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Modification and Development of Process for Improving Productivity

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Abstract: ***This paper discusses about the modification and development of process for improving productivity of plastic product manufacturing unit.The factory is renowned for its plastic products.This unit is present in Electronic Zone, Hingna MIDC ,Nagpur .This factory has plastic injection molding machine for product manufacturing .In the project , we are going to modify the existing process ,the existing ways of doing work in the industry to increase its productivity. Also reducing time consumption for particular process and reducing workers fatigue is our main focus. We are using Industrial Engineering principles, tools and techniques such as work study,method study ,work measurement ,plant layout, material handling ,ergonomics to upgrade the existing ways of production in the industry.The modification of manufacturing line will lead to increased productivity of the production unit.***

Keywords: Plastic Injection Molding Machines ,Work Study, Method Study, Plant Layout, Industrial Engineering and its Applications, Automation ,Robots, Material Handling, Ergonomics, Productivity, Efficiency.

I. OBJECTIVES OF THE MODIFICATION

The development and application of more effective methods to reduce cost, increase overall productivity and efficiency .is the main objective.Following are some more objectives :

1) Reducing Time consumption, human efforts and reducing travel distance of raw materials from unloading point to storage room.
2) Reducing total travel distance of material within industry.
3) Reducing time consumption for processes like mold changing by introducing new technologies. .
4) Reducing use of workers and resources by introducing newer ways of production to the industry.
5) Increasing overall productivity of the manufacturing unit.

II. LITERATURE REVIEW

1) Martand Telsang (1) in his book named *Industrial engineering and Production management* discussed various material handling systems and equipments used in industry to transfer the material from one place or workstation to another place or workstation.
2) Akash Verma,Aniket Gaikwad(2) studied the existing process of the plastic product manufacturing company having plastic injection molding machines. The author suggested new methods of increasing productivity in that company. The author has shared his studies and concluded about introducing automation in some processes and modifying plant layout.
3) V.P.Kulkarni(3) studied the present method of a machining industry which manufactures products like engine cover, wind turbine parts, etc. His research uses work study techniques to solve the problems in that machining industry.
4) Ashish Kalra, Sumit Sharma(4) conducted the study at automobile assembly plant which aims to reduce cycle time of different workstations to complete work in time.
5) P R Akkoni, Vinayak N Kulkarni and V N Gaitonde(5)applied work study techniques to improve productivity at valve manufacturing industry. The author analyzed existing plant layout and proposed new plant layout which reduces total time cycle.
6) Khalid, S. and Saleh(6) have studied the existing process in automobile industry and using operation process chart and simulation software Arenaand they have obtained solution which increases the industry's manufacturing capacity.
7) Dr. M. K. Sonpimple, Sagar D. Shelare, Anurag N. Raghorte(7) designed the motorized hand truck use for material handling. The authors discussed merits of hand truck applications in the industry instead of transferring material manually by workers.

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III. METHODOLOGY

1) Studying ,analyzing and examining the details of existing working processes in an industry.
2) Finding new solutions to eliminate problems which were occurred in studies.
3) Proposing change in plant layout,new material handling systems in the industry according to problem .
4) Analyzing and examining the results of modified processes which were proposed.
5) Recommendation of new method to concerns.

IV. RELATED TERMINOLOGIES

1) *Plant Layout:* According to Moore,"Plant layout is a plan of an optimized arrangement of facilities including personnel, operating equipment,material handling equipment,storage space and all other supporting services along with the design of best structured unit to contain all these facilities".The main objectives of plant layout are as follows :
   - Streamline material flow.
   - Minimized material handling.
   - Minimized material travel distance.
   - Make full utilization of space.
   - Facilitate the manufacturing process.
2) *Material Handling:* Material handling can be defined as movement of bulk, packaged and individual products by means of manual human effort of by power actuated machines within the industry limits. Main objectives of Material Handling are as follows :
   - Minimizing cost of material handling in industry.
   - Minimizing time consumption in material transfer within industry.
   - Increasing the productivity.
   - *Types Of Material Handling Equipments:*
   - *Conveyors*:Belt conveyor, Roller conveyor, Pipeline conveyor,Screw conveyor.
   - *Cranes and Hoists:* Overhead travelling crane, Jib crane, Gantry crane,*Hoists:*Chain hoists, Pneumatic hoists, Electric hoists.
   - *Industrial Trucks:* Forklift Truck, Platform truck, Powered Hand truck.
   - *Material handling equipments images :*

