Six Sigma Approach for Material Handling System for a Tobacco Threshing Plant

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Abstract
The prevailing global market which is competitive and fierce demands superior quality and high flexibility of production with shorter lead times. In order to stay competitive in the market, companies need to attain both customer satisfaction and cost reductions in production operations. Material Handling Systems (MHS) is the place to accomplish this goal, since they have direct impact on production. Material handling and its storage are features of all the companies although they are unexplored areas. Significant contribution made in the material handling area will go a long way in reducing the cost of production and improving profitability and rate of return. Therefore, the aim of this paper is to analyze how an in house MHS that could be efficient for the production it serves. With this intention, a case study has been conducted in A.S.KRISHNA&COMPANY PVT.LTD. Guntur. During the information is gathered through various sources, interviews, observations and measurements. Gathered data is further evaluated according to theoretical framework. By analyzing the findings from literature review and study, first problems and challenges related to present MHS’s are identified. Thereafter, possible features that the system should possess are drawn out and a design is built out of selected features with a compatible plant layout.

Key Words
Six Sigma, Customer satisfaction, Cost reductions Global market, Material handling system

Introduction
Today’s fierce competitive global markets, short product life cycles, and increased customer expectations have forced organizations to recognize the viral importance of investing and focusing on their logistics systems in terms of gaining competitive advantages. Material handling and storage features of all the companies although for many years they are unexplored areas. So to counter such problems proper research should be done. Logistics involves activities that ensure the necessary material is available at the right place and at the right time [1, 2].

Figure: 1 Logistics Management Process

The primary objective of the store is to provide storage of materials. Some methods of storage are associated with particular method of handling materials and therefore task of handling or stock and that of storage must be taken together. Therefore provision of material handling is another essential objective of the store function. The plant should be designed in such a way that easy flow of items or materials held are ensured without hindrances and minimizing the waste of time. Today materials are the livelihood of any company and no company can operate
without them, they must be made available at the right time, right quality, right quantity, right place and the right price to promote profitability of the company [3, 4].

The company procures its tobacco products from reliable vendors. The timeframe can be still reduced by updating certain methods and management techniques being adopted in the threshing plant. The infrastructure alone cannot bring the best outcomes but the way they are being handled and proper sequence of operations can lead the company to greater profits in terms of money, man and material. The different types of tobacco leaves being processed are gathered from different corners of the A.P and surrounding areas which makes the farmers around the Guntur locality to sell their crops at good price with less transportation costs [5, 6].

Green Leaf Threshing Plant changes the raw tobacco into a processed tobacco leaves which had its extensive usage for manufacturing cigarettes and tobacco products. Blending, tipping, conditioning, classification and re-drying are the important unit operations in tobacco threshing. The quality specifications during threshing operations are stringent and difficult to adhere [7].

Table 1: Typical Plant Layout of a Conventional Threshing Plant

| Quality Parameter of Lamina | Approximate Test Interval (min) | Sample size (gm) | Procedure And Apparatus |
|----------------------------|--------------------------------|------------------|-------------------------|
| Particle Size              | 20                             | 2500 to 3500     | Lamina particle size tester (Degradation shaker) |
| Stem Content               | 20                             | 2500 to 3500     | Stem Tester             |
| Moisture                   | 5                              | 50               | Brabander (quick moisture analyzer) and Hearson oven |

Quality Parameters of Stem

| Quality Parameter | Approximate Test Interval (min) | Sample size (gm) | Procedure And Apparatus |
|-------------------|--------------------------------|------------------|-------------------------|
| Length            | 60                             | 250              | Stem Length Board       |
| Diameter          | 60                             | 250              | Rotap Tester            |
| Moisture          | 30                             | 50               | Brabander and Hearson oven |
Figure 2: Flow process starting from the raw material (lamina) to the end material i.e., packing.

**Experimentation**

The present study was carried out on the MHS available in the company. To provide a deeper knowledge about the problems and challenges in the current in-house MHS and also to be able to suggest suitable solutions for the arisen issues a case study was conducted in this research. The DMAIC methodology is followed by a sequence of operations followed to evaluate the study. This study utilized descriptive survey which involves asking the same set of questions to a large number of individuals either by telephone, mail or in person. This design provides a precise picture of events and it also seeks to explain perceptions and behavior on the basis of data gathered at a particular time. Nevertheless results produced by this design can however be erratic because the questions which are normally asked seek to probe into private matters of the respondents and respondents may not be completely truthful about the response.
Table 2: Main classes and Attributes of Material Handling System

