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Relationship between implementation of TQM, JIT and TPM techniques of Lean Construction

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Abstract:- This paper gives a relationship model and supporting activities of Just In Time (JIT), TOTAL QUALITY MANAGEMENT (TQM), and Total Productive Maintenance (TPM). By reviewing the concepts, 5s, Kaizen, preventive maintenance, Kanban, visual control, and quality control tools are the main supporting activities. Based on the analysis, 5s, preventive maintenance, and Kaizen are the foundation of the three concepts. QC tools are required activities for implementing TQM, whereas visual control is necessary activities for implementing TPM. After successfully implementing TQM and TPM, Kanban is needed for JIT. Research on total quality management, just in time and total productive maintenance generally investigates the implementation and impact of these manufacturing programs in isolation. However, many researchers believe and argue conceptually the value of understanding the joint implementation and effect of manufacturing programs. Study shows that there is evidence supporting the compatibility of the practices in these programs and that manufacturing performance is associated with the level of implementation of both socially- and technically- oriented practices of the three programs.

Keywords: *JIT, TQM, TPM, Relationship Model.*

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I. Introduction

Since 1980s there has been an increasing awareness and implementation of practices associated with total quality management, just in time and total productive maintenance. Nevertheless, there has not been a careful examination of the common and unique practices associated with these programs. We develop a framework for TQM, JIT and TPM and examine the relationships between the use of these practices and manufacturing performance. TQM, JIT and TPM have similar fundamental goals of continuous improvement and waste reduction. Together the practices of TQM, JIT, and TPM form a comprehensive and consistent set of manufacturing practices directed towards improved performance. Therefore, manufacturing plants are likely to combine the implementation of TQM, JIT, and TPM practices. However, most of the studies on TQM, JIT and TPM investigate these programs separately. Only a few studies have tried to explore the relationship between TQM and JIT empirically. Also, some studies indirectly consider all three programs while focusing on only one of them. TPM has a positive and significant direct relationship as well as an indirect relationship through JIT with low cost, high levels of quality and strong delivery performance.

On the other hand, many researchers believe and argue conceptually the value of understanding the simultaneous use of different manufacturing programs. The conceptual research cited above provides evidence of a renewed interest in the study of manufacturing programs with an emphasis on their simultaneous investigation. While researchers recognize the value investigating interrelated entities simultaneously, there is no study that provides empirical examination of the joint implementation of TQM, JIT and TPM practices. Therefore, this study seeks to examine these manufacturing practices within a single theoretical framework. Our goal is to identify the differences between high and low performing manufacturing plants with respect to their implementation of TQM, JIT, and TPM practices.[1]

II. Literature Review

The research study on TQM, JIT and TPM and develop a single framework for the practices.TQM is a manufacturing program aimed at continuously improving and sustaining quality products and processes by capitalizing on the involvement of management, workforce, suppliers, and customers, in order to meet or exceed customer expectations.[1] A comparison of the practices of TQM discussed in six empirical studies which leads to the identification of nine practices that are commonly cited as part of a TQM program. These practices are cross functional product design, process management, supplier quality management, customer involvement, information and feedback, committed leadership, strategic planning, cross functional training, and employee involvement.In the literature, quality management frameworks typically stress the importance of cross functional product design and systematic process management.[2] Furthermore, they emphasize the involvement of customers, suppliers and employees to insure quality products and processes. Finally, quality management programs all emphasize the importance of management commitment and a well-established strategy.JIT is a manufacturing program with the primary goal of continuously reducing and ultimately eliminating all forms of waste. A comparison of six recent empirical studies on JIT leads to the identification of nine practices that are frequently cited as JIT practices. These are set up time reduction, pull system production, JIT delivery by supplier, functional equipment layout, daily schedule adherence, committed leadership, strategic planning, cross functional training, and employee involvement.Two major forms of waste, work in process inventory and unnecessary delays in flow time can be addressed through the implementation of

JIT practices, such as set up time reduction and pull system production. These JIT practices, however, require employees to be trained t perform multiple tasks and to be involved in the improvement efforts. To further support JIT, leadership must be committed to the programs and employee development.[3]

TPM is a manufacturing program designed primarily to maximize equipment effectiveness throughout its entire life through the participation and motivation of the entire work force. Since there are only two empirical studies that address the elements of TPM implementation, the study includes conceptual working the identification of TPM and interviews from three site visit. The comparison leads to the identification of autonomous maintenance and planned maintenance, equipment technology emphasis, committed leadership, strategic planning, cross functional training, and employee involvement as the most commonly cited practices of TPM. Based on the site visits, the use of proprietary equipment as a component of TPM since several plants emphasized its importance in gaining competitive advantage is also considered. [3]

To maintain equipment effectiveness, daily maintenance by operators is crucial. Unexpected breakdowns can be prevented through carefully planned maintenance and the improvement or development of equipment. To conduct this maintenance, cross functional training is necessary to improve operator skills. It is also important that all employees from management to the shop floor are committed to the maintenance process, providing the time and resources to improve equipment performance.[4] More generally, emphasis on maintenance may also be reflected by the emphasis given to technological acquisition and improvement and the development of proprietary equipment. Apart from the practices that are common to all of the three programs, each of the programs also has unique practices that are more technically or process oriented. We refer to these program specific practices as the basic techniques. TQM basic techniques include cross functional product design, process management, supplier quality management, and customer involvement, JIT basic techniques include set up time reduction, pull systems production, JIT delivery by suppliers, equipment layout, and daily schedule adherence, and TPM basic practices are autonomous and planned maintenance, technology emphasis and proprietary equipment development.[5]

