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Introducing Vertical Storage System for Managing Space and Increasing Production Rate

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ABSTRACT: The Atlas Copco Company is a Sweden corporation and has its unit plant in Nashik. The assemblage of the trucks and drills is done in the company. These trucks are water well rigs practiced for drilling the water wells. The height of towers of each truck is approximately 40ft. Besides therefore throughout the assembly, these towers inhabit maximum of the space. The parts essential for the assembly is deposited on the shopfloor along the floor. This has constrained the manufacturing rate to one machine assembly at a time in one month

For overcoming this issue, vertical storage system was brought into the picture. Along with its introduction, the Kanban system also needed redesigning and material sorting is done in this research work. Initially the space available for working was 35%, by introducing this machine, the space available for working now is 71%. This has helped the company to increase its sales three times and also reduce the number of labours.

KEYWORDS: Assembly, Carousal System, DB40K, KardexShuttle System, TH10.

I. INTRODUCTION

Atlas Copco Building and Mining Procedure advances productions and marketplaces tools used for the mining and construction businesses as well as breaking down constructions, water well drilling, oil and gas production, examination drilling and earth engineering

Water wells generally have a bigger diameter, closed and airtight surface area, also a well bore that is drilled. Basically, their depths are 70-250 m and diameters of 4.5” to 6.5”. For the companies that manufacture these rigs require better presentation, dependability along with presence of proper service and support. The maintenance of these rigs plays a very important role in order to get good results, as shown in figure 1 the construction of the water well rigs can be represented and understood.



Fig. 1 Image showing Maintenance of Drill.

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The present investigation follows the process of Kanban with the help of new machine known as Kardex. The deep study of the machines and the technique used is given in this project. The working position TH10 is represented in the figures 2. With the help of this new machine, the sales of the company have gone up three times per month and the cost of workers also reduced from 76% to 24%. The details of the sales can be seen in the results provided in the project.



Fig. 2 Image Showing TH10 Working Position

Figure 3 shows the image of working position of Diamond back 40k. These machine are basically used in the areas affected by draughts which can be helped by drilling the water wells. Many times they are also used for extracting the natural gas and crude oil from the interior of the earth.



Fig. 3 Image Showing Diamond Back 40K Working

II. RELATED WORK

Wenrong Lu et al in [1] introduced an interfering steering algorithm for enhancing active command selection. The algorithm repeats the calculation of the ideal methods all through the selection process. The algorithm exists verified by means of simulations created on an industrial case example. Advantages were provided over mutually motionless and experimental active selection algorithms.

Marco Bortolini et al in [2] proposed a non-conventional simple in usage formation for unit load (UL) warehouses, by the purpose of refining the treatment routine by means of the journeyed space. The influence of the acceptance of one otherwise additional inline diagonal cross-lanes inside a customary warehouse is examined below solo order processes.

F. Guerriero et al in [3] worked on one of the maximum substantial actions in *warehouse management* apprehensions the distribution of materials to the loading locations. This issue is identified in the works as the *Product Allocation Problem* (PAP). It mostly targets to enhance mutually the warehouse area consumption plus the materials treatment

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expenses (minimum 40% of the entire logistics rate). They also stated the PAP in a several layer warehouse, through adjustments restraints amongst the material standard.

H.Y. Lam et al in [4] studied and presented an innovative background to enable the assessment practice in the warehouse also dynamically observes plus improves the logistics stream by means of hybrid procedures. The technique of recommending a technique which remains measured appropriate on behalf of warehouse threat calculation and study manufactured goods features and place order as per requirement in logistics approach construction. The exhibition of the effectiveness of organization by leading an experimental course in a 3PL firm is done.

Paul J, et al in [5] explained that industrialized placement on the Internet Of Things (IOT) delivers growth of a perfect stage for regionalized administration of warehouses. In this research, they have projected an IOT organization for cooperative warehouse demand satisfaction depending on RFID, ambient aptitude along with the systems having more than one agent.

