ship, and the batches are calculated. Next, both the policy of arrival of pilgrims at initial stage and the policy of departure of pilgrims at final stage need to be decided. Finally, the operations of kanban in each stage should be scheduled.

It is worth mentioning that the kanban system is utilised in order to manage the waiting period of pilgrims. This tool includes several bins of the same size, which are assumed to be located in the consumption area. The kanban system helps to simplify queue control, by issuing neat service to the pilgrims and asking them to relax until the pull signal returns. In other words, when the temple manager notes that the darshan process for the batch in progress is over, in other words, the present kanban is empty, he receives a pull signal and then send the next kanban in the queue for processing. During this process, the remaining filled bins remain in the pilgrims holding area to cover the required replacement time.

The final formula for quantity of kanban cards is the following:

$$N = (T \times Q_1 \times Q_2) / Q_{max} \quad (1)$$

N = Quantity of virtual kanban needed.
T = Maximum service time.
Q_1 = Quantity of pilgrims served in one hour.
Q_2 = Quantity of pilgrims allocated in one service process.
Q_{max} = Maximum quantity of pilgrims that can be accumulated in one row (Kanban).

Taking real example for our case, where in one hour, maximum 600 pilgrims can be served. The average capacity of every row is approximately 25 pilgrims.

$N = (0.5 \times 600 \times 1) / 25 = 12$ (2)

N = 12 kanban cards needed for this system. It indicates that maximum 12 rows of 25 pilgrims can be used for the queuing purpose.

The experimentation starts at 9.00 am. The actual darshan process was already started from 6.00 am. At 9.00 am we found that there were 75 pilgrims in the queue. These pilgrims are asked to occupy the rows made in the temple premises for waiting. All these pilgrims occupies 2 rows (kanbans) of 25 pilgrims each and 25 pilgrims were in the queue within the temple As the signal from upstream came, one row was asked to continue for darshan. As the darshan process rate is 10 pilgrims per minutes, hereafter within 2.5 minutes it was expected that all the pilgrims in that row (virtual kanban) should take darshan. As all the pilgrims' darshan process were over, signal was send downstream and the next kanban was asked to join the darshan process.

As the next pilgrims arrived, the individual pilgrims were given tokens. This token consists of individual pilgrim's photo, identity number, kanban number and expected time for darshan. Then we have formed the groups (kanban) of 25 the arrived pilgrims asked them to relax in the given location in the provided area. Now the pilgrims know their expected darshan time, so the pilgrims are relaxed till the time at the given location. These pilgrims are just sitting in that position very comfortably, even few pilgrims were observed purchasing some material within the span of time and again joined the row before the time of darshan.

VI. Results And Discussion

The short experiment was started at 9.00 am. Arrived pilgrims were grouped into predefined kanbans. As per calculations number of kanbans is 12, so sitting arrangement of 25 pilgrims was made at 25 locations or rows. Only one row at a time was allowed for darshan. So the maximum waiting period of any pilgrim in the queue was 2.5 minutes. If we have not designed and implemented the Temple-Pull-Kanban system more than 25 pilgrims have to wait with standing position in the queue. It was observed from last experience that maximum waiting period was 30 minutes, now with this kanban system, they were relaxed for 27.5 minutes. The experiment has been continued till 6.00pm, arrival rate as well as darshan times were noted down neatly. The graph was plotted for waiting period minute wise as shown in fig. 3. The maximum waiting period in the queue through physical queue was observed through software as 30 minutes, but it got reduced to 2.5 minutes. It was observed the designed capacity of kanban was 12 kanban but maximum 10 kanbans were used in this experiment.

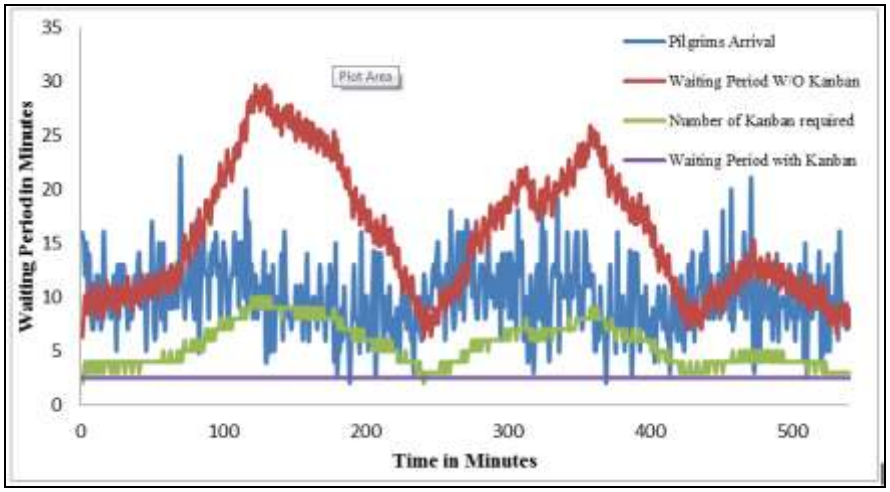

Fig 3 Waiting Period through Physical Queue and Kanban

VII. Conclusion

The case study is done on the pilgrimage day. By experience, on such pilgrimage days, the maximum waiting period of the pilgrims in physical queue was observed as 30 minutes. On the same day, by simulation maximum waiting period was obtained as 29.625 minutes and average waiting period was 15.8 minutes, whereas maximum waiting period gets reduced to 2.5 minutes by using Temple-Pull-Kanban system. It clearly indicates

that waiting period is reduced tremendously by using this system. Moreover the pilgrims had enjoyable darshan by this system as they were aware about the exact time of darshan, which was not possible for the pilgrims being in physical queue as uncertainty about the waiting period.

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