

Robotic Vehicle for Material Handling System in Tire Manufacturing Industry

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ABSTRACT

Material Handling is not a Production Process but a necessary link between Raw Material and actual Process of Product manufacturing, Materials handling includes all the activities with regards to acquisition, handling, control, and movement of material used in manufacturing like Loading, Unloading and transportation of Materials is carried out. . The main objective of this project is to fabricate a robotic trolley for material handling in industries. In this project a robotic vehicle is fabricated which runs like a car by carrying tools from place to another.The overall aim of the project was to identify the risks associated with pushing and pulling of heavy trolley in tire manufacturing industry and also to improve the material handling in heavy trolley without suffering any deformation or local fractures if it would go into real world production at an ideal scale. And to improve over all material handling with lean approach. Material handling is an essential and significant component of any productive activity; it is something that goes on in every plant all the time. When large amounts of material are being moved, this is because accidents can happen when large material is being moved. This results into organisations paying compensation lawsuits.

Keywords: Ergonomics, Heavy trolley, Law suits, Lean approach, Manufacturing, Material handling, Risk.

I. INTRODUCTION

In order to handle the huge volume of material and final products, different material handling methods, tools and machines are used. Machines such as forklifts, manual trucks, conveyors and manual trolley

other different strategies are used to handle various materials and products. One method a company can use to improve its performance is Material handling.. Manual handling operations of heavy tires, industries may expose workers to risks related to efficiency as well as occupational safety and health. Heavy tires are

difficult to move and burdensome to lift/ transfer, and handling the heavy load may result in contact stress and/or injuries on the workers.

II. MATERIAL HANDLING

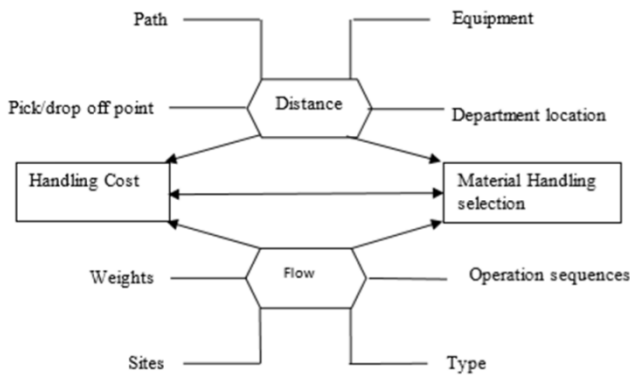


Fig 1

Material handling has been described as the process that is done to move, control, protect as well as to store material. The process of material handling is very important as material has to be handled very well to keep it from damage and deliver it safely to the destination with the desired quality and conditions. When a proper material handling is put in place, accidents are reduced and/or eliminated as a result of proper and careful handling of material is done. Stated that material handling improves the profitability of an organisation when accidents are eliminated and/or reduced in that, the organisation does not need to spend on the costs of accidents and the same time attain optimum output. In the same tone, stated that proper material handling reduces stress and effort

III. CHALLENGES IN MATERIAL HANDLING

We need to understand what is required of a material handling system even before various solutions of improving it can be suggested. To find out challenges in the internal material handling or factors that may cause problems, it is important to lay out what contributes to a well-functioning performing internal material handling system. This is done by looking at

the various factors, internal and external to the system that might have an influence on it. An internal material handling system more than just handling of material, it involves a lot more i.e. the moving, storing, controlling and protecting material with a sole purpose of providing the utilities of time and place.

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To understand more on the internal material handling systems, what purposes an internal material handling systems should achieve at the end of the day.

- Smooth flow of information and material
- Reduction of operational costs
- Delivery of material to the right place and at the right time
- Reduction of safety hazards and damage to material

Material handling systems suggested nine factors that an organisation needs to do in order to get rid of the problems faced in internal material handling systems. The following are the nine factors.

- ❖ **Right material amount:** the use of Just in time concept (JIT) which is focused on the significance of holding the needed materials/parts in the logistics function
- ❖ **Correct material:** there should be a system which accurately picks identifies the right material, picks it up and the deliver it to the correct destination.

- ❖ **Right material quality:** the material quality in the system should be that which is desired by the various users.
- ❖ **Following right sequence:** it is very important that the correct sequence in the manufacturing process is followed, i.e. the movement, storage, protection and the controlling of material should be done in the correct way.
- ❖ **Correct orientation:** Correct orientation of the materials being worked on in an organisation on the production lines saves time.
- ❖ **Correct place:** materials or parts must be delivered to the correct destination as this will save time from unwanted movements.
- ❖ **Correct time:** due to time based competition organisations are facing, it is imperative that materials are delivered to a working station at the correct time i.e. when they are needed.
- ❖ **Correct cost:** in this regard, correct cost does not mean an organisation need to cut on the cost of the material handling system but rather, it means that the system should be more inclined to contributing more to the collection of revenue than acting as a cost contributor.
- ❖ **Correct method:** in order for the all eight factors above to work properly, the correct methods have to be used.

