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A Study about Use of Kanban İn Production Logistics with Sample Application

Hülya Çağiran Kendirli, Mehmet Onur Ekal
Hitit University, FEAS, Department of Business, CORUM, TURKEY,
Master DegreeStudent, Hitit University, SSI, Business Department, CORUM, TURKEY
Corresponding author: Hülya Çağıran Kendirli

ABSTRACT: *In this study, the use of Kanban as a traction system in the procurement department of the supply chain will be analyzed and the inventory quantities, shipping speed and operational advantages of this system will be examined in detail.It will be examined how the method of kanban can be affected by facts such as production quantities, duration of supply, storage space capacity.The advantage and disadvantage of Kanban will be compared with pushing systems such as MRP and the application on sample raw materials provided with external procurement in the sample plant will be examined.*
KEYWORDS: *Logistics, Production, Kanban, Jit, Just in Time*

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I. INTRODUCTION

The term just-in-time (JIT), especially born in the Japanese automobile industry, refers to an advanced procurement system and stock management system. (Nebol, 2016, 86) A simpler, faster and more cost-effective logistics structure is aimed at the creation of systems to ensure that procurement, production, intermediate stock transportation, storage, and shipment are always on time. The idea of kanban, which we will examine in the study, is a sign that activates the 'just in time' structure in all the logistic steps we have mentioned. The Kanban system is an information system that controls the production or delivery of the required products at the required time. (Yuksel, 2009, 186). In this study, we will examine the advantages of kanban system over traditional propulsion systems and whether it is suitable for all production and delivery structures. The comparison with the propulsion systems was made with a sample application before/after comparisons.

II. LOGISTICS AND SUPPLY CHAIN

The definition of logistics according to the Council of Logistics Management, which is the association of all logistic services companies in the world, "Efficient and efficient movement of all kinds of products, service and information flow from the starting point to the end planning, implementation, transportation, storage and control of the service "(Borusan, 2018). The Supply Chain concept is the set of relationships and connections that move your product between suppliers, manufacturers, wholesalers, distributors, retailers and ultimately consumers. Looking at these definitions, we see that the supply chain is the information link between the structures that make up the chain and logistics is the physical structure that connects this chain.

2.1. Development of Logistics and Supply Chain Structures Over Time

At the beginning of the 20th century, with the transition from workshop-type production to mass production, products began to be produced one after the other in a fast-flowing manner on the production line. This method not only changed the mounting system but also improved the pre-assembly processes with the appropriate machines installed, to provide more efficient and sufficient semi-finished products to the assembly tapes when needed.

This development in production in the 1920s has become the most important example of spreading all over the world and especially in automotive production as a result of the combination of Ford and Sloan and its coordination with suppliers and a new distribution and marketing system.

2.2. Structures Needed by Changing Economic Structure

The mass application, which is an example to the whole world, has also been the focus of Japanese manufacturers, and this model of Ford has been taken by Japanese pioneers and taken to their countries for later development. (Liker &Hoseus, 2008, 53) TaiichiOhno, the founder of Toyota production system (TPS) and architect of lean manufacturing thinking, today's industry, such as the importance of lean, timely production, wastage, value flow, and customer demands. Combining the most important approaches, he brought a Japanese approach to mass production.

2.3. Kanban

Kanban, on the other hand, emerged as a sign language providing communication in Onho's lean philosophy. Kanban is a communication method for the production of the required product or semi-finished product or for shipping it from one place to another. (Yüksel, 2009, 186).

III. STOCK MANAGEMENT IN PRODUCTION FACILITIES

Inventory is the holding of goods owned by supply or production before being supplied according to customer demands. (Acar and Köseoğlu, 2016, 109) This holding process can be applied to ensure the continuity of production, to meet demand fluctuations, to meet excessive demand, and to reduce logistics costs. The size of these inventories constitutes the inventory cost of the entity. There is a cost of working with stock as well as the cost of working completely without stock. (Keskin, 2018, 101) The point that the enterprise should decide and manage is how much inventory it has to keep in order to provide optimum inventory cost. In this context, the benefit of the just-in-time production system to ensure the minimum inventory cost has been clearly demonstrated due to keeping stocks at the optimum level.