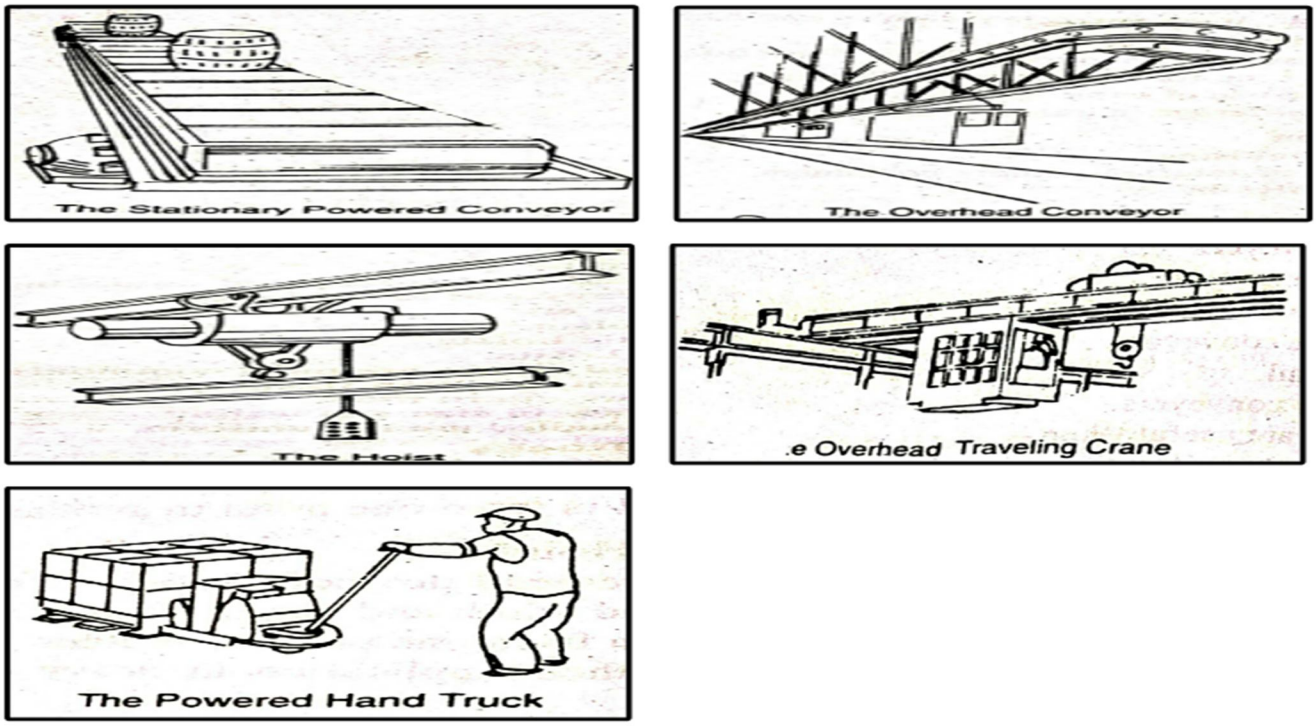

Fig 1:Various Material Handeling Equipments

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3) *Ergonomics:* It may be defined as a study of man in relation to his work. It is also called as human engineering. It focuses on human worker interaction with the machines and environment in his workplace. The main objective is
   - Increasing efficiency and effectiveness in work.
   - Reduce human efforts, fatigue, stress and improve quality of life.
4) *Productivity:* Productivity refers to the efficiency of production system .It is the concept that guides the management of production system. it is an indicator of telling that how well the factors of productions are utilize i.e. utilization of land, labor ,capital and energy.