Hassan established that organisations that don't have properly designed material handling systems experience a lot of problems. The problems can range from production delays, production lead time and costs may increase and also that defective products may be produced. In the same vein, having a well laid out material handling system results in many advantages such as operations in manufacturing and the entire logistics being improved, improved quality of products and the delivery performance and also reduction in the Accidents. Radin Zaid Radin Umar et al discussed the pilot study of the trolley-lifter showed promising results in terms of improving the cycle time, manpower utilization, and working postures compared with the traditional handling

method. G. BalaKrishnan et al, The motor is connected with the wheel arrangement with the help of speed reduction gear box. When the trolley is loaded with a tool or some other goods it can be easily move to the place as per need by means of wireless remote controller. Dr. S. S. Pawar et al deals with various MHS with the help of which one can get guidelines in Selection and designing a custom built MHS which will suit the requirement in industries Material Handling Problems. Gulexea and Awate designed a gearbox for an existing trolley in a foundry, which used to take a lot of time for completion of material handling. Aydin Azizi et al Claimed that Shorter time response, economic parameters & demand to fulfil customer's satisfaction raised the need for design of Smart Material Handling System. Hence this paper suggests that Custom-built Material Handling systems should be designed.

IV. PROBLEMS FACED IN INTERNAL MATERIAL HANDLING SYSTEM

- ❖ **Delivery precision:** An inefficient internal material handling system leads to delays in production and an increased production lead time. This is handled by making sure that all material movements which are not necessary are eliminated in an organisation and also following the right sequence of the manufacturing process. This brings about delivery of material to the right place and at the right time.
- ❖ **Inventory levels:** Having an inefficient internal handling system leads to having high levels of inventory stocks which is kind of a waste. Just in time (JIT) inventory management has proved to be an effective tool in this situation. With Just in time (JIT), an organisation holds the right levels of inventory in entire logistics system. And this usually results into decreased or low levels of inventory in an organisation.
- ❖ **Operation costs:** An inefficient internal material handling system will always result into increased

cost of operations. In this regard, the entire internal material handling system should be designed in a certain way to ensure that it is enhanced to adding more revenue collection than the operational costs that comes with it.

- ❖ **Delivery quality:** Quality is always compromised when dealing with inefficient internal material handling system. It is therefore important to use the right methods and sequence of manufacturing.

V. EVALUATION

The current material handling system is evaluate by the ECRS method ,which is a lean approach. From this, we can know the time consuming of the material movement and non value tasks are performed by the worker. This ECRS include overall performance of manual handling of heavy trolley from one process to other process. It shows the difference before/after implementation of robotic vehicle, the collision delay and injury of the workers are reduced significantly and the process timing is reduced significantly by the robotic vehicle.

VI. EXISTING MODEL FIGURE



Figure 2

VII.IMPROVEMENT OF MATERIAL HANDLING

- ✓ These trolleys are replaced by the robotic vehicle in which the manual handling is eliminated.
- ✓ The non value tasks such as, accident, injuries, collision delay, travelling time of the trolley are reduced.
- ✓ Save time.

- ✓ And the overall mass production increase significantly in industries.

VIII. DRAWBACKS IN MATERIAL HANDLING

- Initial investment is high.
- The maintenance of the robotic vehicle should be done properly.
- The robotic vehicle should be planned according to the plant layout to reduce the overall running time.
- Low employment due to use of robotic vehicle.
- No flexibility in the production planning.

IX. CONCEPT AND IMPLEMENTATION

Many methodologies of material handling system developed over the years, but most of them can be categorised into three approaches.

- a) Determining or improving a material handling system when the layout of the plant is already known.
- b) Determining or improving a layout of a plant when the material handling system is already known.
- c) Determining and improving both the material handling system and the layout of a plant.

Designing of a material handling system is dependent on the layout of a facility. This is because material handling system deals with the movement of materials between points in a Plant. And the positioning of these points in the Plant is determined by the Plant layout.

X. PHYSICAL METHODOLOGY FOR DESIGNING

Twenty principles used for designing a material handling system have been put up. These principles are also used for controlling and improving material handling systems. The principles were developed in Pittsburgh in 1990

- **Planning**

Plan all material handling and storage activities in order to achieve maximum overall operating efficiency

- **System**

Integrate these activities into a coordinated system of operations, including receiving, inspection, storage, production, assembly, packaging, warehousing, shipping and transportation.

- **Materials Flow**

Provide an operation sequence and equipment layout that optimizes materials flow.