3.1. The Use of Modern Logistics Methods in Production Enterprises

There are two different methods that can be divided into two classes, traditionally and modernly, used in internal logistics between raw material external procurement and production processes in production enterprises. The push method is the traditional method, the pull system as the modern or innovative methods are the methods in which the enterprises can choose in the logistics area.

3.2. Using ERP in Manufacturing

ERP (Enterprise Resource Planning), Enterprise resource planning is the information processing systems used by the enterprise to ensure the best efficiency and supply of goods and services. MRP (Material Requirement Planning), which is a part of this system, is used by the enterprises to ensure that the material required for production is located in the relevant part when needed. Although this is the purpose of this system, it turns out that this system is insufficient and there are points to be supported for the minimum stock target due to different customer demands and different production methods.

IV. COMPARISON OF CLASSICAL AND MODERN METHODS

4.1. Push Method

It is based on the method of supplying the raw material to be supplied or the semi-product to be produced in in-production processes in a pre-prepared program, or producing it in a program and transmitting it to the next process. In this method, the need works within a pre-prepared program, and the next need is not important. What is important is the wishes of the program prepared before the production starts.

4.2. Differences According to Kanban and Push Methods

The material to be processed in the kanban is in the drawing process, is demanded from the previous process/storage as much as needed and at the time of need. In this way, the required material is prevented from being over or over, and it is not shipped at a time when it is not needed.

If we make a comparison in the light of this information;

In the Push System;

•Supply and production are shaped according to a demand forecast.

•Fluctuations in demand can lead to excessive stock or idle stock.

•Safety stocks should be created against possible faults.

In the Kanban System;

•Supply and production are shaped according to current demand.

•Fluctuations in demand are compensated by the previous operation.

•Safety stocks are not required since precautionary measures are taken.

V. SAMPLE APPLICATION

5.1. Introducing the Sample Application Business

The enterprise is a manufacturer of kitchen utensils in Merzifon Organized Industrial Zone. The company produces semi-finished products and assemblies and produces one million two hundred and fifty thousand hoods and aspirators per year. SAP software is used in raw material procurement, storage, semi-finished production processes, assembly production, finished product storage, logistics, finance and operations of the enterprise.

5.2. Introducing the Material Selected for Sample Application

The sample selected material is the packaging material used in each product produced but due to the difference in size and customer variety of products. A material, which is supplied by the enterprise as raw

material, is stocked in the warehouse for a certain period after the purchase in the current operation and some inventory is left in the inventory after the production is completed. Kanban system will be applied to the sample group selected material is produced in the local supplier of the enterprise. This material, which can be defined as a parcel in general, is shipped to the company with its own vehicles. Each pallet has 200 packaging materials.

5.3. Application Method

As an example, we will evaluate this study in order to reveal the differences between the current functioning of the selected material and its management with kanban.

1. Storage cost: We will interpret this cost as the number of pallets required to store the material. We will examine how it changes according to the push and pull systems.
2. Material stock cost: We will interpret the total monetary amount of instant material in stock. We will examine how this amount changes according to the push and pull systems.