Jennifer A. et al in [6] introduced a technique in which warehouse reshuffling is a restructuring approach that contains of relocation substances by stirring them consecutively. This training examines the techniques of enhancing warehouse reshuffling plus counts the consequence of mutual conventions. A scientific program design construction for the overall warehouse reshuffling issue, the difficulty of the issue, numerous heuristics dependent on the issue type, an official evidence delimitating example wherever both handed can be a creative transfer, plus administrative visions on the presentation of reorganizing strategies in several situations are offered.

Whereas Jiun-Yan Shiau and Ming-Chang Lee in [7] mentioned that the parting of gathering plus stuffing method of a warehouse administration system frequently conveys additional storing barriers plus comparatively lengthier functioning period. This paper grows a fusion system to produce a gathering order for joining gathering and stuffing actions.

Bhaba R. Sarker and P.Sobhan Babu in [8] expressed their views as, a short-lived, acute evaluation besides a proportional training of certain strategy features of computerized storing/recovery schemes with distinct importance on *travel time models*. These features comprise refining *material rate*, altering *recovery ordering guidelines*, with *demand batching algorithms*, smearing numerous *reside point approaches* plus growing the *storage/retrieval mechanism capability*.

Ming K. Lim et al in [9] mentioned the examination of in what way RFID expertise has had an impression in warehousing, a complete investigation of study results offered since articles over important technical article records has been piloted. Articles from years 1995 to 2010 have been studied then examined in comparison to warehouse actions, RFID submission domains, aids accomplished and difficulties came across.

Alejandro Maté et al in [10] proposed an addition of the summary for DWs bearing in mind the modularization of aims. It offers a set of strategies permitted to appropriately relate this offer. In addition, they have accomplished an investigation for the evaluation of the strength their offer. The profit of this research is intensifying in the modularity as well as measurability of the prototypes, those, consecutively, raises the mistake alteration ability, and then creates intricate prototypes calmer to comprehend by DW designers also unskilled operators.

III. PROPOSED METHODOLOGY AND DISCUSSION

Once the Kardex machine specifications were studied and introduced to the company, the main hurdle of space management was overcome and at one time the company was able to increase their production from one machine per month to three machines per month. Along with this, there were other factors also required to be studied for the production is increased the material requirement also needed to be considered. The number of trays required to be necessary to be calculated depending on the material required along with its new Kanban system was designed. Figure 4 represents the outline of kardex machine and the trays piled up on each other. The opening of the machine can be seen at the bottom where a standing figure can be seen.

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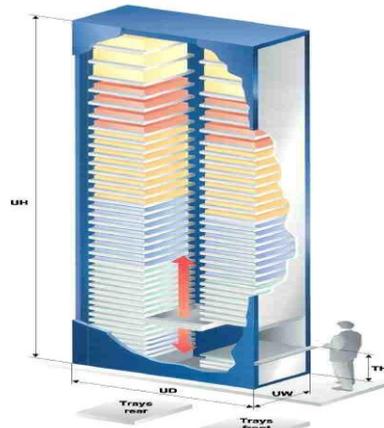


Fig. 4 Concept of Kardex Shuttle System.

3.1 Material Sorting

The parts and units required for manufacturing of the machines TH10 and DB40K were around 1500 each. All the parts were studied in deep to understand its nature. These parts after studying deeply were divided according to the size, dimensions, cost, sturdiness, frequency of using during the manufacturing of machines and cost. Every single part has a different nature and different behavioral properties. Total there were 3500 parts to be sorted out. There were four divisions made which were Kardex, yard, rack and paint shop in which these parts were distributed. Figure 5 represents the bins arrangements and utilization of the floor space and as it can be seen, the entire shopfloor space is consumed only for storing the material.



Fig. 5 Image Showing the Bins Arrangement on the Shop Floor.

