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An Approach of Warehouse Space Utilization in Automobile Industry | Case Study on Pragoti Industries Limited

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Abstract

Warehouse is one of the critical aspects of industries in modern days. Industries are focusing on maintaining the most optimized warehouse in order to decrease warehouse costs, meet customer requirements and to obtain competitive advantages. Many of the time industries fail to utilize its maximum capacity space and it remains unused. In this paper, we described effective models of warehouse management optimization in automobile industries. We used some methodologies such as First In First Out (FIFO), RFID card-based segregation system, Marking guideline and Last In First Out (LIFO) etc. By using these methodologies, the warehouse capacity can increase from 35 to 40 percentage.

Keywords: Warehouse; Optimization; First In First Out (FIFO); Last In First Out (LIFO)

"1. Introduction"

Pragoti Industries Limited is a name of glory since 1966. It has produced the world's renown vehicles like Vauxhall Viva, Mitsubishi Lancer, Mitsubishi Pajero Sport. Along with Pajero Sport, it also assembles Tata Motors buses and mini trucks, Ashok Leyland minibuses and Mahindra Scorpio. Pragoti imports Complete Knock Down (CKD) parts from abroad and assembles these parts for the local market. We inspected Pajero Sports QX model here for 4 weeks. Pragoti imports 56 cases of parts from Thailand and 1 case from Japan. These 57 cases contain all the parts of 10 cars. Normally it takes 3 months to give order and have supply. Every morning around 300 workers get busy to assemble cars. Everyday Pragoti produces 2 or 3 vehicles for local market. The assembly line divides into five parts. These are- material handling department (MHD), trim line, chassis and engine line, finish line and quality control and audit.

Supply-chain management (SCM), the management of the flow of goods and services, involves the movement and storage of raw materials, work-in-process warehouse, and finished goods from point of origin to point of consumption. Interconnected or interlinked networks, channels and node businesses combine in the provision of products and services required by end customers in a supply chain. Supply-chain management has been defined as the design, planning, execution, control, and monitoring of supply-chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand and measuring performance globally. SCM practice draws heavily from the areas of industrial engineering, engineering, operations management, logistics, procurement, information technology, and marketing and strives for an integrated approach. Marketing channels play an important role in supply-chain management.

Warehouse management is critical and one of the most major parts of modern industries. Company success relies on the warehouse system. A good warehouse system can give opportunities like cost reduction, good responsiveness and competitive advantages. But most of the organizations fail to reach the maximum capacity level of their warehouses. So, it is very important to make an effective warehouse model to utilize most of the warehouse capacity.

"2. Literature Review"

Warehouse is "stocks or items used to support production (raw materials and work-in-process items), supporting activities (maintenance, repair, and operating supplies), and customer service (finished goods and spare parts)" [1].

Warehouse management is strategically important in three main areas: customer service (fill rates), cash flow (working capital management) [2], and competitive advantage [3]. Furthermore, high warehouse level does not guarantee good service. Due to the impact of uncertainty some items might be overstock and other understock which leaves the customer still waiting for the delivery [4]. Moreover, obsolescence and perishability are not seldom a problem when dealing with warehouse [5]. Some researchers consider warehouse as a muda (waste) and all efforts are directed on minimizing warehouse in the supply chain [6]. The reduction of warehouse is considered to lead to productivity growth [7]. Warehouse used wisely as a buffer against demand uncertainty can be advantageous as it reduces fluctuations in production levels [7]. Warehouse also protects against stock-outs (lack of availability). Stock-outs lead to lost 13 sales, backorder costs, delayed cash flow and, as a result, lost customers. Warehouse provides product availability which is a key indicator of customer service [8].

There is an optimal level of warehouse beyond which the marginal effect of decrease in warehouse on financial performance becomes negative. Therefore, companies need to develop effective warehouse management policy to achieve optimal and healthy warehouse stock [9].

"3. Methodology"

Automobile warehouse can be designed in various ways. But the aim of this study is to accumulate the maximum number of finished products within existing warehouse.

First In First out method means that first vehicle inputted in warehouse will be out first. Last In First Out method means that first vehicle inputted in warehouse will be out last. FIFO and LIFO methodologies reduce extra roadway that is used to in or out the vehicles. It also helps the warehouse system to work swiftly according to the situations. Marking guideline is the remark in warehouse which gives the clearance of parking vehicles. RFID based segregation means using RFID tags or barcodes which scan and identify the parts and segregate it in proper location. It also records the data of the items.

