



Essence of Maintenance Planning and Scheduling For Improving Quality and Productivity in Fly Ash Brick Manufacturing Industry

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Abstract

Effective Maintenance Planning and scheduling work is significantly important in the day to day work of fly ash brick manufacturing industry for increasing its productivity. For successful maintenance optimization, it requires a well trained work force, good management and an organizational structure. Utilization of the essential resources of fly ash brick industry must be made efficient and effective in getting the work accomplished. Here we examine the working process right from work initiatives, to planning and scheduling, to work executive, to work completion and finally to continuous improvement. This paper focuses over the enhancement of the fly ash brick quality and productivity with the help of proper maintenance planning and scheduling.

Keywords: *Maintenance, Planning, Scheduling, Productivity, Quality, Capital Productivity.*



INTRODUCTION

Industries in the 21st century are facing problems due to continual evolving of world technology, global competitiveness, environmental and safety requirement, and perception towards total quality with different aspects threatening company's profitability.

Nowadays fly ash is considered as a valuable resource and needs to be studied in order to facilitate the application of fly ash to new and innovative areas of economic interest. Fly ash brick industry, as it is one of the potential economic sectors, should be given proper attention for sustainable development of the country. On seeing the present day demand for bricks, an attempt was made to increase the productivity and quality of fly ash bricks by maintaining Maintenance Planning & Scheduling.

Maintenance Planning assumes great importance in a competitive world, where it plays a very important role to shape the organization as a profitable one. Planning can occur at any stage during the life of a work order or maintenance job. Scheduling provides the flexibility in the transformation process to accommodate the ever changing situations due to availability / non-availability of various resources and environmental factors. It integrates the people, machine, materials, customer demands, and quality requirements. It also determines the exact order in which the works are to be executed.

An industry, in order to sustain and succeed in the market should give importance to Quality. Manufacturing sector is not an exception to it. In fact, the awareness towards quality is high in the manufacturing sector all over the world. The basic concept of the Productivity is the relationship between the quality & quantity of goods or services produced and the quantity of resources used to produce them. ILO defines productivity as the ratio between "output of work" and "input of resources" used in the process of creating product. Thus

$$\text{Productivity} = \frac{\text{Value of the output}}{\text{Value of the input}}$$

LITERATURE REVIEW

Maintenance Planning and Scheduling is the combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to a state in which it can perform the required function. (EN 13306: 2001). It is logical to utilize the resources like machinery, men, and material as optimally as possible (Krishnaiah 1995).

According to Vashisth and Kumar (2011), the desired production output is achieved through high availability, which is influenced by equipment reliability and maintainability. The reliability of equipment is decreasing with time. That has brought the maintenance functions into focus to improve the production system's performance. There is consensus among authors [Madu, 1999; Cooke, 2000; Madu, 2000] that equipment maintenance and system reliability are important factors that affect organization's ability to provide quality and timely services to customers and to be ahead of competition.



Peters, (1999) defined quality as a ‘magic bullet’ which provides lower cost, higher customer service, better products and higher margins. He also explained that ‘quality is in the eyes of the beholder’, this means it is what the customer says.

George Bernard cited in Stebbing, (1992) noted that two forms of qualities exist in the world, efficiency and inefficiency. To him, efficiency is what every senior manager should strive to achieve and the efficiency in service is what the customers expect to get. He explained that organisations are inefficient because of the inadequate trainings given to employees by the employers or the assignment of task to unqualified workers. Whichever way quality is defined, it is viewed as part of an organisational culture; this should be inclusive of all different facets of production.

According to Juran (1988), the basic goal of quality management is the elimination of failure; both in the concept and in the reality of products, services and processes.

Productivity is the relationship between what comes out of an organizational system (assuming that the output meets the attributes established for them) divided by what comes into the system (i.e. labor, capital, material etc.) during a given period of time (*Alsyouf, 2004*).

The word “Productivity” was coined in 1776 and defined differently objective being the same as – “Productivity denotes the efficiency with which output is produced by the resources utilized”. An effort to save time, energy, power, money and materials to achieve higher production of goods and services at lower cost.

According to Bailey and Hubert Productivity is a comparative tool for managers, industrial engineers, economists and politicians. To be useful, measures must be as simple and as consistent as possible. When deciding to measure productivity, consider what a person does, how well, how much, and how often.