   Productivity =Output /Input
5) *Automation:* Automation is the technology of doing processes or procedure without human assistance. It is implemented using a program of instructions combined with a control system which executes the instructions, To automate a process,power is required for both to run the process itself and to operate the program and control system. Although automation can be applied in a multiple areas, it is mostly associated with the manufacturing industries.

V. PROPOSED SOLUTIONS

1) *Plant Layout :(Present Plant Layout) :(Ref. 2)*

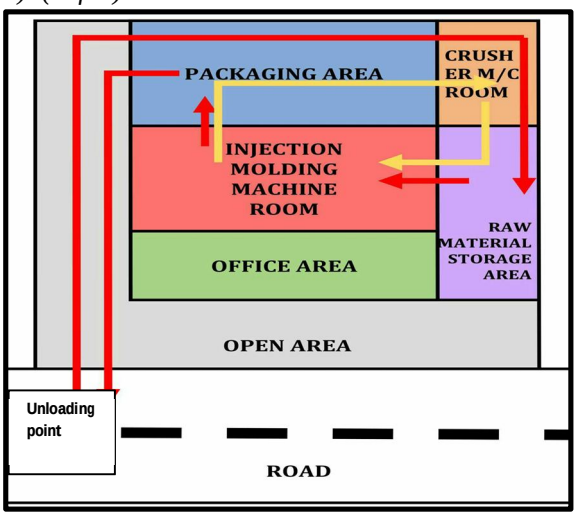

Fig 2:Present Plant layout

Material Flow is shown in Two colored Lines Viz. Red And Yellow
Red Line: From Unloading Raw Material To Finished products out for Delivery
Yellow Line : From M/C room to Crusher room for Crushing of Waste Plastic Material and again to M/C room for Reuse.

2) *Plant Layout (Modified Plant Layout) :*

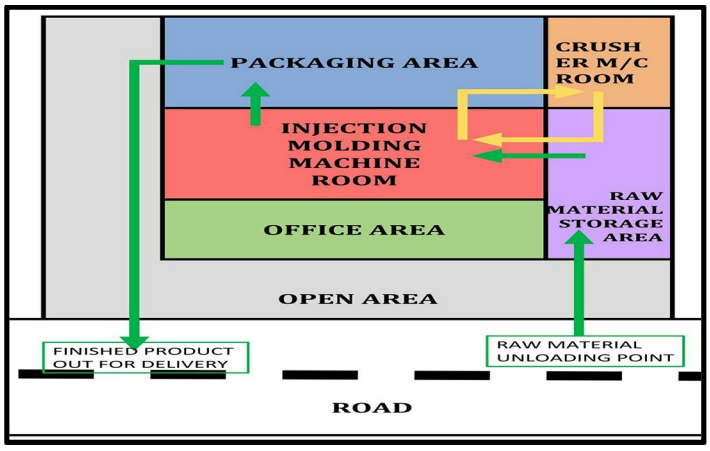

Fig 3:Modified Plant Layout

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Material Flow is shown in two Colored lines Viz. Green and Yellow
Green Line: From Unloading Raw Material to Finished Products Out For Delivery.
Yellow Line : From M/C Room to Crusher room for crushing of waste Plastic material and again to M/C Room for Reuse.

3) Use Of Material Handling Equipment For Material Handling Process (Manually Operated Powered Hand Truck) :

Fig 4:The powered hand truck

Manually operated Powered Hand truck to be used in Industry primarily for transferring raw materials from unloading point to raw material storage room. This facilitates more load transferring in one go around and also reduced worker effort and fatigue.

4) Use Of Quick Mold Change System:

This system is used to lower mold change times,which results in shorter machine down time and increase in productivity. The system uses a special mold clamp that doesn't require a cut out on the mold, increasing its versatility to use ,allowing it to be used with number of different product molds.

