Concurrent Engineering in Rice Industry: Benefits and Shortcomings

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Abstract— *Concurrent Engineering plays a vital role in firm's performance and has affected serious research attention over the last few years. A literature review provides a considerable support in theoretical and practical aspects of Concurrent engineering. Concurrent Engineering acts as an important tool to improve the productivity and quality of the product in any industry. A large number of research papers have been published in the last two decades regarding the concept. This paper reflects the benefits of Concurrent Engineering in rice industry and problems faced by rice industry like low productivity and Quality.*

Keywords— Concurrent Engineering, Productivity, Quality, Literature Review, Rice Industry

I. INTRODUCTION

In term of production, India has become the second largest producer of rice in the world (21 percent of global rice production), next to China. As on 2009, rough total production of paddy was 14,8260 thousand MT in the country, but as estimated by USDA, it was 13,2013 thousand MT. On the demand side, on an average India's domestic consumption was 95% of what it produced and was still the third largest exporter of rice, after Thailand and Vietnam, with about 20% of the world's total rice exports in 2006-07. Population growth is rapidly increasing till the extend that companies cannot meet up with the demand. Customers are also having a high taste for new and advanced products which are health wise good. This demands a lot to the companies as they would have to improve on their quality and produce different variety of products at same time or concurrently, so as to meet the customers taste and demand. In developing countries, most companies do not meet the customers or market demand. The main objective of this study is to examine the existing system before designing the proposed model and to propose the best alternative by using applications of concurrent engineering and thereby contribute to improve the production and quality of the rice. Rice has been the staple food for more than half of the humanity in the world or two-third of the World's population. Rice is the seed or kernel of paddy, which is covered by two different layers, namely-bran (inner layer) and husk (outer layer). Literally, paddy becomes rice only when the two layers are removed properly through different milling processes. In the first step, brown rice is extracted by removing hull/husk from the paddy, which contains bran layer still intact around the kernel. In the second step, the bran layer is removed by polishing machine that rubs the grains together under pressure, and the output is the polished white kernel or fine rice, which is ready for cooking. The former process is known as hulling and the latter is known as milling of paddy. But, in short, it is the conversion ratio from paddy to rice.

II. LITERATURE SURVEY

A. Objectives of Literature Survey

There is a vast amount of literature related to the concurrent engineering. This chapter reviews the literature related to concurrent engineering. The objectives of survey are:

- To study the various aspects of concurrent engineering in rice industries.
- To find the technical problems in rice industry which affects the productivity and quality of rice.
- To maximize the percentage of on time delivery of rice to the market.
- To elaborate the benefits & shortcomings of concurrent engineering in rice industries.
- To identify the effect of Concurrent Engineering on productivity and quality.

B. Methodology of Data Collection

Literature has been reviewed through Indian and International journals, books, conference paper etc. Online journals and magazines provides the detailed information regarding the topic.

C. The Literature about the Concurrent Engineering

Several pieces of literature from which no specific ideas were used or drawn for this dissertation, but which were extremely necessary to gain the background needed to understand other work being done.

Concurrent engineering has been developed and practiced by large multi-national companies working in consumer oriented industries. As a result, the implementation methods, tools and techniques have been geared towards these industries. Some of these methods, tools and techniques, cannot be easily applied in small to medium sized companies in traditional industries. During the world recession of the early 1990s, it became clear to the 600 Group management that the company must adopt a market led approach and that it must have the ability to react quickly to the market needs. Concurrent engineering was recognized as the philosophy that would enable rapid new product introduction. Three issues were fundamental to 600 Lathes Concurrent Engineering practice, project initiation, involving all functional disciplines, teamwork, and risk management. It was necessary to adapt the general principles to use them in a medium sized manufacturing company. None of the concurrent engineering techniques were used formally. However, the underlying philosophies were informally used to good effect. Teamwork made the most significant contribution. Inspite of not formally using some of the recognised tools and techniques of concurrent engineering, for example, quality function deployment (QFD) and failure modes and effects analysis (FMEA), the application of the generic principles resulted in significant benefits. The use of parallel work philosophy in a team environment reduced the product introduction lead-time by 30% and the cost by a third.

Concurrent engineering is a keyword in today's enterprises. Almost every enterprise parallelizes its engineering processes to reach a higher efficiency in designing their products. Unfortunately, the time- and cost-saving potential of concurrent engineering cannot be used to its full capacity. In fact, design problems arise and lead to a lot of rework.

Concurrent engineering is defined as a systematic approach to create a product design that simultaneously considers all elements of the product life cycle, from conception through disposal. It is a critical part of the rapid application development technique as well as the joint application development technique.