Gunasekaran et al. (1994) argued that an integration of various functional groups within a manufacturing organization can improve both productivity and quality in the organization.

CASE STUDY

There is a XYZ Company in 24 PGS (N) which is producing fly ash bricks for last 5years. They are facing problem related to fly ash brick productivity as well as quality. This manufacturing industry invested a lot of capital in brick production but not getting the results accordingly, rejection of the bricks is increasing day by day. Now they are looking for the solution of the above mentioned problem.

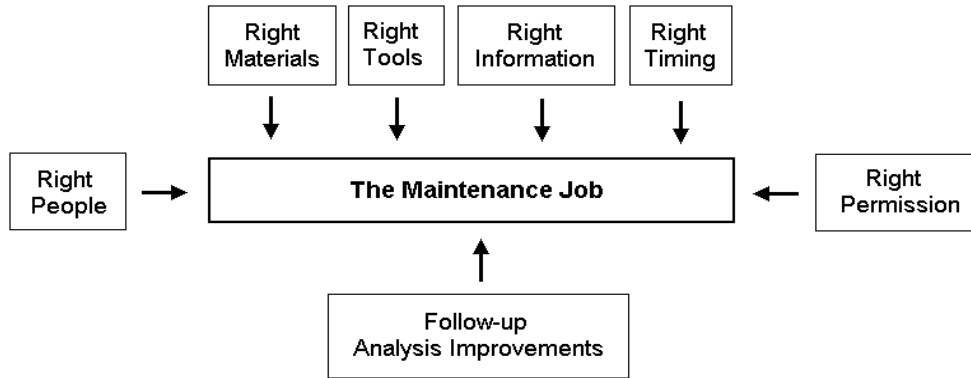
METHODOLOGY

The data have been collected by interview; study of the previous records and mainly by observations.

Maintenance Planning & Scheduling program taken for fly ash brick industry:-



Fig. 1 Maintenance Job



Manufacturing process of fly ash brick of above mentioned company:

The manufacturing process of fly ash brick requires fly ash, sand and cement (ingredients). First, fly ash and sand are mixed in pan mixture and then cement is added to have uniform dry mixture. Water is added to the pan mixture. Once the bricks are taken out of the mould, they are Sundried for 24 hours. Water curing is then done for about 21 days to allow required strength to be achieved.

Considering the manufacturing process of fly ash brick, the main objective of the paper is to increase the productivity of the fly ash brick industry without sacrificing the total quality of the product. The quality of bricks mainly depends on:

- Quality of the raw materials.
- Proportioning of the raw materials.
- Handling & mixing of raw materials.
- Handling & pressing of the raw materials.
- Curing of the finished product.

So, Plant maintenance is of great importance as it provides a means to maintain the plant and equipment in a high state of operating efficiency and enhance its Capital Productivity (CP). CP includes all money invested either for buying or leasing land, buying machineries and equipment and procuring raw materials. Fly ash brick manufacturing industry purely involved in producing bricks which require very large capital to build production facilities. On the other hand, to improve the total productivity of the brick industry it is important to improve the Labour Productivity (LP).

$$\begin{aligned}
 \text{Total factor productivity} &= \frac{\text{Net output}}{(\text{Labour} + \text{capital}) \text{ input}} \\
 &= \frac{(\text{Total output} - \text{materials and services purchased})}{(\text{Labour} + \text{capital}) \text{ input}}
 \end{aligned}$$