| MHS Equipment Type | Load Type | Load Capacity | Size | Nature | Speed of System | Accumulation Requirement | Distance | FreQUENCY OF MOVE | Flexibility of Path | Loading and Unloading Ability |
|---------------------|-----------|---------------|------|--------|-----------------|--------------------------|----------|-----------------|---------------------|-----------------------------|
| Robots              | Discrete  | Low – Medium  | Mediu m | Solid  | Low – Medi m    | no                        | short    | Often           | Low                 | Mediu m                   |
| AGVs                | Discrete  | Mediu m       | mediu m | Solid - Fragile | Medi um               | no                        | Mediu m  | Often           | High                | High                       |
| Rail Guided Vehicle | Discrete  | High          | Mediu m- Large | Solid  | High            | no                        | Long     | Low             | Low                 | High                       |
| Gantry              | Discre t e | Low-medi u m  | Mediu m | solid  | Low-medi u m    | no                        | Mediu m  | Low             | Low                 | Low                        |
| Forklift            | Discrete  | High          | Large  | Solid  | High            | no                        | Long     | High            | High                | Low                        |
| Conveyor            | Continuous | Low-mediu m  | Small-mediu | Solid  | Low-medi u m    | yes                       | Short-medi u m | Low             | Low                 | Low                        |
| Manual              | Discrete  | Low           | mediu m | Solid  | Low             | no                        | short    | high            | High                | Mediu m                   |

Results and Discussion
To gain the complete knowledge of the production let us see the time attribute taking place in each step of the production.

Table 3: Table of the time attribute of the production processes inside the plant

| Time Attributes | Process                     | Time Taken (seconds) |
|-----------------|-----------------------------|----------------------|
|                 | Unloading a bale on conveyer| 45                   |
|                 | Travelling Time on Conveyer I| 19.28                |
|                 | Conveyer to condenser       | 18.33                |
|                 | Inclined Conveyer to Condenser| 12                   |
|                 | Condenser operation         | 30                   |
|                 | Non Tobacco material Removal| 120 (2 mins)         |
|                 | Travelling in Pneumatic unit| 600 (10 mins)        |
|                 | Inside Dehydrator           | 360 (6 mins)         |
As the time attributes are calculated simultaneously the production data is also calculated in the plant. As a part of this case study the entire day’s production is calculated. The details are like this. The production inside the plant starts at 8.40 am in the morning.

Table 4: Timings along with the processes at the starting of production in a day

| S. No | Time     | Process                                      | Remarks                                      |
|-------|----------|----------------------------------------------|----------------------------------------------|
| 1     | 8.00 - 8.40 | The machinery starts in the plant.         | Trail run of machinery                      |
| 2     | 9.01     | Removal of the first bale and placing onto conveyer | Delayed to 9.01 from 8.47 because of labor problem |
| 3     | 9.04     | Outlet of steamed leaves from conditioner   | Leaves get buffered in conditioner          |
| 4     | 9.24     | Leaves coming into dehydrator from threshing plant | The leaves get threshed and segregated for 20 mins in pneumatic unit. |
| 5     | 9.36     | Leaves comes outside from the dehydrator for packing | 14 mins of time needed to get equal moisture content. |
| 6     | 9.42     | The processed tobacco fills and gets rammed into box of required weight. | To maintain the density inside the plant the leaves get rammed with high pressure |
| 7     | 9.5      | The second comes to fill and the first box leaves the filling station. | The box gets strapped and leaves to the warehouse |

The number of bales consumed per day: 500 bales
The processed box comes from 500 bales: 180 boxes

**Productivity**

*On an average the input of raw tobacco is 50 tons*

The yield of processed tobacco is 60 to 70% of raw bales.

**Electricity Consumption:**

The power consumed for hour is 500 units
The power consumption for a day is nearly 4500 units. The cost of single unit is 9 rupees.

**Labor and their Wages:**

The daily wage workers inside the plant are about 80 members.
The office staff constitutes of 30 members
On the whole, The running cost of the plant per kg is 8 Rs.
The running cost of the plant per day 4 Lacs.

**Financial Impact because of the Solution**

The solution lets the company to lessen the human fatigue at the different places of the production leading to save the production time and the cost of production incurred previously on the production happened in the plant.

Let us go through a case happening in the plant

Number of workers involved in loading and unloading of the bales and processed tobacco are 60 men.

The daily wage of a labor is 600 to 800 rupees depending up on their work. The money incurred on wages for the workers by the plant is:
Wage on an average 750Rs

Total money incurred per day on them 750*60=45,000 Rs.
Total money incurred per day on power 4500*9=40,500 Rs.

The power consumed by the machinery costs less than the wages for the workers. So, by using the above solution the loss for the company in this particular aspect can be removed by implementing the solution which cost less than the wage of labors.

Conclusion

The tobacco will go through several treatments for about 30 minutes in threshing process. Hence the processing loss is high. New methods and process optimization must be tried for all stages such as conditioning, threshing and classification to minimize the processing loss. In GLT operation of FCV tobacco, around 8 to12% of the tobacco is packed as scrap (by-products) and these products are sold for the production of bidi and other low quality products at a low price. In some developed countries, the tobacco by-products are converted into sheet tobacco or reconstituted tobacco and used along with the lamina. But due to high initial investment, this technology has not been used in India. Low cost methods to produce reconstituted tobacco must be developed to give value addition to the tobacco byproducts.

So our project which had been done on the Design and Analysis of Material Handling for the Tobacco threshing plant is mainly concentrated on the

- Reduction of the human effort
- Reducing the time being wasted in material movement in production area precisely at
  - Production lines
  - Raw material loading and unloading
  - Final Product Loading
- Reducing the facial issues incurred in material Management.
- Suggesting the best plant Layout.

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