Quick Mold Change Systems in manufacturing unit will allow easy changeover of molds in less time, reducing labor costs .Using this system with a Mold Cart System will facilitate fully automatic mold changing, further enhancing the productivity of manufacturing plant.

Fig 5:Quick mold changing system representation

5) Use Of Industrial Robots

In modern plastics industry industrial robots are being used probably in all areas of plastic production, including plastic injection molding and its related processes. From loading raw materials into the injection molding machine to finishing and assembling injection molded plastic parts, the use of robots provides manufacturers increases in productivity and high quality.

The most common application of industrial robots in injection molding is machine tending that is to take out finished parts from the injection moulding machine for further processes. In traditional injection molding, this work is done by labor and requires high skills in handling due to the heat sensitive material being molded. The use of a robot benefits worker from this repetitive work and reduces the risk of injuries, which results in improved product consistency and production capacity.

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Fig 6:Industrial Robot use in injection molding representation

6) Time Study Observations :(Present Required Time) :(Ref. 2)

Time study observations of some important processes :				
SR. NO.	PROCESS	TIME REQUIRED	DISTANCE TRAVELLED	MANPOWER UTILIZED
01	Unloading of Raw Material	60 minutes	40 meters	4 workers
02	Mold Changing Operation	45 minutes	5 meters	2 workers
03	Packaging Operation	-	-	15 workers
04	Total Material Travel	-	65 meters	-

7) Time Study Observations (After Modification) :

Time study of the important processes after modification :				
SR. NO.	PROCESS	TIME REQUIRED	DISTANCE TRAVELLED	MANPOWER UTILIZED
01	Unloading of Raw Material	30 minutes	10 meters	4 workers
02	Mold Changing Operation	5 minutes	5 meters	0 workers
03	Packaging Operation	-	-	15 workers
04	Total Material Travel	-	35 meters	-

VI. CALCULATIONS AND RESULTS

1) Time reduction in Raw Material unloading :

Reduction in time consumption =Existing Time Consumption - Modified Time consumption

Reduction in time consumption =60 min -30 min

Reduction in time consumption =30 minutes.

- *Percentage Time saved = 50%*

2) Reduction in Total Material Travel distance within industry :

Reduction in Total material travel distance =Present distance travelled -Modified distance travelled
Reduction in Total material travel distance =110 meters - 50 meters
Reduction in Total material travel distance =60 meters

- *Percentage Material Travel distance reduced=54%*

3) Time reduction in mold changing :

Reduction in time consumption =Existing Time Consumption - Modified Time consumption
Reduction in time consumption =45 min -5 min
Reduction in time consumption =40 minutes.

- *Percentage Time saved = 88%*

4) Man power consumption reduction in mold changing operation :

Reduction in mold changing operation =Existing requirement - modified requirement
Reduction in mold changing operation =2-0
Reduction in mold changing operation =2 man power units

- *Percentage Man Power saved=100%*

A significant amount of reduction in stress, fatigue among workers can be observed after modification.The use of above solutions can increases efficiency and productivity of the Industry.

VII. MAJOR SUGGESTIONS

1) Construction of separate raw material unloading point to reduce Total Material Travel distance .
2) Use of powered hand truck or trolley for transferring material from unloading point to raw material storage room.
3) Use of quick mold changing system to save time in mold changing operation.
4) Use of industrial robots for manufacturing operations to increase productivity, efficiency and to save time.
5) Use of comb and dendrite arrangement flow line pattern for packaging unit.

VIII. CONCLUSION

Following points can be concluded in this live industrial project :

1) Applying principles of Industrial Engineering, Productivity and Efficiency of a manufacturing unit can be increased.
2) Decrease in Total Material Travel distance is achieved after modification.
3) Elimination of large time consuming processes is achieved.
4) Introduction to newer technology of quick mold changing and industrial robots decreases risk of injuries to workers and reduces stress and fatigue of worker.
5) Also, Manpower is saved by applying newer method and doing modifications.