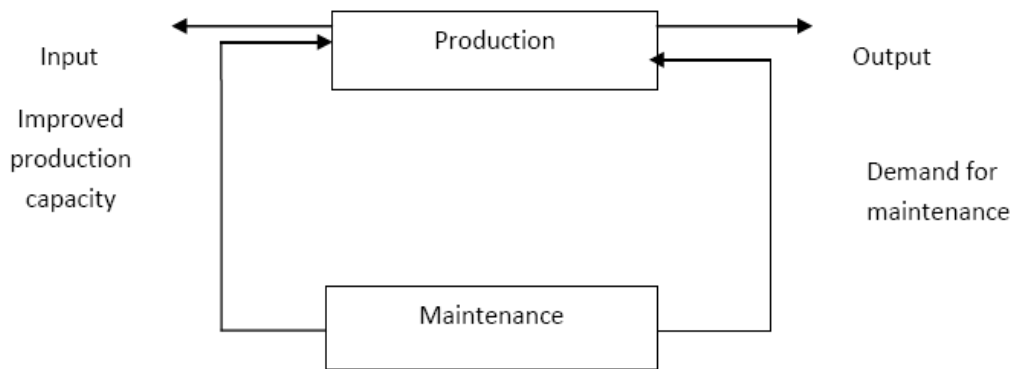


Fig. 2 Production – Maintenance Relationship

The production of fly ash bricks is not limited to just producing the finished products. It includes many other activities such as:

1. **Break down maintenance:** Time to time Proper maintenance of the brick machines is very much required.
2. **Maintenance:** It is a systematic maintenance procedure where the condition of the equipment of brick production is constantly watched through systematic inspection and preventive action is taken to reduce the incidence of breakdown.
3. **Material handling:** All the materials (Fly ash, sand, cement) should be stored in covered shed and suitably protected from rains. Improved method of material handling will increase the productivity and reduce the cost of production. Time & distance of each move of material should be minimized, materials should be pre-positioned for use, route should be planned and controlled.
4. **Inventory control:** It means what and how much should be kept in stock. Basic reason for inventory control is to reduce the inventories cost and run the production without break.
5. **Manpower / Human resource / labour power:** Human resource is another important resource influencing productivity. The number of persons employed in fly ash brick industry is not important as to the quality of the persons employed. The number of persons should neither be less nor more than the requirement.
6. **Rate of production.**
7. **Innovation.**

Productivity is a function of the production process related to efficiency and effectiveness. When we are talking about the Maintenance program of fly ash brick industry, the impact on other working areas is also measured. Maintenance improvements in general aim at reducing the cost of operation and improving the quality of the brick.



