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Implementation of E-Kanban System Design in Inventory Management

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Abstract- Inventory management is used to make decisions regarding the appropriate level of inventory. In practice, all inventories cannot be controlled with equal attention. In this paper the inventory level is decided based on part demand, cost, and supplier location, Share of business and status of receipt. Using ABC analysis the various parts are classified into A, B and C based on its cost. A suitable bin with its rack has to be selected based on the size of the part. Stores layout is designed based on the ABC classification, Bin selection and rack design with the available space constraint. The existing kanban system has to be modified into supplier e-kanban system by which the speed of information sharing between suppliers will be improved.

Index Terms- Inventory Management, Kanban system, Bar code, Supplier Reliability, Production.

I. INTRODUCTION

Inventory or stock refers to the goods and materials that a business holds for the ultimate purpose of resale (or repair) [1]. Inventory management is a science primarily about specifying the shape and percentage of stocked goods. It is required at different locations within a facility or within many locations of a supply network to precede the regular and planned course of production and stock of materials.

Inventory management involves a retailer seeking to acquire and maintain a proper merchandise assortment while ordering, shipping, handling, and related costs are kept in check. It also involves systems and processes that identify inventory requirements, set targets, provide replenishment techniques, report actual and projected inventory status and handle all functions related to the tracking and management of material. It includes ABC analysis, lot tracking, cycle counting support, etc. The ABC Analysis is a business term used to define an inventory categorization technique often used in materials management. The ABC analysis suggests that inventories of an organization are not of equal value [2]. Thus, the inventory is grouped into three categories (A, B, and C) in order of their estimated importance.

II. STORE AND STORE LAYOUT

Stores are an essential component of any supply chain. Their major roles includes buffering the material flow along the supply chain to accommodate variability caused by factors such as product seasonality and/or batching in production and transportation; consolidation of products from various suppliers for combined delivery to customers; and value-added-processing such as kitting, pricing, labelling, and product customization. Stores include Store Area, Store facilities, and Store location. Stores layout is very important because it is having direct impact on material handling time and material transport cost and time requirement for issue of material and thus directly on production cost. Store should be located as to reduce the cost in terms of money, labour and time. To do the particular storage Bins are used. Bin is defined as a finest physical location or bay/bucket where stock is stored. It is a container or space where goods are kept.

III. KANBAN SYSTEM

Kanban is a signal for demand of specific product, in specific quantities, to be delivered to a specific process. Kanban is a critical element of the pull system. Each Kanban is sized differently to meet the replenishment requirements, and capabilities, of the upstream suppliers so that the downstream customer will always have adequate supply, and can meet fluctuating customer demand.

Kanban is a card with an inventory number that's attached to a part. Right before the part is installed; the Kanban card is detached and sent up the supply chain as a request for another part. A part is only manufactured (or ordered) if there is a kanban card for it. When the bin on the factory floor becomes empty, i.e., there is demand for parts, the empty bin and kanban cards are returned to the factory store. The factory store then replaces the bin on the factory floor with a full bin, which also contains a kanban card. The store then contacts the supplier's store and returns the now-empty bin with its kanban card. The supplier's inbound product bin with its kanban card is then delivered into the factory store completing the final step to the system. Thus the process will never run out of product and could be described as a loop, providing the exact amount required, with only one spare so there will never be an oversupply. This 'spare' bin allows for the uncertainty in supply, use and transport that are inherent in the system. The secret to a good kanban system is to calculate how many kanban cards are required for each product. Most factories using kanban use the coloured board system this consists of a board created especially for holding the kanban cards. Kanban cards are a key component of kanban that utilizes cards to signal the need to move materials within a manufacturing or production facility or move materials from an outside supplier to the production facility. The model of kanban material identification tag is shown in the table.1.

