Improvement in Productivity Using FMS: A Case Study

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ABSTRACT

The rapid growth of technology in the last two decades has been characterized by full automation. As only the affluent and developed countries can afford to adopt full automation, a large productivity gap has been created. This gap can be bridged through low cost automation. The concept and principles of low cost automation are basically the same as those of full automation, except that the former builds an improvement around existing equipment and machine system rather than replacing the whole system with automated processes. Material handling is the primary activity of every manufacturing organization. It has been estimated that at least 15 to 25% of the cost of the product are attributable to material handling activities. Unlike many other operations, material handling adds to the cost of the product and not its value [1].

It is therefore important first to eliminate or at least minimize the need for material handling and second to minimize the cost of handling. The objective of the project is carried out critical analysis as to time-motion and economics of the developed conveyor system with linear and rotary conveyor to determine the i) Transfer time ii) Maximum load carrying capacity [2]. Comparative analysis of the performance of the developed system with conventional conveyor to derive. Change in job transfer time, and to save time and money. The project was done in two phases; the low-cost automation involved conceptualizing, designing and fabricating a Job Auto Loader, whereas in effective material handling several innovative ideas of improvising upon the existing material handling system were proposed and implemented.

Key Words: FMS, Material Handling, low cost automation, conveyor. Efficiency, Conveyor

1. INTRODUCTION

Flexible manufacturing systems (FMS) are distinguished by the use of computer control in place of the hard automation usually found in transfer lines. This enables FMS's to reconfigure very rapidly to produce multiple part types [3]. Use of fixtures and tool magazines practically eliminates setup time. These features permit economic production of a large variety of parts in low volumes. FMS's are increasingly being adopted in the manufacturing sector on account of the additional advantages of rapid turnaround, high quality, low inventory costs, and low labor costs [4].

The Belt conveyor and Bucket elevator are the media of transportation of material from one location to another in a commercial space. Belt conveyor has a huge load carrying capacity, large, covering area simplified design, easy maintenance and high reliability of operation [5]. The belt Conveyor system is also used in the material transport in a foundry shop like supply and distribution of molding sand, molds and removal of waste. This based on the combination of Belt & Bucket Conveyers to perform complex task within a short time and successfully in a cost-effective way [6].

The conveyor belt changed the face of the industrial economy around the world. Today, it has applicable uses in countless industries, such as transportation and food services. Efficiency & accuracy of the system were ensured using the sensor [7].

The concept and principles of low cost automation are basically the same as those of full automation, except that the former builds an improvement around existing equipment and, machine system rather than replacing the whole system with automated processes [8].

Material handling is the primary activity of every manufacturing organization. It has been estimated that at least 15 to 25% of the cost of the product are attributable to material handling activities [9].

Unlike many other operations, material handling adds to the cost of the product and not its value. It is therefore important first to eliminate or at least minimize the need for material handling and second to minimize the cost of handling [10].

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The project done was an effort of low cost automation and material handling by implementing very simple and innovative ideas for achieving effective material handling. The project was done in the low-cost automation involved conceptualizing, designing and fabricating a Job Auto Loader, whereas in effective Material handling several innovative ideas of improvising upon the existing material handling system was proposed. The design was made as per the requirement, we assumed within the limit of space, mass and cost budget. The designs were found acceptable and most of them were implemented.

2. IMPLEMENTATION OF FLEXIBLE MANUFACTURING STYSTEM: CASE STUDY

The following is a case study which exhibits a perfect example of how flexible and low-cost manufacturing can be incorporated into the existing industry like the Indian SME's. It was implemented in an Indian SME, which manufacturing automobile parts and components. It was a low cost and highly effective solution which saved the company a lot of money.

2.1 Problem

The current conveyor system problems are mentioned below;

- ✓ The current conveyor system in the company is fixed type, i.e. fixed length, fixed weight carrying capacity.
- ✓ The present conveyor is of high implementing cost approximately Rs.75000 to 80000 per meter.
- ✓ The cost of running the conveyor is very high as the motor runs continuously for 3 shifts and consumes a lot of energy. Electricity cost annual for the conveyor is Rs.18000
- ✓ The conveyor has high maintenance cost due to various electric sensors and systems.
- ✓ Annual routine maintenance cost / check up is Rs.20000.
- ✓ Cannot be adjusted/used with different machines at different angles.

The following figure 1, illustrates the existing electric motor-powered conveyor system which is used in the manufacturing lines. It is used to transfer the job from one CNC machine to another.

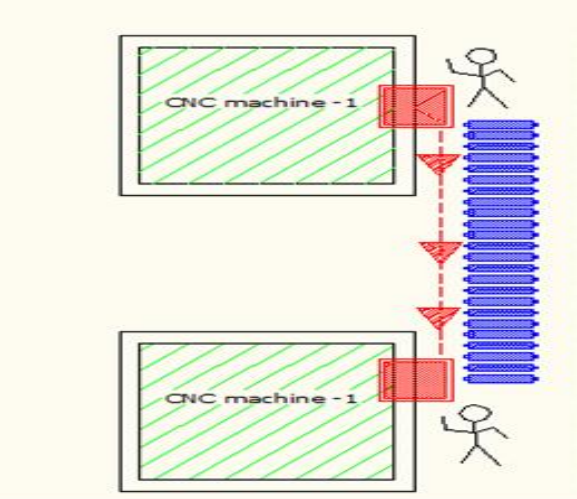

Figure 1: The existing conveyor system

2.2 Analysis

The conveyor should be modular, which is comprised of the following points;

- ✓ Length should be adjustable to incorporate various machines which are away from each other.
- ✓ Weight carrying capacity of conveyor to be varied from 5kg to 12kg in tray system.
- ✓ Conveyor should not require power to run (Powerless system).