MAINTENANCE GOAL

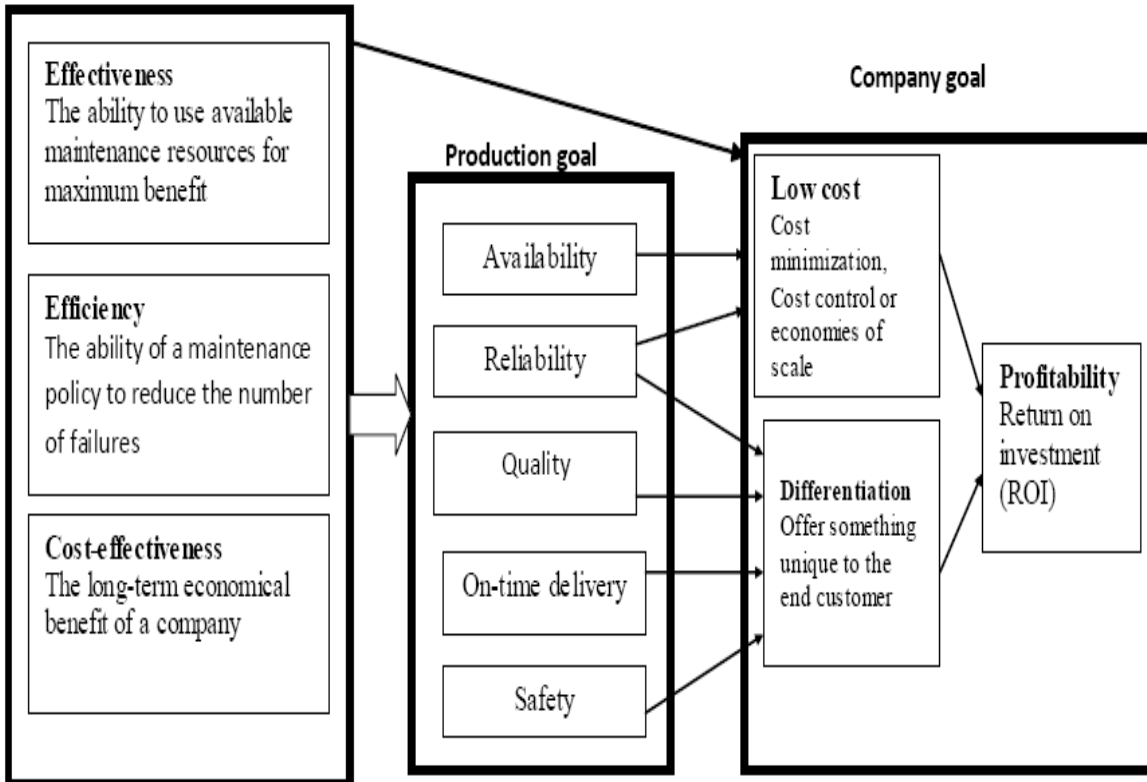


Fig. 3 Connection between Maintenance Goal and Profitability.

Present Maintenance Planning & scheduling structure / details of the company will give us an idea about the causes of the problems:

1. Machines are checked only when those get broken. Machines are not getting adequate maintenance. So production system is hampered sometime.
2. Machine operator is not properly trained so maintenance work is not regularly done.
3. Fly ash is not obtained from 1st and 2nd field of ESP only so carbon content is changed every time which needs to be checked before use.
4. Water used for mixing is alkaline in nature but not neutral every time.
5. Labourers are not regular so production is hampered due to absenteeism.
6. Compressive strength of the machine is 70 which is not enough for large production.
7. It is not possible to run double shifts so production is like many other small brick industries.
8. In rainy seasons sand is not kept under shaded area.



This fishbone diagram finds out the causes of defects and its effects for the concerned fly ash brick industry.

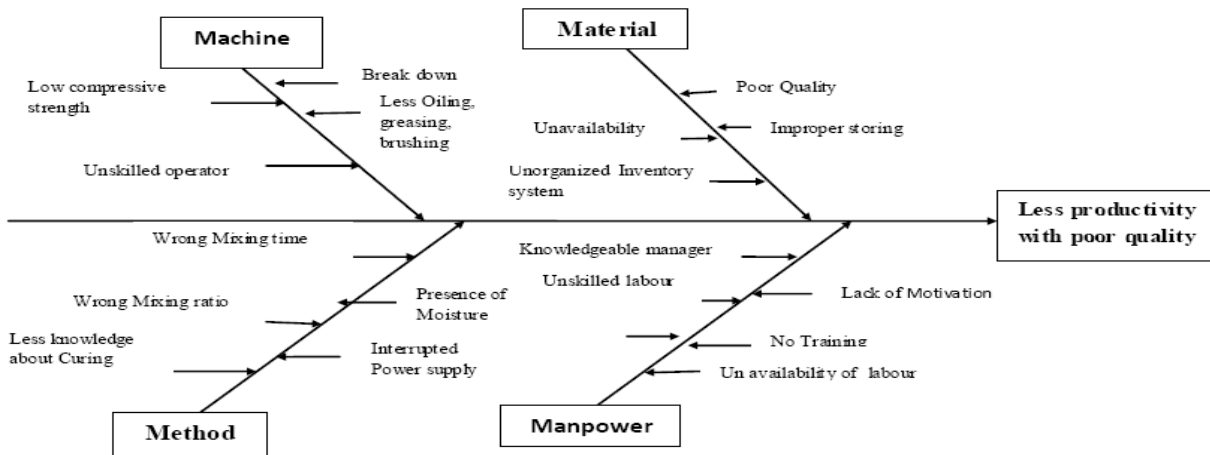


Fig4. Cause-effect structure for fly ash brick industry

Above mentioned problems of fly ash brick industry can be controlled by implementing proper Maintenance Planning and Scheduling. Many areas can be addressed to improve the productivity and quality of fly ash brick industry. Each one contributes to a higher level of productivity and quality. Some suggested planning and scheduling for productivity improvement and quality control are given here:-

PRODUCTIVITY:

A good design of the brick plant and an efficient system arrangement for the various operations play a key role in higher productivity.

1. Assessing the need of maintenance: Develop the maintenance concepts and list out the principles to work. Training should be imparted in such a way so that every member of the fly ash brick is able to remember “what to do or what not to do”.

2. Inventory of equipment: Prepare an inventory of all equipments in the plant. Small spare parts of the machines are also be always kept in stock. May be their prices are very minimum but necessary to keep the machine running.