The methodology of this paper step by step is given below-

Step 1: Analysis of the warehouses and collect data

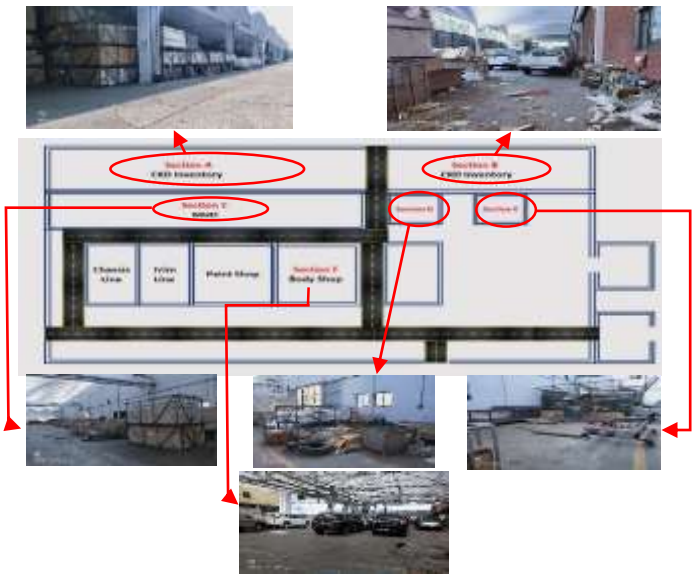
Step 2: Analyze the data and find out the root cause of the problems

Step 3: Use First In First Out method, RFID card-based segregation system, Marking guideline and Last In First Out method to improve and optimize the warehouse capacity.

"4. Result Analysis"

Current Scenario of CKD Warehouse

Pragoti Industries Limited is finding difficulties to accumulate their CKD cases in its warehouse. In Fig. 1, we can see that Pragoti uses **Section A** and **Section B** as its CKD warehouse. But this place is not good for these cases. It is an open place, so it can be harmed by rain, flood or due to heavy sunlight. Again, the place is not enough for these hugs lots. So, Pragoti needs to capitalize other free spaces too. Section A is able to accumulate 520 cases of CKD and Section B is capable of 400 cases (approximate). In Figure, Section D and Section E are totally free space and Section C is used by Material Handling Department (MHD) horizontally only. Section C is almost as same as Section A.



"Fig. 1. Current Scenario of CKD warehouse"

Proposed Model of CKD Warehouse

In Fig. 2 showed that CKD warehouse should be at Section C, Section D and Section E. Section C and Section A occupies the same space. So, we can say that Section C can accumulate 520 cases easily. Section D is able to accumulate 48 CKD cases and Section E 36 cases. Now the bodies of cars can easily be accumulated in Section A and Section B. We estimated 88 bodies or approximate 9 lots can be accumulated here.

Segregation: Segregation can be done in Body shop. This place is totally free and it has a large space. So, Segregation can be done easily here. Our recommendation is to use QR code scanner eliminating error.

"Fig. 2. Proposed Model of CKD warehouse"

Current Scenario of Assembly Line

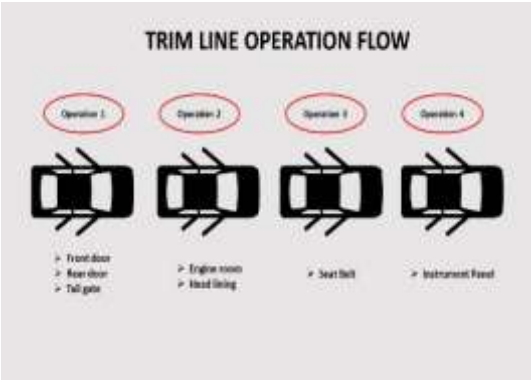
Trim line (Fig. 3) and chassis line (Fig. 4) workers do their work in one step or at most two. Sometimes 12-14 people work together. This surely makes the place messy and quality work hampers. Implementing 5s becomes more difficult. Workers are skilled but sometimes they do not follow work flow process. This creates more opportunity for defective work.

"Fig. 3. Trim Line"

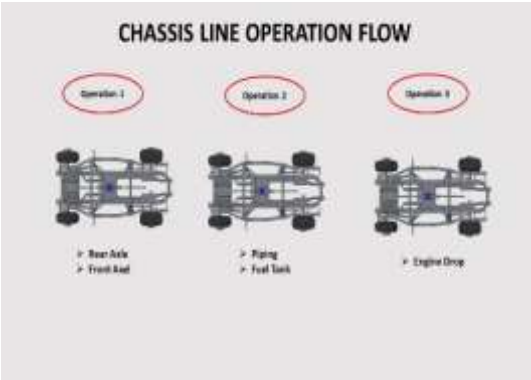
"Fig. 4. Chassis Line"

Proposed Model of Assembly Line

Trim Line (Fig. 5) and Chassis line (Fig. 6) should be divided at least 3 to 4 steps to maintain quality work. Always remember, quality control is better than quality assurance. So, maintaining quality and defect free work, trim line and chassis line should be divided as much as possible. And after finishing one step quality inspector should inspect very well whether there is any defective or not. This will also bring the works in discipline. Workers can concentrate more on their work and do quality work. This will also reduce lead time and increase productivity.