Concurrent engineering is a means to shorten the product development time. Information system supporting concurrent engineering must facilitate the exchange and unambiguous interpretation of product data from various design and manufacturing stages, the collaboration of geographically dispersed experts in a complex design process, and the use of diverse computing platforms and tools. Department of Mechanical Engineering, builds an integrated information system for concurrent engineering applications. The system is based on a single, integrated object-oriented data model and schema, the so-called product and production model, which covers all phases of the product life cycle.

Klaus et al. (1996), presented a holistic approach to concurrent engineering and its implementation which is under development by the Brite-EuRam funded PACE consortium. PACE stands for a 'Practical Approach to Concurrent Engineering'. It is a pan-European project consisting of a consortium of eight partners (four industrial and four academic research institutions) from four European countries (UK, Germany, Denmark and Portugal). The primary aim of PACE is to provide a holistic technology transfer infrastructure enabling the effective and efficient change and improvement of present engineering practices towards concurrent engineering principles.

At the outset the question of what is meant by a conceptual model is discussed, together with what it should contain and how it should be structured. This is followed by a description of how the PACE conceptual model was derived and why the consortium considers that it encapsulates the pertinent issues of CE. The most well-known existing models are reviewed, examined and critiqued. Through analysis of previous case studies and in the authors experience, many companies consider that there are difficulties with existing models for CE implementation. It was felt that none of them presented the full picture in terms of what constitutes CE and what bearing it will have on companies that decide to go ahead with implementation. The authors and the PACE consortium believe that the conceptual model will be unique due to its high level of industrial relevance. This section is augmented by the developments to date on the Knowledge Platform environment and its user interface.

The final section of the paper focuses on the issues relating to a generic concurrent engineering implementation support framework. A methodology defining the introduction of CE-based product engineering processes is outlined. This is generic in nature but designed to be adaptable to specific company needs. Implementing CE successfully requires a huge cultural change in an organization. The framework presented in the paper is especially aimed at showing how to implement CE in an ordinary company i.e. not using a 'super-motivated' project team. It provides a structure for implementation, drawing on literature and experiences of the PACE industrial partners.

Implementing concurrent engineering successfully requires a significant cultural change in an organisation. This paper has provided a structure for implementing concurrent engineering within PACE, drawing on literature and experiences of the industrial partners. An in-depth study of the situation within the industrial partners with respect to CE attitudes was both useful and revealing. A generic methodology has been proposed to help companies achieve the change towards concurrent engineering.

Dr. David M. Anderson (2008), described concurrent engineering as the practice of concurrently developing products and their design and manufacturing processes. If the existing processes are to be utilized, then the product and the processes must be developed concurrently. Here, this requires knowing much about manufacturing processes and one of the best ways to do this is to develop products in multifunctional teams. He shows how to design products for all aspects of manufacturability and use multifunctional product development teams and Concurrent Engineering principles to achieve the goals of Design for low cost. He presents many effective methodologies to design low-cost products by concurrently engineering products in multifunctional teams that will simplify concepts, optimize architecture, optimize the use of modules and off-the-shelf parts, have pre-selected vendors help design custom parts, understand and avoid previous problems, and then thoroughly design for manufacturability for quick launches without expensive change orders. He shows how to design quality and reliability into the product and thorough up-front work is the key to quickly developing products, avoiding changes, and achieving fast ramps.

Sandra et al. (2009), defined concurrent engineering (CE) as a systematic approach to the integrated, concurrent design of products and their related processes, including production and support. Winner et al. (1988) stated that one of the widest known definitions of CE is the one given by the American Institute for Defense Analysis, which considers it to be a systematic approach to the integrated, concurrent design of products and related processes, including manufacturing and support. This approach is intended to cause the developers to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements

Portioli et al. (2003) examined the extent to which Concurrent Engineering best practices are being used effectively in companies. Companies in India were investigated using a Concurrent Engineering compliance checklist. The concept of concurrent engineering (CE) has been known for quite a while now, and it has been widely recognized as a major enabler of fast and efficient product development and examines the extent to which CE best practices, as obtained from a broad literature review, are being used effectively in companies. Companies both in

Belgium and in Italy were investigated using a CE compliance checklist. Specific information per sector is also included. Finally, the positive impact of formal Concurrent Engineering programs is proven by the data.

According to Pennell and Winner, (1988), "Concurrent Engineering is a systematic approach to the integrated, concurrent design of products and their related processes, including, manufacturing and support. This approach is intended to cause the developers from the very outset to consider all elements of the product life cycle, from conception to disposal, including cost, schedule, quality and user requirements". This strategy focuses on the optimization and distribution of a firm's resources in the design and development process to ensure effective and efficient product development process also enhances productivity and leads to high-class designs.