The Kardex contained the maximum number of units since it is the most convenient and consists of the biggest storage system. The parts having smaller dimensions, high cost, high frequency of use and delicate in nature, were put in the Kardex. On the other hand, materials having larger dimensions which would not fit in the bucket size of the kardex yet delicate were put in the racks. The larger parts that could bear the harsh weather conditions were shifted to the yard. The material like the pipes, oil barrels, water barrels, trucks etc. the paintshop consisted of the materials related to the painting of the machine like the paints, thinner, coating liquids etc.

3.2. Kanban Quantity:

Once the sorting was done, the next task was to find out the Kanban quantity. This was done to make sure, the flow of material is right in time and the production should not get affected due to any kind of delay in the availability of the material. For deciding the Kanban system, the two bin system is followed. The quantity of material in each bin is to be calculated and accordingly the order is needed to be placed. For calculating the quantity, the parameters required are:

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- 1) Lead time: Lead time indicates the time required from placing the order to the supplier's manufacturing time along with the time required for transportation and placing the material in the right location. Every supplier requires different lead time according to the nature of the part being manufactured along with the travel distance.
- 2) Monthly production: The number of machines being assembled every month comes into this category. The machines that are being manufactured here are TH10 and DB40k. In one month, the number of TH10 being manufactured are 2, and that of DB40k is 3. While considering the number of kanban quantities, these quantities are required to be considered and decided accordingly.
- 3) Daily requirement of the material: Once we have the monthly production rate of the machines, we can then calculate the daily requirement of every part. This can be calculated by multiplying the part required for every machine and dividing it by 30 days.

The formula derived for calculating the kanban quantity can be given as:

$$\text{Kanban quantity} = (\text{daily requirement}) \times (\text{lead time})$$

IV. EXPERIMENTAL RESULTS

4.1. Material Arrangement:

The number of trays required for these parts were calculated as:

Total no. of parts = 873.

Total number of bins that can fit on one tray is calculated as:

Length wise:

$$\frac{3026}{375} = 8.06 \approx 8 \text{ bins}$$

Width wise:

$$\frac{820}{250} = 3.2 \approx 3 \text{ bins}$$

Since we are following the two bin system, it is not possible to take 3 bins and therefore, only 2 bins can come on each tray widthwise.

Therefore the total numbers of bins that can fit on one tray are:

$$8 \times 2 = 16 \text{ bins}$$

That means, if there are total 873 parts in total, the number of bins as per two bin concept would be:

$$873 \times 2 = 1746 \text{ bins}$$

Total number of bins required for storing these parts is 1746.

As it was found out, the number of bins on one tray is 16, therefore, number of trays required for accommodating 1746 bins can be found out by:

$$\frac{1746}{16} = 109 \text{ trays}$$

For accommodating these many parts, there are 109 trays required. And accordingly the machine is required to be ordered.

4.2. Material Sorting:

When the quantity of the material that kardex system can accommodate was found out, it was also required to find which material can go on which tray. The trays are so designed, that the maximum height among the material on the tray will be considered and accordingly the tray will be placed at certain height from the above and tray below it.

The material sorted was done according to its nature. The smaller parts went to the carousel, the bigger parts were placed in the yard and the hoses were kept separately.

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4.3. Cost optimization:

Currently there are technical people who are assigned for assemblies of the machine are also working for pulling the material from their location. The rate of these persons per hour is **Rs. 1450/-**.

Approximately for every assembly, the time required for material pulling only is 30 hours.

Therefore, the total cost required for only pulling the material can be calculated as:

$$1450 * 30 = 43500/-.$$

Since the current project was undertaken for working on space management for assemblies of three machines at one time.