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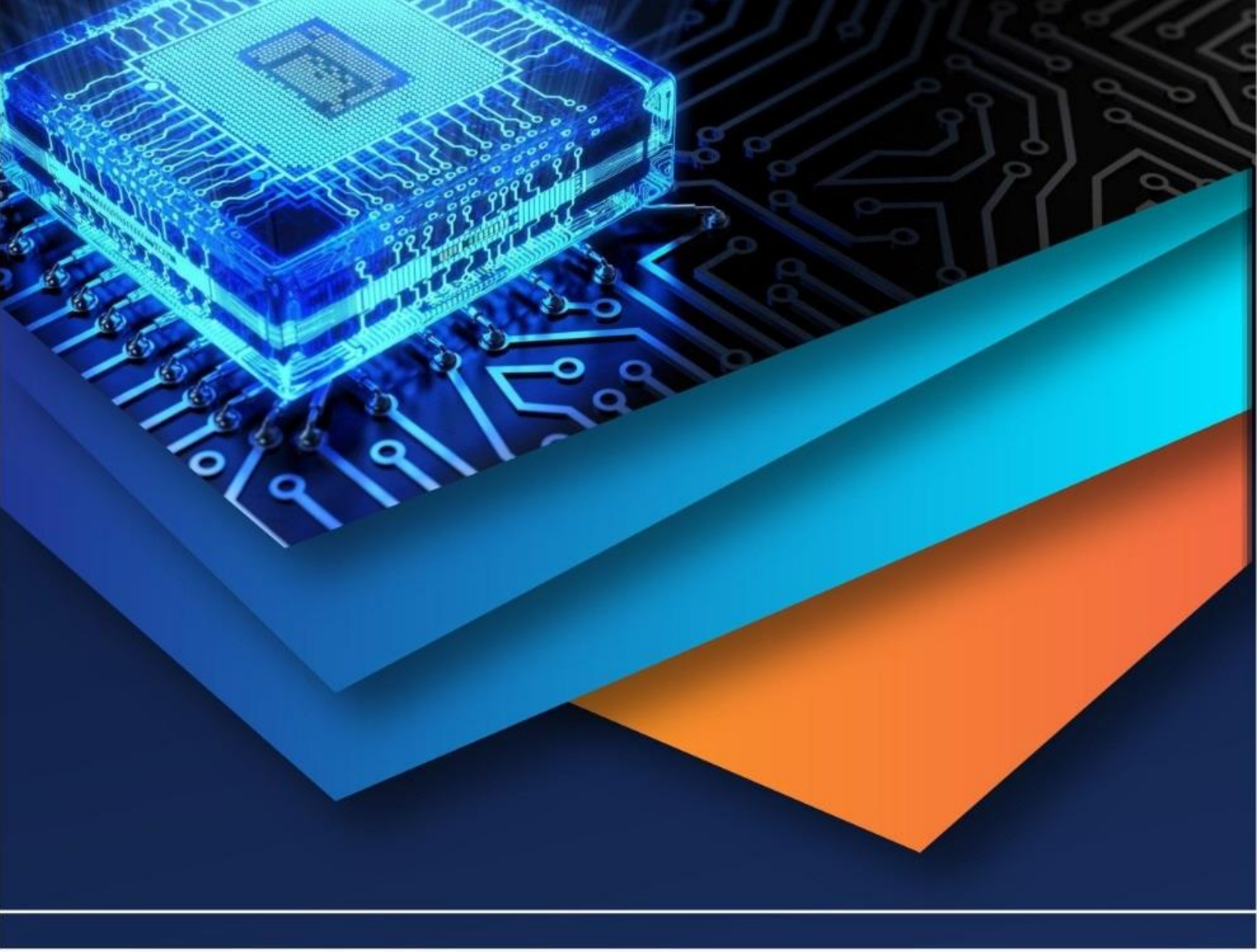

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