5.4. Kanban Working

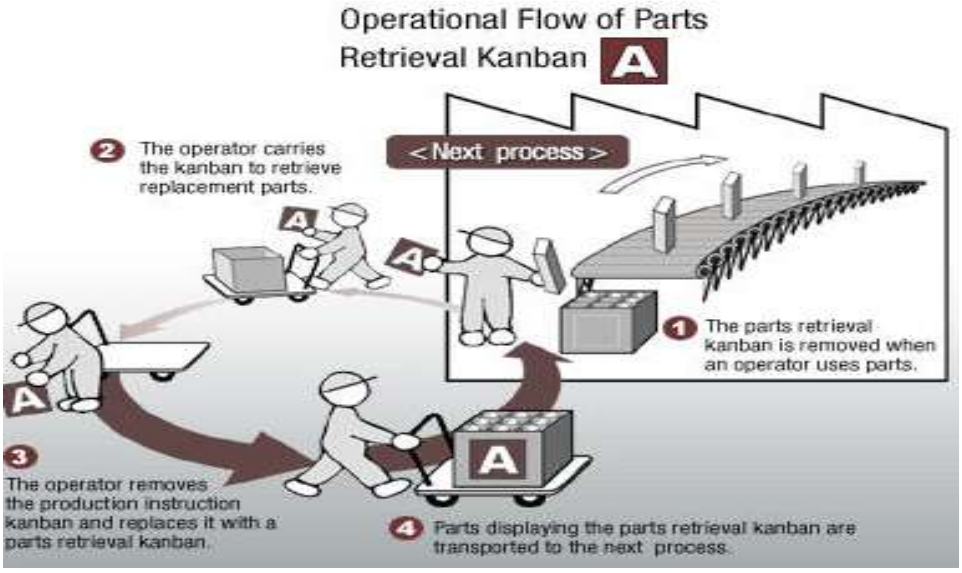
The amount of material needed in the propulsion system and the time to be shipped are calculated by the MRP (material requirements planning) system before production using order and long-term forecasts. Entries in this calculation; orders, long-term forecasts, lot size, lead time, and safety stock data. In the withdrawal system, communication (in shipment requests) is made with a card in this method called supplier (vendor) kanban (Figure 1). This card contains information such as the name of the supplier (seller), the material code/name to be requested, the quantity, the amount of material inside the box.

Figure 1: Sample of Kanban Card

Part Description				Part Number	
Smoke-shifter, left handed.				14613	
Qty	20	Lead Time	1 week	Order Date	9/3
Supplier	Acme Smoke-Shifter, LLC			Due Date	9/10
Planner	John R.		Card 1 of 2		
			Location	Rack 1B3	

The kanban card on the material taken into production is carried by the distribution officers against the flow direction of the material. In this way, the information goes to the supplier at the beginning of the chain. The supplier who receives this information starts production again (or the material in stock) as shown at Figure 2.

Figure 2: Kanban Working



The aim here is to reach the point of consumption only when the material is needed. In other words, it is not to create an extra stock that production does not need.**Kanban Calculations**

The amount of material to be requested for shipment by kanban or the production to be requested is expressed by the number of kanban cards. The following four basic variables are used in this calculation. (Yüksel, 2009, 197)

• Average number of daily needs (GOI)
• Lead time (production time in production kanban) (IS)
• Safety stock (GS)
• Standard box capacity (SKK)

The following formula calculates the amount of cards that should beavailablewhen starting kanban.

Number of Kanban Cards: [GOI*IS*(1+%GS)]/ SKK

5.5. Comparison of Application Results with Current Status

At present, material requirement planning is done with MRP, and the quantities to be requested fifteen days in advance, which is the supply period of the material for the plan horizon in which orders and projections take place, are transferred to the supplier as purchase order. From now on, orders are fixed and closed for revision. As there is no chance of interfering with the material and the materials that are required to be produced as a result of the changes in the production plan, it causes disruptions in the production plan and excessive stock that cannot be consumed in a short time. If there is no change in the production plan, there is no difference between push and pull methods. However, as a result of a change to be made in the production plan, over-stock is created due to the fact that the material supplied cannot be consumed in time. For this study, let us consider the following production plan example. (Table 2)

Table 1: Sample Production Plan Table

	1. Day	2. Day	3. Gün	4. Day	5. Day	6. Day	7. Day	8. Day	9. Day	10. Day	11. Day	12. Day	13. Day	14. Day	15. Day	16. Day
Order1	400	800	700	500	400	500	750	400	650	600	400	750	400	600	200	0
Consumption 1	400	800	700	500	400	500	750	400	650	600	400	750	400	600	200	0
Remaining1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2: Sample Production Plan Table 2