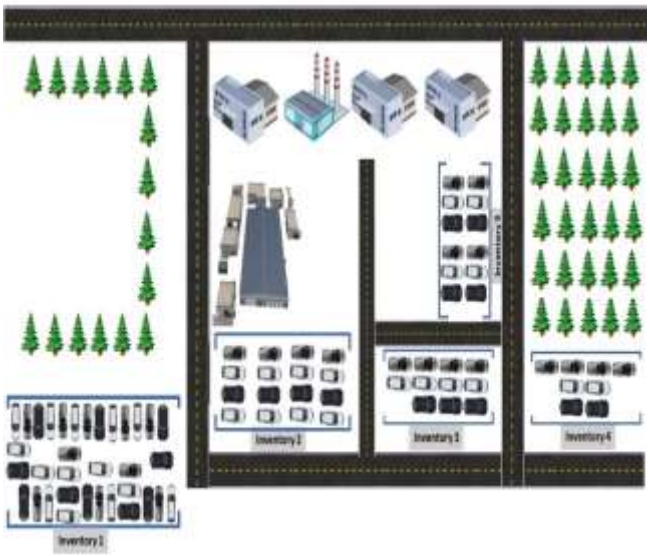
"Fig. 5. Proposed Model for trim line"



"Fig. 6. Proposed Model for chassis line"

Current Scenario of Assembled Vehicle Warehouse

Pragoti Industries Limited has five warehouses that keep assembled vehicles. At present Pragoti is finding difficulties to allocate these large number assembled vehicles in the existing warehouse (Fig. 7). Warehouse-1 has an area of 16649 sq. feet. It contains only 93 assembled vehicles at a time. Warehouse-2, warehouse-3, warehouse-4 and warehouse-5 can keep 34, 24, 13 and 21 assembled vehicles respectively. In total Pragoti's warehouse system can allocate only 184 cars. Pragoti's production rate is in mid-range, but these warehouse facilities will find more find difficulties to face upcoming challenges in near future. So, the automobile industry should focus on optimizing and using the maximum space of the existing warehouses.



"Fig. 7. Existing Warehouses scenario of Pragoti Industries Ltd."

Problem Analysis of Assembled Vehicle Warehouse

We went to inspect the current status of the warehouses of Pragoti Industries Limited and identified the main causes which effect the warehouse management system (Fig. 8). The main causes are-

1. Cars are not oriented in one particular specific orientation.
2. Space between the two cars is large
3. First In First Out system is not applied
4. No marking guideline on the parking surface for minimum space tolerance between two cars
5. Warehouse design is not suitable for car parking
6. Vertical space is not used

"Fig. 8. Car spacing of Warehouse-1"

Proposed Model of Assembled Vehicle Warehouse

Orientation: Cars should be oriented in one specific orientation as we can see in Figure 9, the same model and same color cars should be allocated in every specific line.

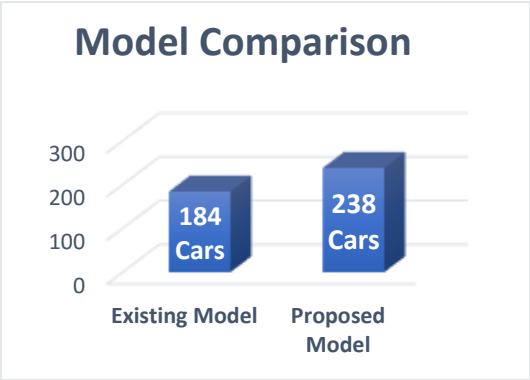
First In, First Out (FIFO): First In, First Out method should be applied. First in, first out (FIFO) is an asset-management and valuation method in which the assets produced or acquired first are sold, used or disposed of first and may be used by an individual or a corporation. Here, the first car which will be allocated in the warehouse will be discharged first. And this sequence will be continued for the rest of the cars as well. To apply this method, the warehouse should be open at the front and back, so that the cars can easily in and out.

"Fig. 9. Car Orientation Model"

Marking Guideline: In parking, marking guideline should be available. This model will help the drivers to orient the cars according to order (Fig. 9). And it will also help to minimize the space between two cars and maximum use of warehouse.

Outcome of Proposed Models of Assembled Vehicle Warehouse

As survey was done in every warehouse, it states that our proposed models can increase 30% capacity of the existing warehouses without big investing. It will increase the capacity of warehouse-1 at least 120. Warehouse-2, warehouse-3, warehouse-4 and warehouse-5 will have the capacity of 38, 30, 20 and 30 assembled vehicles respectively. In Fig. 10 we see the total number of assembled vehicles is 238 which is higher than the existing system (184 assembled vehicles).