Therefore, the total cost required for material pulling of three machines can be given as:

$$43500 * 3 = 130500/-.$$

Whereas, in this proposed technique, non-technical persons can be employed for pulling the material since there will be only the need of knowing the location and number of tray to be pulled out. The rate of these people is around 500 per hour. When the total cost is calculated for these workers we get:

$$500 * 30 = 15000/-.$$

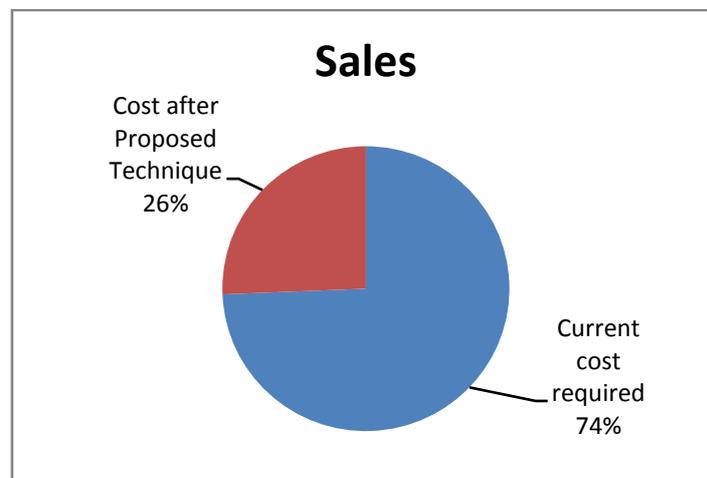
And for three machines we can get:

$$15000 * 3 = 45000/-.$$

When these costs are compared, it can be seen a drastic difference is observed which can be found out by:

$$130500 - 45000 = 85500/-$$

Therefore the amount saved is **Rs. 85500/-**.



Graph 1 Comparison of Costs Required.

Graph 1 gives the clear picture of costs. On the other hand, the technical persons engaged in pulling out the material can now be assigned for doing some other technical work as per their calibre which in return would help the company to enhance their performance and productivity.

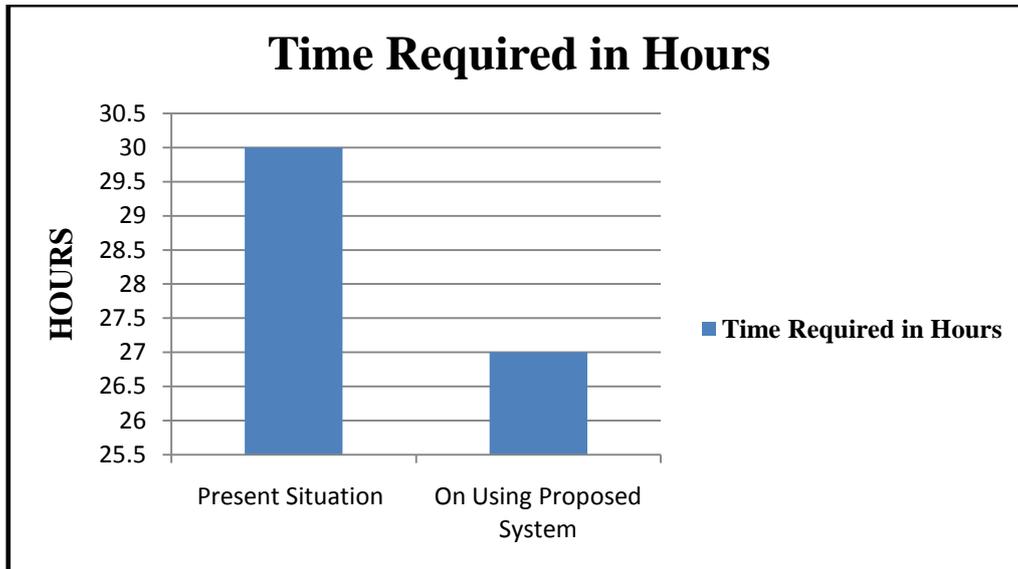
4.4. Time Required for Pulling out the Material:

When the assembly is carried out, the workers have to go to the various places for selecting the required material for the assembly. Since the material placed along the floor in the entire shopfloor required a lot of time for the workers for going to that particular location and picking up the material and bringing it back to the assembly. By introducing the Kardex system, the location of all the materials is concentrated in one place and which is near to the assembly. This helps the assemblers to avoid going long ways for the selecting the materials and in addition to that saves a lot of time and energy. For completing one assembly, the total time required only for removing the materials is around 30 hours. This system will help in reducing the time by 10%.