	1. Day	2. Day	3. Day	4. Day	5. Day	6. Day	7. Day	8. Day	9. Day	10. Day	11. Day	12. Day	13. Day	14. Day	15. Day	16. Day
Order 2	400	800	700	500	400	500	750	400	650	600	400	750	400	600	200	0
Consumption 2		400	800	700	500	400	500	750	400	650	600	400	750	400	600	200
Remaining 2	400	800	700	500	400	500	750	400	650	600	400	750	400	600	200	0

This table shows the daily necessity of the sample material. In case the daily production amount is the same as the production plan, the material remaining in stock at the end of each shift is ‘0.. If the consumption is delayed by 1 day (Table 2), it is seen that the amount of stock remaining at the end of the shift increases. In this case, it is seen that an average of 500 stocks are formed at the end of the shift.

Comparison of both cases on the graphics Figure 3 and Figure 4.

Figure 3. Stock Amount in Case of Full Implementation of the Plan

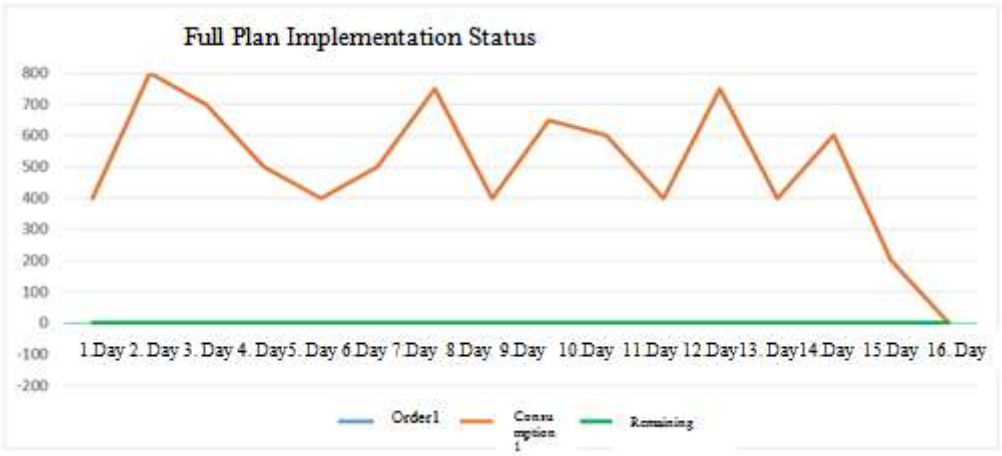
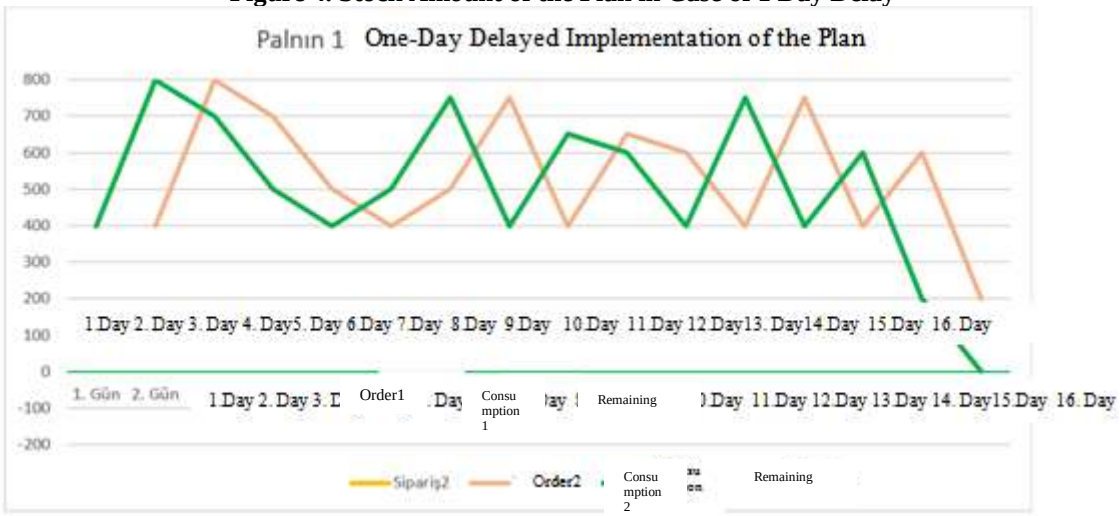