TABLE 1 KANBAN CARD

Material identification tag	
Supplier	
Part number/Code number	
Description/Specification	
Received Qty/ Weight	
Challan number	
Container number	

IV. E-KANBAN SYSTEM

Instead of using a manual system (either fax or e-mail), an electronic signal sent to the supplier. There is no physical card. E-mail or other electronic notification is automatically generated and send to the supplier; the signal would specify the number of parts to be needed. The quantity will be based on the usage, which is usually tracked using a bar-coding system. Usually requires implementation of a custom system or customization of a standard ERP system [3]. It works well that need to manage many part numbers. The ideal Kanban system is an E-Kanban system. An electronic signal is used to indicate that a Kanban representing a specific quantity of parts has just been drawn or consumed. The signal goes directly to the upstream supplier, internal or external, where a new order is automatically processed for a replacement of the same item in the desired quantity, to be delivered within an agreed upon time span.

Electronic Kanban (sometimes referred to as e-Kanban) is a signalling system that uses a mix of technology to trigger the movement of materials within a manufacturing or production facility. Electronic Kanban differs from traditional Kanban in that it uses technology to replace traditional elements such as Kanban cards with barcodes and electronic messages [4]. A typical electronic Kanban system will see inventory marked with barcodes which are scanned at various stages of the manufacturing process to signal usage, messages are then relayed to internal/external stores to ensure restocking of products. E-Kanban systems can be integrated into enterprise resource planning (ERP) systems. Integrating E-Kanban systems into ERP systems allows for real-time demand signalling across the supply chain and improved visibility. Data pulled from E-Kanban systems [5] can be used to optimize inventory levels by better tracking supplier lead and replenishment times eliminates lost cards. Figure 1 represents that various activities involved in the inventory management system.

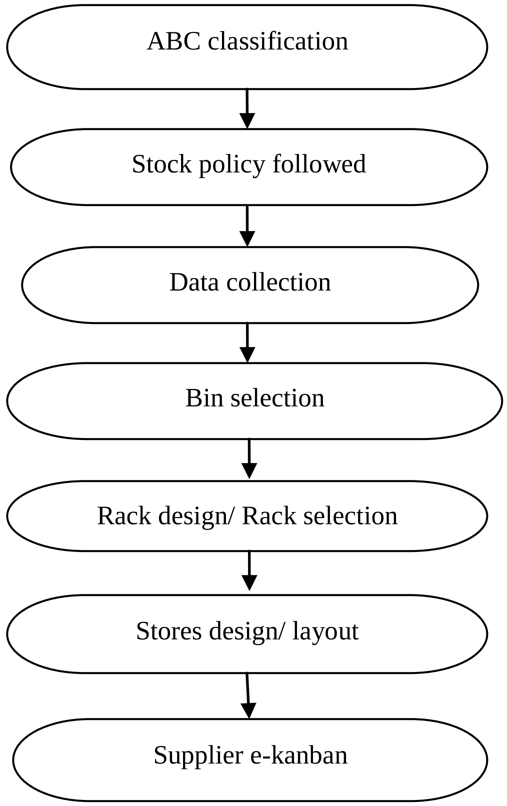

Fig.1 Inventory Management activities

A. Daily quantity of child part

Daily quantity of the Customer is taken as primary consideration.

B. Supplier location

It shows the location of the supplier (i.e. local, other State and International).There are plenty of suppliers and are categorized into three types:

Local – those who are located in and around the Company, *Other States* – the suppliers located outside, *International.*

C. Supplier Location

Supplier location denotes the distance of the supplier from the company.

D. Supplier Reliability

Reliability is simply defined as the ability of a company to consistently supply an acceptable product at the required time.

E. Internal production lot size

The number of parts created during the use of a particular tooling setup.

V. BAR WIDTH CONFIGURATION TABLE

The table 2 shows the bar configuration for each character in the Code 39 set. Note that the * character is used only for the start/stop character. It must be the first and last character appearing in the complete barcode. Decoders do not usually transmit this character as part of the data string.