Shina S.G. in his paper "Concurrent engineering: new rules for world-class companies" (1991) discussed how concurrent engineering technique is best suitable for manufacturing of high quality products by companies highlighting the benefits such as shorter time for product introduction, improved design quality, reduced design iterations, and shorter production time. Also enlightened the effects of multifunctional teaming which include design for manufacturing (DFM) continuous process improvement (CPI), total quality management (TQM), and quality function deployment (QFD) i.e., product development with concurrent engineering involves all parts of organization.

Rob Kinna, in his paper "Team working and Concurrent Engineering – A Success Story" (1995) has discussed the experiences and success of adopting Concurrent engineering highlighting the criticality of team selection, building and empowerment. He is of the opinion that the concurrent engineering team must include both internal group and external group such as customers, suppliers**.**

David Bradley in his paper, "Concurrent Engineering for bespoke products" (1995), discussed the disadvantages of traditional design techniques and shown how concurrent engineering benefits the organization. He says that concurrent engineering will advocate building teams working together from initial phase and in close contact with the customer.

Alireza Aslani studied that different definitions have been used for concurrent engineering (CE). For instance, Pennell defines CE as a systematic approach to integrated design of products and related processes. This approach is considered in three different frames; people, process and Technology. Recent evidences show that CE can cause 30% to 70% less development time, 65% to 90% fewer engineering changes, 20% to 90% less time to market, 200% to 600% higher quality, and 20% to 110% higher white collar productivity. Basically, there are some gaps and challenges in team working that is noticeable in CE project teams too. Since in CE projects members from different disciplines with specific goals are engaged, and they might have never worked on teams, managers face with several challenges to keep the performance of the team in desirable expectation level. In this condition, some suggestions are encouraged to improve the team performance such as; sharing of knowledge, engaging in social interactions, and training in CE teams.

III. FINDINGS FROM THE LITERATURE SURVEY

Concurrent Engineering aspect: It is clear from the literature survey that Concurrent Engineering examples an important role in rice industry. As rice making is a process with the involvement of machines and procedures so there are chances to improve in both the fields.

Rice is the seed or kernel of paddy, which is covered by two different layers, namely- bran (inner layer) and husk (outer layer). Literally, paddy becomes rice only when the two layers are removed properly through different milling processes. In the first step, brown rice is extracted by removing hull/husk from the paddy, which contains bran layer still intact around the kernel. In the second step, the bran layer is removed by polishing machine that rubs the grains together under pressure, and the output is the polished white kernel or fine rice, which is ready for cooking. The former process is known as hulling and the latter is known as milling of paddy which is carried out in following steps:

- Unloading of the paddy to the silo with the help of bucket elevator.
- Drying of the paddy with the help of dryer.
- Pre-cleaning of the paddy to remove foreign matter or impurities like bag strings, soil stones, insects and sometime iron parts.
- After that the de-husking/hulling operation is performed on the cleaned paddy to remove the husk from the grain paddy.
- The de-husked paddy is passed through the polishers to remove the bran layer of the brown rice.
- Then Storing/packaging of the rice is done.

It is clear from above discussions that the rice industry is facing a threat of low productivity and quality due to one of more technical errors in processing. Concurrent Engineering is the technique which can help to overcome all these problems.

From the literature it is clear that the productivity and quality in rice industry may be low due to the following reasons:

1) Inaccurate milling process
2) Lack of knowledge
3) Technical errors in processing
4) Worker carelessness
5) Unskilled worker
6) Decreased milling hours
7) Poor quality of the paddy
8) Not proper maintenance
9) Due to fault in the polisher or bucket elevator

IV. BENEFITS OF CONCURRENT ENGINEERING IN RICE INDUSTRY

A. Benefits of CE concept

It has been observed from Literature survey that rice industry is facing some problems regarding its productivity and quality. From the above literature it is clearly notice that Concurrent Engineering can be very useful tool for the rice industry. Concurrent Engineering can:

- Improve the productivity of rice industry.

- Reduce the percentage of delayed time delivery of rice to the market.
- Identify and solve technical problems of rice industry.
- Maximize the milling hours i.e. the no. of hours for which milling of rice is done.
- Reduce the percentage of broken rice in the long grain rice.
- It maintains the good relationship between buyer and supplier.
- Maintains the quality of rice by employing one additional polisher and elevator.

B. Shortcomings of CE concept

- Increased initial investment is required for the implementation of CE.
- Increased floor space is required to implement spare elevator and polisher.

V. CONCLUSION

Concurrent Engineering practices can play an important role in maintaining productivity and quality in rice industry. While reviewing the literature we have found some factors which critically influence the production and quality in rice industry. The analysis done in this study demonstrates that the factors like technical errors in processing, fault in the polishers and bucket elevators becomes the cause of low productivity and quality. If all these factors are balanced in a systematic way, the concept of concurrent engineering will provide a competitive edge to the Indian rice industries resulting in higher productivity, less time to market and maintained quality and hence higher revenue and profit.

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