Figure 4. Stock Amount of the Plan in Case of 1 Day Delay



5.6. Comparison of kanban with existing methods.

Although the previously prepared production plan has been prepared for realization on time, this is not always possible under real production conditions. The most important reasons are:

• Problems in raw material supply.
• Delays in the production of semi-finished products.
• Performance losses
• Urgent order production

In order to prevent the stock increase experienced in the case of delayed realization of the plan in the previous section, the following data were obtained at the end of the application with the kanban method which was commissioned.

Calculation of the amount of Kanban card:

Average production per day: 537
Lead time: 1 Day
Quantity of pallet: 200
Safety stock: 33%

In the calculation of the safety stop, the deviation of the average production amount according to the planned maximum daily amount was taken into consideration.

Number of Kanban Cards: [GOI*IS*(1+%GS)]/ SKK

Number of Kanban cards = 537*1*(1+0,20)/200
= 3,56palette. It is designated as 4pallet.

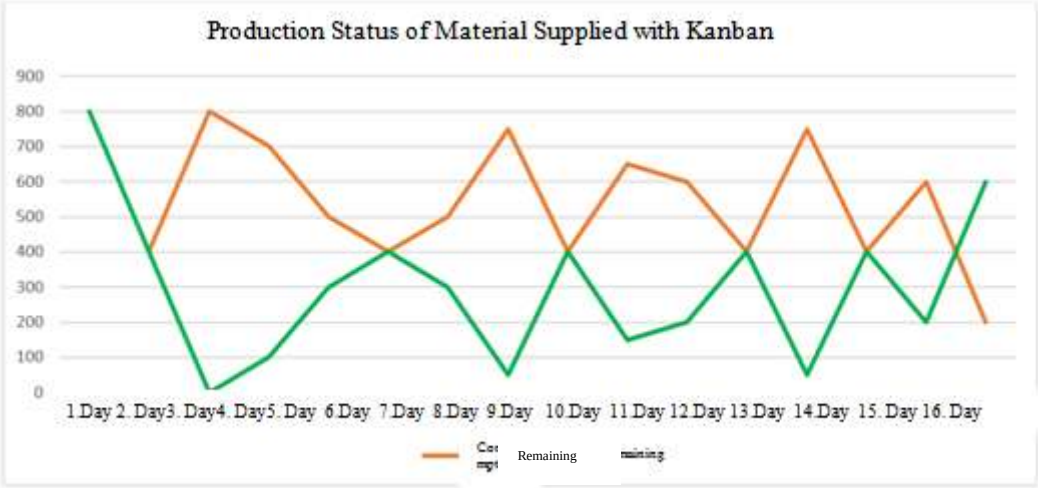
Our sample production table which is planned according to 4 kanbans is formed as follows. (Table 4).

Table 4. Sample Production Plan Table 3

	1. Day	2. Day	3. Day	4. Day	5. Day	6. Day	7. Day	8. Day	9. Day	10. Day	11. Day	12. Day	13. Day	14. Day	15. Day	16. Day
Order	400	800	700	500	400	500	750	400	650	600	400	750	400	600	200	0
Kanban	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
Remaining	400	0	100	300	400	300	50	400	150	200	400	50	400	200	600	

In this case, the status of the stocks remaining at the end of the shift is indicated on the chart (Figure 5).

