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The effect of TQM on performance in R&D environments: A perspective from South Korean firms

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Abstract

This paper presents an empirical study, which examines the effectiveness of Total Quality Management (TQM) practices in R&D environments by demonstrating the effect of TQM practices on R&D performance in terms of product quality and product innovation. Despite numerous studies of the relationship between TQM and organisational performance, little research has been done on the relationship between TQM and R&D performance. This study used data from 130 R&D divisions of Korean manufacturing firms. Two research questions were posed, with the first pertaining to the implementation of TQM principles in R&D environments and the second focusing on the effect of TQM on R&D performance. TQM practices were measured by six criteria of Malcolm Baldrige National Quality Award, and R&D performance measures consist of quality and innovation aspects. Using structural equation modelling techniques, the findings showed the integration of the implementation of TQM practices in R&D divisions as well as the significant contribution of TQM to R&D performance. These findings suggest that TQM as a set of generic principles can be adapted in environments other than manufacturing or production areas.

Keywords: TQM; R&D; Quality; Innovation; Structural equation modelling

1. Introduction

In the last two decades, Total Quality Management (TQM) has won considerable attention from both industry and academics. It is one of the most popular and durable modern management concepts and philosophies developed in the end of the last century, which has had a profound and unparalleled impact on modern business history. It is evident from empirical studies that majority of the organisations that implement TQM have viewed the benefits of TQM in various ways (Easton and Jarell, 1998; Hendricks and Singhal, 1996). The development of TQM theory has undergone an evolutionary process from quality control, to quality assurance and through to TQM (Bounds et al., 1994; Dale et al., 1994; Ghobadian and Gallear, 2001). The conceptual development of TQM has been reflected in its application, which has permeated beyond production or shop floor areas into wider functions in organisations. However, in the midst of the massive adoption of TQM principles and practices in organisations, there is still lack of rigorous empirical studies on the adoption of TQM in the R&D environment (Kiella and Golhar, 1997; Kumar and Boyle, 2001; May and Pearson, 1993; Price, 1995). This paper seeks to fill this gap using empirical data drawn from R&D divisions of manufacturing firms in Korea. Specifically, the paper aims to test the integration of TQM practices in R&D environments and the effectiveness of TQM in determining R&D performance in terms of product innovation and product quality.

This study contributes to the literature on TQM by empirically examining the flexible use of TQM in a different environment, in this case R&D. From a conceptual point of view, TQM comprises a set of generic principles which can be adapted into different environmental contexts, specifically those which are characterised by uncertainty and "nonroutineness" (Sitkin et al., 1994). Examining this premise is important as traditionally R&D has not been a major part of the TQM literature and none of the TQM proponents, including Deming, Juran, or

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Crosby, have specifically addressed the implication of TQM principles in R&D environments.

2. Literature review

While originating in the quality movement within production, TQM has evolved into a holistic management philosophy which has been adopted as an approach for improving the competitiveness of organisations (Kaynak, 2003; Powell, 1995; Samson and Terziovski, 1999; Sila and Ebrahimpour, 2005). As a result, TQM principles and practices have been applied beyond production into other areas, such as human resources (Cardy and Dobbins, 1996), marketing (Hurley et al., 1996; Wilshaw and Dale, 1996), information systems (Fok et al., 2001; Ragu-Nathan et al., 2004), supply chain (Forker et al., 1997; Sánchez-Rodríguez and Hemsworth, 2005), project (Jung and Wang, 2006; Laszlo, 1996) and environmental system (Madu et al., 1995; Miles and Russell, 1997).

However, implementing TQM in R&D environments is more challenging compared to other areas in the organisation. Anecdotal evidence suggests that although TQM concepts have been introduced since 1980s, it was only in the early 1990s when American companies began to acknowledge that quality management principles were necessary for R&D management (Chatterji and Davidson, 2001). Underlying this trend is a view suggesting that the applicability of quality management principles is stronger in the downstream area (i.e. production) rather than upstream area, where R&D unit is located (Brennan, 2001). This view is among a number of major arguments that have been raised against the applicability of TQM for innovation (Prajogo and Sohal, 2001). Managing innovation is fundamentally different from managing quality (Maguire and Hagen, 1999). For example, it is difficult to apply the main definitions of quality such as fitness for use, right first time and zero defects that have been so prominent in the production area of manufacturing industries directly to the R&D environment (Taylor and Pearson, 1994). As R&D is a function which is primarily responsible for innovation, it can be implied that implementation of TQM in R&D environments could be problematic. However, despite the above concerns, review of literature that has discussed the link of TQM and R&D has generally supported the applicability of TQM in the R&D context (Beasley, 1992; Chatterji and Davidson, 2001; Kiella and Golhar, 1997; Kumar and Boyle, 2001; Reinertsen and Shaeffer, 2005; Weggeman and Groeneveld, 2005). For example, Chatterji and Davidson (2001) suggest five primary benefits TQM can provide in R&D environments. First, TQM directs R&D divisions to focus on customer needs and expectations. Second, TQM helps companies envisage R&D functions as a process, which involves the application of the principles and practices of continuous improvement. Third, TQM drives the integration and improves the channels of communication among different units and departments within an organisation, including that of R&D. This integration has brought R&D units closer to the rest of the business enterprise. Fourth, TQM also makes R&D more receptive to the concept of control and measurement. Finally, through benchmarking, TQM supports communication and sharing of knowledge among R&D peers across industries and speeds up the learning process as well as diminishing the ''Not Invented Here'' syndrome. Kiella and Golhar (1997) summarised key TQM principles that can benefit R&D functions, and these include the development of shared vision, top management commitment, measurement, benchmarking integration of processes and functions.

At the operations level, Kumar and Boyle (2001) have recapped the supporting arguments for applicability of several key TQM practices in R&D environments that have been discussed in literature. These include getting senior management to evaluate research projects, understanding strategic goals of R&D, partnering with clients to identify their requirements, reviewing conformance to client's requirements, documenting current practices, partnering with suppliers, creating employee awareness on quality issues and involving staff in decision making.

The positive arguments listed earlier on the applicability of TQM in R&D environments have also been supported by a number of studies (Dellana and Wiebe, 1995; Fisher et al., 1995; Keiser and Blake, 1996; May and Pearson, 1993; Patino, 1997; Pearson et al., 1998; Szakonyi, 1992; Taylor and Pearson, 1994; Wood and McCamey, 1993). For example, Szakonyi (1992), using six case studies, showed that R&D function should adapt quality principles in order to achieve not only their own objectives but ultimate business successes. May and Pearson (1993) reported the implementation of quality management in 14 R&D departments across the UK and Canada. They discovered that many quality problems found in R&D were also common in other areas where TQM has been implemented. Therefore, quality tools and techniques are highly applicable to the R&D process if used flexibly. Wood and McCamey (1993) studied the implementation of TQM in a biomedical research division of Procter and Gamble, and that the benefits from the implementation included some cost savings and a 20% increase in the Net Present Value of the drug development portfolio.

3. Research model and questions

While these various theoretical arguments and anecdotal studies have supported the applicability of TQM in the R&D environment, none of the earlier studies has employed rigorous statistical analysis. Also, most studies conducted on this topic so far have used only one or few cases, which severely limit the power of generalisation of the results. On account of its importance, this topic warrants a sound empirical study, and this paper aims to fill this void.

Specifically, this study addresses two main research questions underpinning the application and the effectiveness