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Graph 2. Time Consumed Every Month.

4.5. Productivity Improvement:

When the Kardex machine will be introduced, the operation of the machine could be done by a single individual. This will help to increase the coordinating between the workers and the operator can keep the track of materials been removed and would help in avoiding repetitive removal of material and help in keeping the assembly organized.

The machine being automatic, the number of accidents will also come down since during material removal in the current situation from the bins can lead to falling of the material part on the ground which could lead to its damage or even the accidents with the workers. This machine would help in overcoming these issues since the material will be presented to the assemblers at a very comfortable height and in case the material is heavy; the pickup vehicles can be used for carrying these.

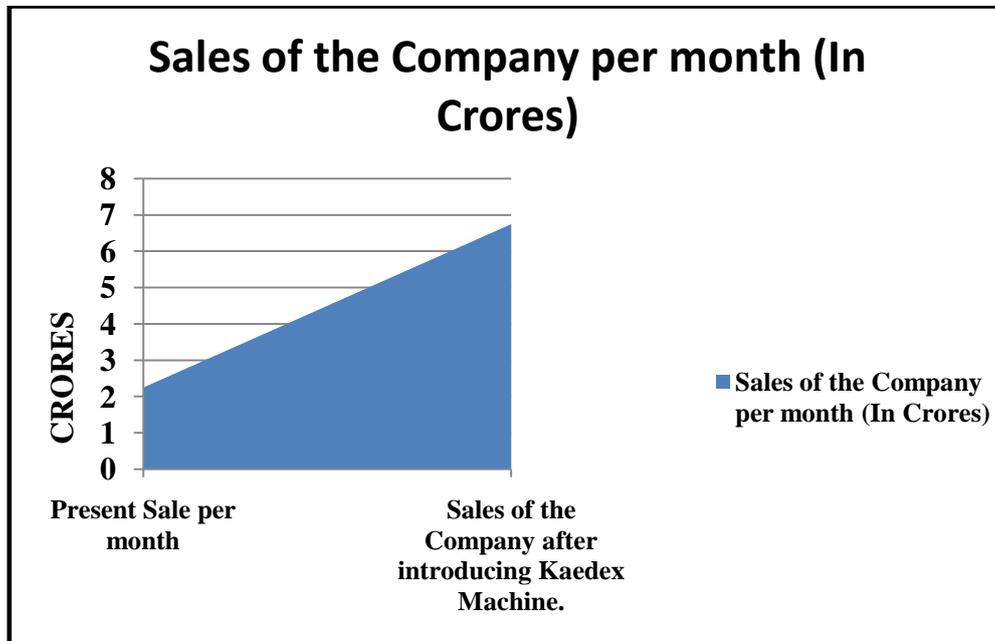
4.6. Company Sales:

As discussed earlier, the company was able to assemble only one machine every month. So the sales were restricted to only that much. As each machine costs Rs.2.25 Crores, the sales were the same. After introducing the Kardex system machine to the company, the assembly rate increase from one machine to three machines per month. The cost of the Kardex system machine is around Rs.38 Lakhs excluding the taxes and shipping costs, this cost is much less as compared to the increased sales cost of the company. Per month sales of the company would go up to Rs.6.75 Crores every month as represented in the graph. This has helped in proving that the project has given a positive result which would help the company to grow and prosper more and can be seen in graph 3.

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Graph 3 Company Sales Every Month.

V. CONCLUSIONS

Introduction of a vertical storage system has helped in not only managing the space on the shopfloor but also helped the company to increase its sales three times and reduce the labour cost. In the initial case when the technically qualified workers had to pick up the material for assembly, it can now be done by non-technical persons.

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