TABLE 2.BAR WIDTH CONFIGURATION

Char.	Pattern	Bars	Spaces	Char.	Pattern	Bars	Spaces
1		10001	0100	M		11000	0001
2		01001	0100	N		00101	0001
3		11000	0100	O		10100	0001
4		00101	0100	P		01100	0001
5		10100	0100	Q		00011	0001
6		01100	0100	R		10010	0001
7		00011	0100	S		01010	0001
8		10010	0100	T		00110	0001
9		01010	0100	U		10001	1000
0		00110	0100	V		01001	1000
A		10001	0010	W		11000	1000
B		01001	0010	X		00101	1000
C		11000	0010	Y		10100	1000
D		00101	0010	Z		01100	1000
E		10100	0010	-		00011	1000
F		01100	0010	.		10010	1000
G		00011	0010	Space		01010	1000
H		10010	0010	*		00110	1000
I		01010	0010	$		00000	1110
J		00110	0010	/		00000	1101
K		10001	0001	+		00000	1011
L		01001	0001	%		00000	0111

Bin Type and Number of Bin Calculation formula

$$N = \sum_{n=1}^{\infty} B_n \qquad \text{---------} \quad 1$$

Where,

$$\sum_{n}^{\infty} = \mathbf{B_1+B_2+B_3+\dots\dots\dots\dots\dots+B_{n=1}} \qquad \text{---------} \quad 2$$

N= Total number of bin type.
B=bin
n =1 to α

Number of bin required,

$$B_n = \frac{N_d * D_q}{B_q} \qquad \text{---------} \quad 3$$

Where,
$\mathbf{B_n}$=Number of bin
$\mathbf{N_d}$=Number of days in store
$\mathbf{D_q}$=Daily quantity
$\mathbf{B_q}$=Quantity per bin

VI. APPLICATION OF E-KANBAN SYSTEM

Electronic kanban systems or closely related kanban type systems have been developed during recent years. However, the scientific reports and descriptions of electronic kanban system or their implementation are rare.

Several articles describe the advantages of electronic signals over the cards [7]. Some articles notice that electronic kanbans are in use to some extent, but they do not include more detailed information of the principles and practices utilized. [9][10] Motor vehicle manufacturers have been the first companies reported to have electronic kanban systems in place. Rover used as early as 1986 an EDI based signalling system used to pull materials from the suppliers. General Motors was reported in 1990 to have bar-code based pull production system. [10] Toyota studied the possibilities of replacing the card based kanban with an electronic system in 1999. Toyota had a working interned based kanban solution in their factories in France and England in the year 2000 to pull materials from suppliers. [6] The suppliers attach a bar-code to each delivered container, which is used for batch identification. After the material is used the bar-code is removed from the container. However, the practice described above has some push control features. The orders or pull signals are sent based on the production schedule, not the realized production or system status. Ford has implemented a simple bar-code based pull production system called SMART. BMW is reported to have an electronic kanban system in place. ERP vendors such as SAP have included kanban functionality in their products. The SAP solution utilizes RFID tags attached to containers to automate batch identification and location tracking. The manufacturing decisions can be made based on accurate information of production batch status. Most of the electronic kanban systems described use RFID-codes or bar-codes in production batch identification. Bar-codes are applied more often to manage material flow between companies, because the containers are used for different batches. RFID tags are more applicable in inter-company situations because the same containers are used many times. The earlier mentioned Toyota example is limited only to pull the materials from the suppliers. Toyota still uses card-based kanbans in its own manufacturing operations [12].

VII. E-KANBAN BENEFITS

i. Reduces manual card handling and order-entry activities.
ii. Clarifies communication with suppliers.
iii. Enables real-time visibility of demand signals.
iv. Speeds analysis of supplier performance.
v. Allows efficient analysis and adjustment of Kanban quantities.
vi. An electronic kanban system has many advantages over the traditional kanban system. It is as simple as the traditional kanban, but signals are transferred faster.

VIII. CONCLUSION

The study suggests that the most of the original Kanban ideas should be followed while planning an electronic kanban system. However an electronic kanban system gives possibilities to solve some of the limitations of existing kanban system, like the model mix change management and failure recovery. The support for continuous improvement should be built into system to achieve the effectiveness of original kanban ideas. This suggests that the process is more effective and efficient tool to be used for developing factory floor information systems. The context of use, number of systems user and the systems tight integration into factory operations management necessitates careful and multidisciplinary planning process.

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