"Fig. 10. Model Comparison"

Recommendations

In upcoming years, the existing warehouses will not be enough to allocate the assembled vehicles. So, new warehouses will be needed. We recommend Pragoti Industries Limited to build new plants as close as possible to the finishing line, so that the lead time will be minimized. And also need to keep in mind to use vertical space of new location. In Pragoti, all the warehouses are one stored building. In near future, the areas will not be available for this type of warehouses. But multi-stored warehouses can allocate three to five times more assembled vehicles than one stored warehouse.

Current Scenario of Yard Warehouse

Pragoti Industries Limited is finding difficulties allocating space for its assembled vehicles. It has 5 (five) warehouses which are not enough. So, the cars need new space and location. Pragoti is trying to minimize this problem by using a rectangle yard. But Pragoti can only accumulate 230 assembled vehicles in this yard (Fig. 11).

"Fig. 11. Current Scenario of parking yard"

Problem Identification of Yard Warehouse

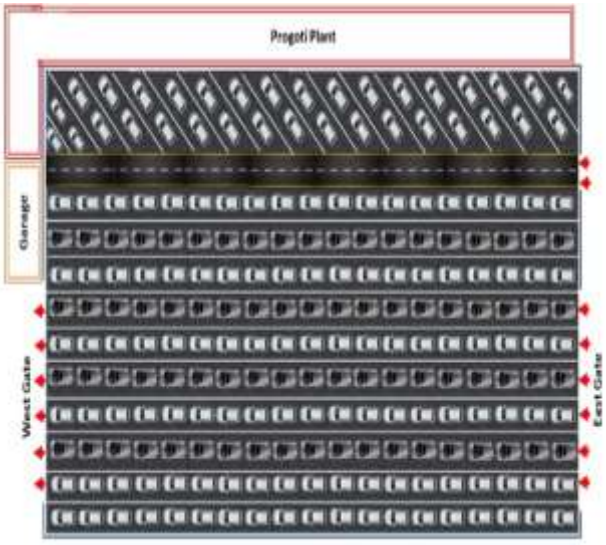
We inspected the yard to find out what are the main problems and how we can have maximum output from this yard by eliminating these problems.

1. Cars are not oriented in one particular specific orientation.
2. A big street and lots of dumps which waste lots of space.
3. Different models and colors of vehicles are mixed up.
4. Space between two cars is large.
5. First In First Out system is not applied.
6. No marking guideline on the parking surface.

Proposed Model of Yard Warehouse

We applied **First In First Out (FIFO), Last In First Out, Marking Guideline** and **Angled Parking** in this model. We can divide the yard into two sections; Section A and Section B. Between these two sections there will be a street.

Section A will be arranged in 45 degrees angled. This will ease the car to Park and Exit. Section A will use **Last In First Out** method. A least two assembled vehicles can be accumulated here in each row. And 15 to 16 rows are possible here. So,



"Fig. 12. Proposed Model of parking yard"

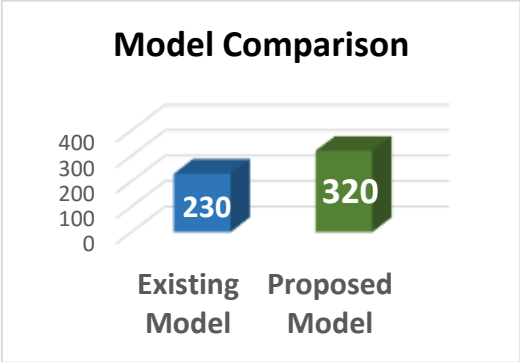
our analysis results at least **30 to 32** assembled vehicles can be parked easily here.

Section B will use **First In First Out** method. Cars will entry from **East Gate** and it will exit from **West Gate.** These gates will be all open so that the cars can entry and exit in a straight line. 18 columns are possible here and each column can consist of at least 15 cars. So, in total **270 to 280** assembled vehicles are possible to accumulate here (Fig. 12).

Parking Guideline will ease to maintain this orientation.

Outcome of Proposed Model of Yard Warehouse

Statistical analysis states that our proposed models can increase the capacity by 35% to 40% of the existing parking yard without investing. This model surely can increase the capacity from 230 to at least 300 to 320 assembled vehicles (Fig. 13).



"Fig. 13. Model Comparison"

"5. Conclusion"

This research is a brief presentation on how warehouses can be optimized and how an effective model can be redesigned of the existing model. This will be helpful for the industries to maximize their warehouse capacity especially for automobile industries. The modern world is being more challenging day by day. So, a good warehouse model is essential for the sustainability of an industry. There is still scope for future research. Researchers may focus on developing ideas on multi-stored warehouse system which will the bigger challenge in the near future. But our proposals will be effective and beneficial for further research and development and a guideline for the organizations.

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