3. Machinery:-

- Productivity is related with machinery. Management should always review the need for replacement of the old machinery by a more modern one in their maintenance planning. May be the price of the high compressive machine is costly but it will increase the productivity and reduce the cost of the product.



- Failure analysis: - Review the equipment design of the brick machine to identify functional failure modes and mechanism so that proper maintenance planning can be done.
- Recruit a machine engineer or if possible make a contract with the machine company for monthly inspection by their engineer.
- Prepare maintenance procedures and standard practices, instructions and check lists of all preventive maintenance works like inspection, lubrication, adjustment and part replacement.

4. Resources:

- **Manpower:** Manpower is an important resource influencing productivity. Skilled labourer will be more productive with proper training and motivation. Trained labourers are more useful in maintenance than unskilled labourers.
- **Material:** - Materials of fly ash brick production should be always kept under shaded area to protect them from rain.

5. Management: A management with appropriate responsibility and delegation with clear procedures is found to be more productive as compared to other industry.

6. Supplier: It is preferable to purchase the raw material from known supplier to whom we can trust for quality.

7. Method: - It is not mandatory that every fly ash brick company will use the same material for brick production. But the process of brick making is very important to all. Proper mixing, sun drying and curing play a key role to improve the quality of the product. By maintenance planning and scheduling, the company can delegate the each responsibility to each group of people. Appropriate responsibility and delegation with clear procedures are found to be more productive in comparison with other industry.

QUALITY:-

- 1. Machine:** With the higher of compressive strength of the brick manufacturing machine, product quality is also increased. It will take lesser time to get the right strength of the brick.
- 2. Material:**
 - The quality of the each ingredient must be checked every time before use. On the basis of the quality and presence of different mineral content, mixing ratio of raw materials is changed. It is only possible with skilled manpower and proper maintenance planning and scheduling.
 - It is essential to ensure correct stock keeping details of material.



Table 1 Year wise brick sold and percentage of rejection

Serial No.	Year	No of Fly Ash Bricks sold	% of Rejection
1.	2009-10	61,38,000	7 %
2.	2010-11	66,49,667	5 %
3.	2011-12	72,00,000	4 %
4.	2012-13	79,95,000	2.5 %
5.	2013-14	86,68,000	1.5%