a) TQM Basic Techniques

1. Cross functional product design- direct labour employees are involved to a great extent before introducing new products or making product changes. Manufacturing engineers are involved to a great extent before the introduction of new products.
2. Process management- a large percent of the equipment or processes on the shop floor are currently under statistical quality control.[4]
3. Supplier quality management- quality is number one criterion in selecting suppliers. Suppliers are certified, or qualified, for quality.
4. Customer involvement- we frequently are in close contact with customers. Customers give feedback on quality and delivery performance.[5]

b) JIT Basic Techniques

1. Set up time reduction- Aggressively working to lower set up times in plant. Low set up times of equipment in plant. Crews practice set ups to reduce the time required.[4]
2. Pull system production- Suppliers fill Kanban containers, rather than filling purchase orders. Use a Kanban pull system for production control. Use Kanban squares, containers or signals for production control.[4]
3. JIT delivery by suppliers- suppliers deliver on a JIT basis. Suppliers deliver on short notice.
4. Equipment layout- machines are grouped according to the product family to which they are dedicated the layout of the shop floor facilitates low inventories and fast throughout. Our processes are located close together so that material handling and part storage are minimized.[5]
5. Daily schedule adherence- usually meet the production schedule each day. Daily schedule is reasonable to complete on time.[4]

c) TPM Basic Techniques

1. Autonomous and planned maintenance- emphasize good maintenance as a strategy for achieving quality and schedule compliance. Maintenance department focuses on assisting machine operators perform their own preventive maintenance.[5]
2. Technology emphasis- constantly thinking of the next generation of technology. Leader in effective use of new process technology. Search for continuing learning and improvement after installation of the equipment.[5]
3. Proprietary equipment development- actively develop proprietary equipment. Rely on vendors for most of equipment's. Equipment is protected by the firm's patents. Proprietary equipment helps us gain a competitive advantage.[6]

III. Comparison of JIT, TQM and TPM

General characteristics of JIT, TQM and TPM are shown in table 1. JIT and TPM were originally found in japan whereas TQM was established in US. JIT emphasizes waste reduction, continuous improvement and customer responsiveness. There are seven waste in JIT, which are waste from over production, waste of waiting time, transportation waste, inventory waste, waste of motion, and waste from product defects. TQM stresses customer satisfaction underlying quality by using employee involvement. TPM highlights machine and equipment maintenance in order to increase machine efficiency and decrease machine downtime. The factors supporting JIT, TQM and TPM are quite similar. They are administrator deployment, team employment, and employee involvement.JIT extends the supporting factors to JIT flow and pull system whereas TQM does education and TPM does maintenance activities. There are many tools used in making JIT, TQM and TPM active. They are shown in table 1

Table 1. Similarities and difference of JIT, TQM and TPM.[7]

Characteristics	JIT	TQM	TPM
Originality	Japan	United State	Japan
Emphasis	1. Waste reduction including inventory Customer responsiveness including flexibility	1. Customer satisfaction 2. Employee involvement	1. Machine and equipment downtime 2. Machine and equipment efficiency
Supporting Factors	1. Administrator deployment 2. Team employment	1. Team employment 2. education	1. maintenance activity 2. employee involvement
Inclusion	1. line balancing 2. set up time reduction 3. skill development	1. 7 traditional QC tools 2. Statistical methods 3. Cross functional administration	1. Individual improvement 2. Planned maintenance 3. Operations and maintenance development
Usefulness	1. Increase product quality 2. Decrease manufacturing defective 3. Reduce inventory	1. Increase customer satisfaction in quality 2. Decrease operations wastes	1. Increase efficiency of machines and equipment 2. Increase product quality 3. Reduce loss of set up
Objectives	1. Inventory control 2. Lead time reduction	1. Cost down and quality improvement 2. Customer satisfaction increase	1. Increase machine efficiency 2. Maintenance system establishment
Wastes	1. Seven wastes	1.defects	1.Machine breakdown
Employees	1. Multiskilled workers 2. employee involvement	1. educated workers 2. employee involvement	1. self-maintenance workers 2. employee involvement

IV. JIT, TQM and TPM implementation

As shown in figure 1. There are three stages of JIT, TQM and TPM implementation. The first stage is employing 5S and preventive maintenance. The second stage is implementing Kaizen. In case of emphasizing in TQM, QC tools is needed in the second stage whereas emphasizing TPM needs visual control. When both TQM and TPM are achieved, Kanban is required in the third stage to accomplish JIT.

Fig 1. Relationship Model

V. Conclusion

This paper presents a relationship model and supporting activities of JIT, TQM and TPM. Based on reviewing the concept of JIT, TQM and TPM, the supporting activities relating to JIT, TQM and TPM include 5S, Kaizen, preventive maintenance, Kanban, visual control, and QC tools. Based on the conceptual review, the initial model was constructed. 5S and Kaizen were the foundation of the three concepts whereas preventive maintenance seemed to be required. Kanban was needed for implementing JIT and visual control was necessary for TPM. Lastly, implementing TQM, which was the last one, required QC tools. Even though the model was constructed based on the conceptual review. JIT becomes the last to obtain while Kanban remains the activity associated with JIT. QC tools are the activities of TQM, and visual control are the activities of TPM. The foundations become 5S, preventive maintenance, and Kaizen.

Even though the relationship model and supporting activities of JIT, TQM and TPM provided in this paper are given based on the conceptual review, the activities considering in this paper seem to be limited. Future researches may be given to the supporting activities. Moreover, more data may need to be collected to get more accurate result.

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