Figure 5. Production Status of Material Supplied with Kanban



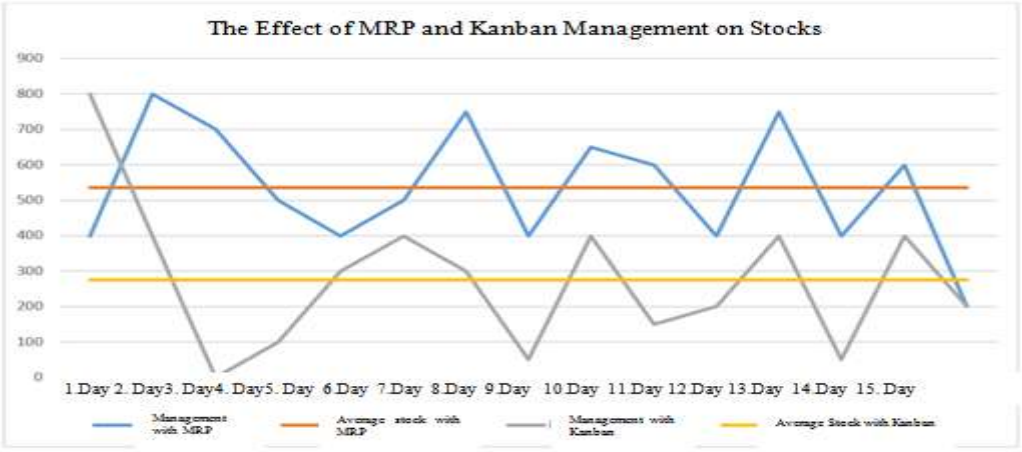
In this study, which I did with real data, the ideal situation was studied with two different scenarios. Consumption of the ordered material from stocking is realized in the form of ideal management. In this method, there is no material left in stock at the end of the shift.

In the first scenario, orders are ordered by the company's MRP software, but production takes place one day late for the reasons described earlier. In this case, at the end of the shift, the material to be consumed one day later had to wait in the stocks.

In the second scenario, with the kanban independent of the production plan, the material withdrawn from the supplier was consumed with the girl, thus avoiding excess stock. In this scenario, the remaining amount of stock is included in the formula as the safety stock when the kanban card calculation is performed. Therefore, we can comment that the remaining stock is a controlled stock.

The graph shows the amount of material that will remain in stock at the end of the shift as a result of managing inventories with MRP and Kanban (Figure 6).

Figure 6. MRP and Kanban Stock Comparison



The gains obtained at the end of the study are indicated in the table. (Table 5)

Table 5: Post-work earnings

	Average daily stock	Average amount of pallets in stock
Procurement with Push Management	536	3
Procurement with Kanban	276	2
Improvement	49%	33%

If we interpret the table; Due to the high number of materials available on the pallet, 49% improvement is achieved in terms of quantity (cost of material) and 33% in terms of the number of pallets. We can evaluate this gain as a warehouse cost.

VI. RESULTS AND RECOMMENDATIONS

According to the material and production plan we have taken as an example, the profit obtained in the scenarios we determined was met both in the amount of stock and warehouse usage by meeting our project target. Improvements to be made during the studies carried out within the scope of the project and limitations related to kanban were also revealed.

Although Kanban is mainly used to compensate for fluctuations in demand, the fluctuations in demand horizon lead to incomplete stockpile if it is above the forecast. This necessitates the calculation of kanban quantity calculations for short periods by evaluating both actual production quantities and order and long-term forecasts together.

As another constraint, the increase in the supply (or production) time makes the advantage of the stock provided to the disadvantage. Keeping supply time to a minimum is an important requirement to keep the advantages to be maximized.

Along with these constraints, some improvement points can be applied for more efficient use of kanban and to eliminate the constraints encountered. As an improvement technique within the scope of lean production, heijunka can be used to produce the products frequently in small batches instead of large batches in order to eliminate the fluctuations of the production plan. In this way, we will be able to minimize the safety stock ratio used in kanban calculations.

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