- **Simplification**

Simplify handling by reducing, eliminating, or combining unnecessary movements and equipment.

- **Gravity**

Utilize gravity to move material wherever it is possible.

- **Space**

Utilization Make effective utilization of all cubic space.

- **Unit Size**

Increase the quantity, size, or weight of unit loads or their flow rates.

- **Mechanization**

Mechanize handling operations.

- **Automation**

Provide automation that includes production, handling, and storage functions

- **Equipment Selection**

While selecting handling equipment, all aspects like material handling, movement and the used methods should be considered.

- **Standardization**

Standardize the handling methods as well as types and size of handling equipment.

Types of trolley

They are the following trolley which going to improve material handling, in tire manufacturing industries.

- ❖ 4 Roll calender trolley

- ❖ A frame trolley

- ❖ Extruder Trolley

- ❖ Bead Trolley

These four types of trolleys are taken for the study. When these manual trolleys are automated using robotic vehicle the manpower utilization in the process is increased, increased in production, reduction of accidents occur in trolley, reducing the risk in pushing and pulling of heavy trolleys and overall performance of the material handling in the plant is significantly increased.

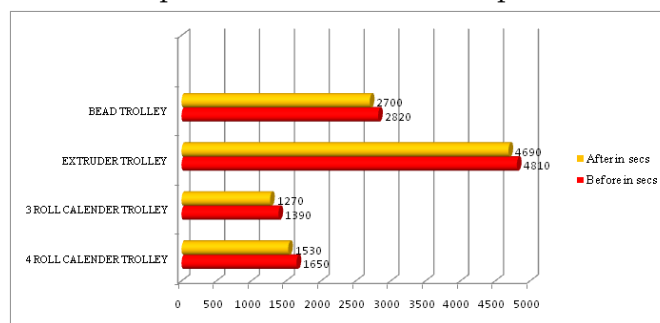
TROLLEY ADVANTAGES

The advantages of robotic vehicle are,

- No delay in the delivery and receiving of materials from a place .
- There is no error will happen in the material handling system.
- The injuries and accidents are reduced.
- The workers ergonomics is improved.
- The collision delay is avoided.
- The trolley fallen are stopped completely.

XI. COMPARISON OF RESULT

Table1. Comparison of exist and new implementation



HEALTH EFFECTS

TYPES OF INJURY

Pushing and pulling may give rise to two types of hazards and the risk of injury:

- Overexertion of the musculoskeletal system (e.g. low back injury)

- Increased risk of accidents (e.g. due to slipping or tripping), which can cause injury to the musculoskeletal system.

In a review of accidents associated with manual truck and trolley handling, identified three major accident types:

- Fingers and hands caught in, on, or between the trolley and a wall or piece of equipment.
- Feet, heels and the lower leg being bumped by or caught under the trolley.
- Arm, shoulder and back strains associated with slips, trips and pushing and pulling of trucks. With powered trucks, the risks of strain injuries were considerably reduced, although hand and foot injuries will still be common.

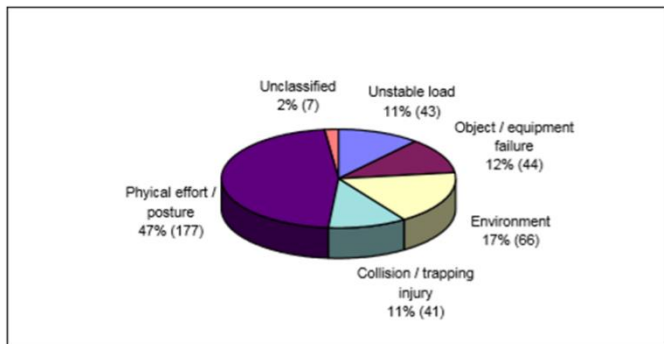


Figure 3

Validation of brain storming points

Table 2 brain storming points

S.NO	Causes	Validation
1	Partially mechanized movement	Less tow trucks available
2	Insufficient trolleys for supply of materials	Assigned trolleys not used
3	More Supply Time	Heavy trolley
4	More number of rehandling	Obstacles are moved on the path
5	Longer distance travelled by supplier	changes path due to obstacles
6	No defined path	Path not assigned for manual Transportation

In the Validation as extent to which the research findings can be generalised or generalisation of a research. The case study designs that are fully described give opportunity to readers to conclude on the external generalisation of the findings. As such, the researcher made extra effort to fully describe the case company in the method chapter.

XII. CONCLUSION

Thus the summary of ECRS shows the results include reduction in processing time and proposing efficient working steps that can reduce unnecessary movement and collision time. By this ECRS after study the trolley handling safety plays a vital role in the production. Which is increase the safety as well as increase the production time by elimination non value added task in the plant.

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