2.3 Designing the proposed conveyor system

The gravity conveyor comprises of following parts:

- ✓ Base frame: The base frame is made of mild steel square tube of 20 x 20 mm cross-section 1.6 mm thickness.
- ✓ Tray slide: The tray slide comprises of the guide-ways mounted on the base frame and the roller system mounted on the tray. The guide ways are made of Mild steel plates of 20 x 6 x 1000 mm whereas the rollers carry ball bearings for free motion.

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✓ The pulley system: The pulley system comprises of two pulleys the tray pulley and the counter weight pulley system. The pulleys are mounted on a shaft mounted on ball bearing.

✓ Cable connector: The cable connectors are basically two wire ropes of 4mm diameter one connecting the tray pulley to the tray where, as the other one connects counter weight to counter weight pulley.

✓ End spring damper: The end spring damper is used to absorb the shock from moving tray at end of stroke. The figure 2, illustrates the diagram of the proposed powerless conveyor solution.

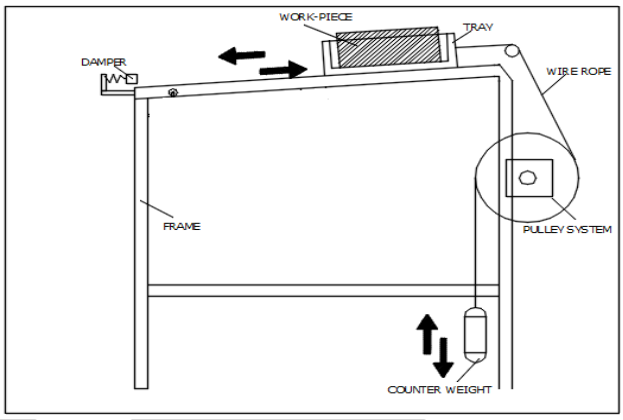

Figure 2: Proposed conveyor system

It is completely mechanically powered. Does not used electric motors or hydraulics.

2.4 Working

✓ Place the job to be transported into the empty tray. Now the weight of the empty tray becomes such that the counterweight is out balanced, and the tray moves down the slide rotating the pulley system such that the tray travels downward were as the counter weight travels upward.

✓ Due to the self-weight of the job the tray begins to slide down the guide system on rollers

✓ While travelling down the tray gather momentum, if this tray moving at a certain speed is suddenly stopped at the end of the stroke by the frame, then there is a chance that the job in the tray will fall down from the tray.

✓ The end spring damper is used to absorb the shock generated by the momentum of the moving tray, thereby preventing the job from falling from tray.

✓ Lift the job from the tray, the weight of the empty tray becomes such that the counter weight outbalances the empty tray weight, which makes the empty tray to move upward the slide rotating the pulley system such that the tray travels upward were as the counter weight travels downward.

2.5 Results

The following results are obtained after implementing FMS;

✓ Low fabrication, running and maintenance cost which is Rs.1000 per year.

✓ Reduces operators handling thus reduces operators fatigue.

✓ Robust, simple, compact and flexible design makes it suitable for almost all short distance material transfer application.

✓ Consumes no electrical power as works on counter weight principle.

✓ The effective productive time increases as the operator can utilize time for loading or unloading jobs from machine which was otherwise wasted material transfer.

✓ If intelligently mounted online, it does not block the passages for operator's movement. The qualification of the above parameters is expected to be done during the test and trial on the fabricated prototype.

✓ Comparative analysis of the performance of the developed system with conventional conveyor;

✓ Change in job transfer time

✓ Minimum and maximum load carrying capacity

✓ Savings in infrastructure cost by application of modified system

✓ Savings in energy cost by application of modified system;

- Total cost of the proposed solution is Rs. 35000 (A)

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- Cost of installation of existing conveyor is Rs. 160000 (B)
- Cost of electricity used annually is Rs. 18000 (C)
- Cost of maintenance of existing conveyor is Rs. 20000 (D)
- Cost of maintenance of the proposed solution is Rs.1000 (E)
- Total savings = B+C+D- (E + A) = 160000+18000+20000-(35000+1000) = Rs.162000

3. CONCLUSION

As we enter a new age of manufacturing and efficiency it is very important that we should focus our efforts to reduce the wastage in the industries. Above case study was just an example of how we can achieve that. Flexible Manufacturing is the future of manufacturing and the Indian SME's should take full advantage of this. Flexible manufacturing can save time money and effort in many ways have help the Indian manufacturing sector reach new heights and compete on a global scale.

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