Fig. 5 Percentage of rejection year wise for brick manufacturing industry

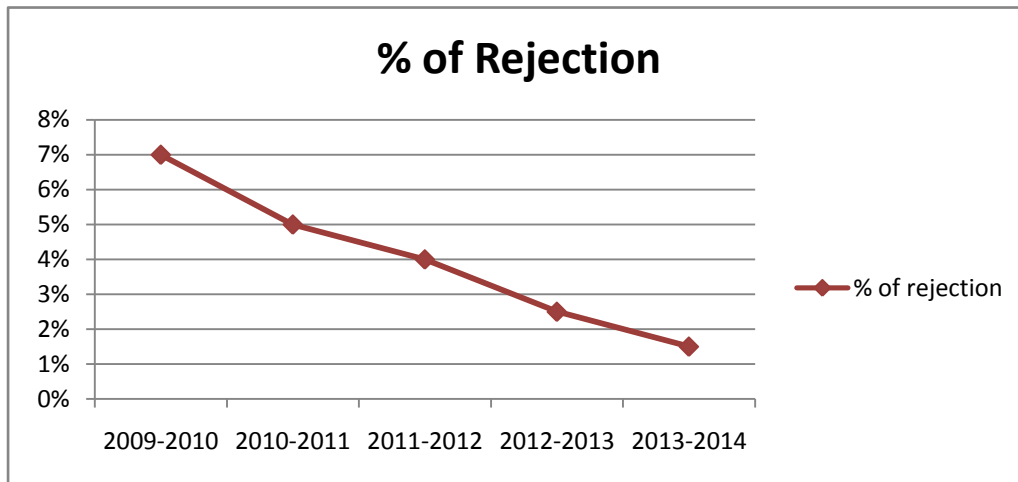


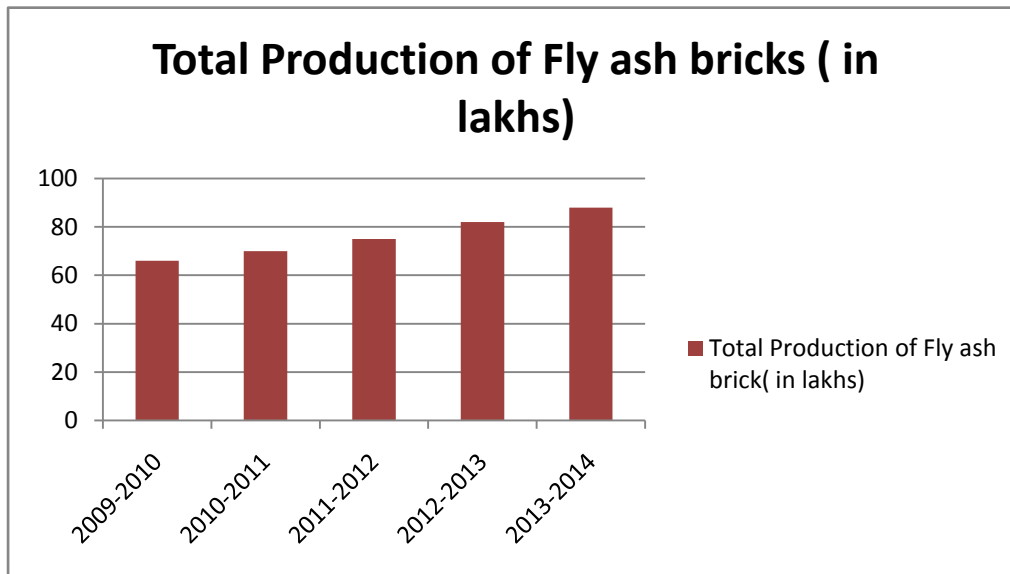
Table 2 Year wise Brick Production

Serial No.	Year	Total Production of Fly Ash Bricks
1.	2009-10	66 lakhs
2.	2010-11	70 lakhs
3.	2011-12	75 lakhs
4.	2012-13	82 lakhs



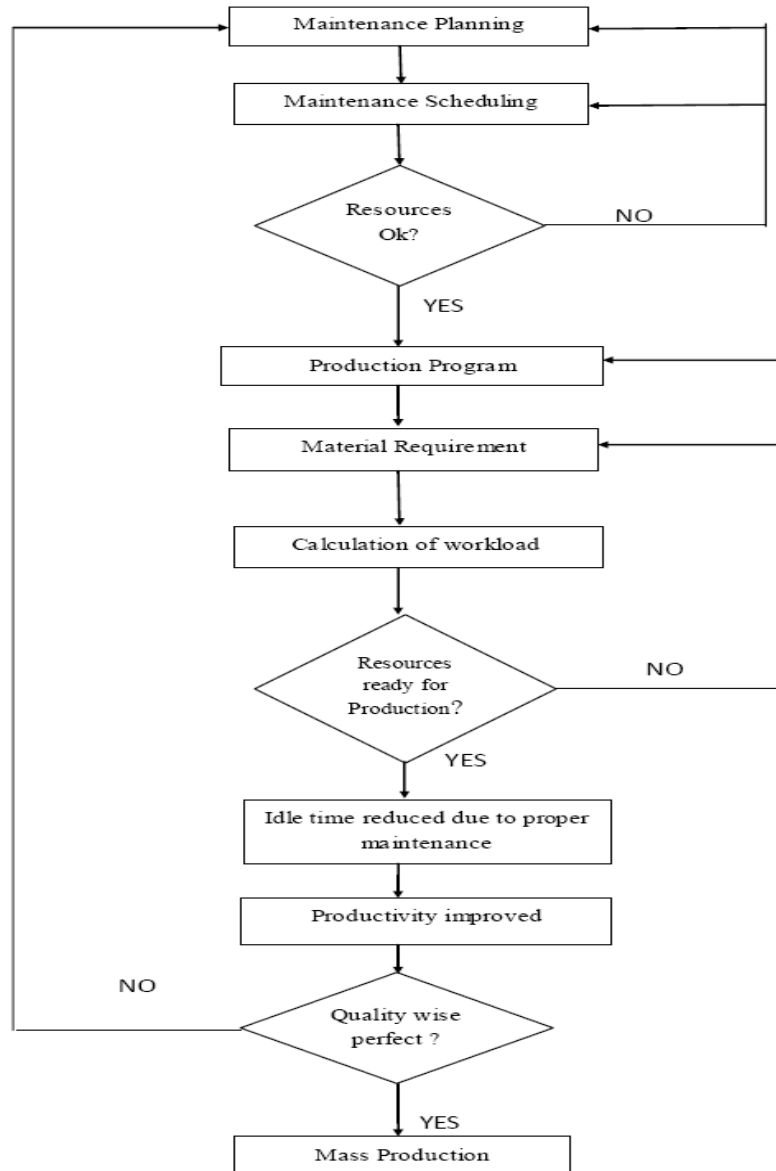
5.	2013-14	88 lakhs
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Fig.6 Total Production of Brick year wise





