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Journal of Operations Management 19 (2001) 675–694

JOURNAL OF OPERATIONS MANAGEMENT

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# Relationships between implementation of TQM, JIT, and TPM and manufacturing performance

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Received 26 January 2001; accepted 20 June 2001

**Abstract**

Research on Total Quality Management (TQM), Just-in-Time (JIT) and Total Productive Maintenance (TPM) 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. This study investigates the practices of the three programs simultaneously. We find 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:* Empirical research; Just-in-Time; Maintenance; Quality

## 1. Introduction

Since the 1980s there has been an increasing awareness and implementation of practices associated with Total Quality Management (TQM), Just-in-Time (JIT), and Total Productive Maintenance (TPM). 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 (Schonberger, 1986; Nakajima, 1988; Ohno, 1988; Powell, 1995). 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 (e.g. Flynn et al., 1995; Sriparavastu and Gupta, 1997). Also, some studies indirectly consider all three programs while focusing on only one of them. For example, McKone et al. (2001) indirectly examines the relationship of TPM with JIT and TQM when investigating the implementation and impact of TPM. They find that 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.

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0272-6963/01/$ – see front matter 
PII: S0272-6963(01)00066-3

On the other hand, many researchers believe and argue conceptually the value of understanding the simultaneous use of different manufacturing programs. For instance, Roth and Miller (1992) contend that maintenance management may well be the biggest challenge facing companies that implement TQM, JIT, and computer-aided manufacturing. Similarly, Huang (1991) discusses the importance of considering the integration of JIT, TPM, quality control, and factory automation with worker participation. Furthermore, Imai (1998) believes that TQM and TPM are the two pillars supporting the JIT production system.

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 of investigating interrelated entities simultaneously, there is no study that provides empirical examination of the joint implementation of TQM, JIT, and TPM practices. Therefore, in this research we seek 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.

In the next section of this paper, we review the literature and present our integrating framework. Then in Section 3 we discuss our hypotheses. In Section 4, we describe the data used for the analysis. Subsequently, we describe our method of analysis in Section 5. Finally, we discuss the results and present the conclusions in Sections 6 and 7, respectively.

## 2. Review of literature

We considered the entire literature on TQM, JIT and TPM but, for brevity of discussion, we focus only on empirical work in this paper. The empirical studies that we draw upon are studies in the last 10 years that have sufficient grounding in the literature and assessment of measurement used in empirical analysis. We consider the research on TQM, JIT, and TPM and develop a single framework for the practices. See Cua (2000) for additional details on this framework and a thorough analysis of the practices associated with TQM, JIT and TPM discussed below.

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 (Dean and Bowen, 1994; Hackman and Wageman, 1995; Powell, 1995). A comparison of the practices of TQM discussed in six empirical studies (Saraph et al., 1989; Flynn et al., 1994; Powell, 1995; Ahire et al., 1996; Black and Porter, 1996; Samson and Terziovski, 1999) 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. 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 (Sugimori et al., 1977; Ohno, 1988; Brown and Mitchell, 1991) through JIT production and involvement of the work force (Schonberger, 1986, 1996; Ohno, 1988). A comparison of six recent empirical studies on JIT (Davy et al., 1992; Mehra and Inman, 1992; Sakakibara et al., 1993; McLachlin, 1997; Sakakibara et al., 1997; Ahmad, 1998) 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 (Brown and Mitchell, 1991) — 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 to perform multiple tasks and to be involved in the improvement efforts. To further support JIT, leadership