Propose model:





CONCLUSION

Plant Maintenance is an important function to keep the plant and machinery operative. It is not only essential for the brick plant and machinery to operate, but also importantly the operation should be carried out uninterruptedly and efficiently. If there are frequent interruptions in the production process due to equipment failure or damage to the equipment, the brick plant faces lots of problems such as loss of productive hours, adverse effect on quality of product and more product rejection.

Maintenance as a function in a production system of a fly ash brick industry can increase production efficiency, reduce downtime or unwanted stoppages, improve product quality and consequently, plant profitability which is one of the most significant motivations of company's investment. Maintenance implementation in a production system can improve production profitability in numerous ways by reducing production process interference. In manufacturing environment, a production system is a company's main process because it produces quality products which when sold, keeps the company in business. In ensuring that bricks are delivered at the right time with the right quality and the lowest possible cost it requires optimum availability which can be attained by efficient maintenance policy. A proper maintenance practice can keep machines and equipments (that constitute a production system) in a reliable machine condition, thus, minimizing production inefficiency, product defects, downtime, etc.

REFERENCES

- [1] Bailey and Hubert, *Productivity Measurement*, Lowe & Brydone printers Limited, Thetford, Norfolk, Great Britain, 1980.
- [2] B. Chatterjee, K.K. Singh, N.G. Goswami “ *Fly ash utilization for value added products*”, February, 1998.
- [3] Das, A.K., (1999) : *Coal ash utilisation: An alternative technology*, Journal of CAII, September, 1999.
- [4] Enofe, M. G., Department of Terotechnology, “*Maintenance impact on Production Profitability - A Case Study* ,” Spring 2010,
- [5] Gunasekaran, A., korukonda, A.R., Virtanen, I. and Yli-Olli, P. (1994), “*Improving productivity and quality in manufacturing organizations*,” International Journal of Production Economics 36, 169-183.
- [6] HMSO, 1970, *Report on Maintenance Engineering*. Department of Industry Committee for Technology (London: HMSO).
- [7] Juran, J. M., and Gryna, F. M., (1988), ‘*Juran’s Quality Control Handbook*’, McGraw-Hill Book Company New York, NY



International Journal of Business Quantitative Economics and Applied Management Research

- [8] Madu, C. (1999): *Reliability & quality interface. International Journal of Quality & Reliability Management*, 16 (7), pp. 691–698.
- [9] Peters, V. J., (1999), ‘*Total Service Quality Management*’, *Managing Service Quality*, 9(1), pp6-12.
- [10] Ross , K.W. (1994) ,”*Assembly-line job satisfaction and productivity*,” *Industrial Engineering* 26, 44-45.
- [11] Shah,Y.M.B,” *Total Productive Maintenance: A Study of Malaysian Automotive SMEs*”, Proceedings of the World Congress on Engineering 2012 Vol III, WCE 2012, July 4 - 6, 2012, London, U.K.
- [12] Tsang, A.H.C. (1999): *Measuring maintenance performance - A holistic approach*, *International Journal of Operations a Production Management*, 19 (7), pp. 691–715.
- [13] Tsang, A. H. C. & Chan, P. K. (2000). TPM Implementation in China: A Case Study, *International Journal of Quality & Reliability Management*, 17(2), 144-157.
- [14] Vashisth, D. S.; Kumar, R. (2011): “*Analysis of a redundant system with common cause failures*,” *International Journal of Engineering Science and Technology*, 3(12), pp. 8247-825.