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Do technology and manufacturing strategy links enhance operational performance? Empirical research in the auto supplier sector

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ABSTRACT

Although much of the literature on manufacturing strategy (MS) and technology studies the implementation and impact of these manufacturing programs in isolation, this paper goes further by assessing the joint implementation and effect of these two manufacturing programs on performance, even when some contextual factors are present. Thus, this paper investigates how plants from the auto supplier sector make use of some operations practices from manufacturing strategy (MS) and from both product and process technology, by testing the effectiveness of both sets of practices, with the ultimate goal of enhancing operational performance. The results suggest that there are only very minor differences between high and standard performers on the aggregated level for technology practices, which may be the reason why technology does not result in significant performance differences between the two plant types. On the other hand, on the aggregated levels, there are somewhat greater differences for MS practices than for technology in both plant types, leading to larger differences in performance. While this study provides a foundation for examining MS, technology and context within a single framework, it is only through further research that a full understanding of the relationship between them will be obtained.

1. Introduction

Traditionally, the management trend with which most companies are familiar is to recommend that manufacturing managers adopt almost every new manufacturing technique, practise or scheme that emerges in any industry. However, this study differs from this familiar way of doing things by using a dynamic perspective for manufacturing plants, which focus on adopting only the manufacturing practices (with adaptations) that produce high performance when interconnected with those already in place (Schroeder and Flynn, 2001).

At the same time, previous studies on manufacturing practices (MPs) shed little light on the reasons why the implementation of any given manufacturing practise set leads to high performance in some plants, but not in others (e.g. Crawford et al., 1988; Nassimbeni, 1996). Theoretically, before manufacturing practices are selected, adapted (as required), implemented and interconnected, a well-conceived strategic plan based on circumstances of the plant (contingency) also needs to be put in place. If this is not done, manufacturing initiatives will not have the desired effect: the attainment of high performance. All of the above should be linked to a planned path of continuous improvement. These three elements (contingency, links between practices and continuous improvement) are, in general terms, the approach of the high performance manufacturing (HPM) conceptualisation.

In this search of high performance and continuous improvement, the effective use of technological resources should be essential for achieving a sustainable competitive advantage and for increasing the performance of the plant. However, although technology practices may in principle increase competitive advantage, it is necessary to analyse them in combination with the MS within plants, since there seems to be a clear influence between them (Porter, 1983, 1985; Schroeder and Flynn, 2001). For this reason, this paper stresses the need to investigate the combined impact of both sets of practices on performance.

Besides, this article focuses on auto suppliers as a first stage on a sequent of sector and intersector studies. However, this selection makes sense in itself, since the automotive sector is one the most dynamic, influential and important industries in the world in terms of production, commercial exchanges, employment and generation of wealth. It also has a great multiplying effect with regard to other sectors of production. Its relative importance in an industrial production in Western Europe in 2006 stood at 10% and it generated direct and indirect employment for almost 10 million

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workers (BEFC, 2006). Of the 100 major transnational companies other than in the financial sector by volume of foreign assets, thirteen are in this sector (UNCTAD, 2009). Thus, it uses data on manufacturing strategy practices, technology practices and operational performance dimensions collected from 90 auto supplier plants which responded to a survey from research teams located in ten countries selected as a major part of the industrialised world in North America, Europe and Asia

Drawing upon the previously mentioned approach, this article takes a set of manufacturing strategy practices and a set of technology practices as a starting point to investigate how auto supplier plants make use of MPs, by testing the impact of both of these sets on an operational performance. Thus, next (Section 2), this paper discusses the concepts and constructs used in this study. A brief review is made of bibliography related to possible impacts on performance, and some possible relationships from the framework of this study are presented, the models are proposed and the respective hypotheses described. Subsequently (Section 3), the research methodology used in this article is described and the analytical methodology discussed. The results are given in Section 4. Finally, in Section 5, the conclusions and final considerations are set out, highlighting the implications and limitations of the research.

2. Theoretical background and hypotheses

This study shall consider and define some operational performance dimensions, a set of some manufacturing strategy practices and a set of some technology practices through some of the constructs defined in operations management (OM) literature, as the focus of the present paper will be the possible impact of these two sets of practices on performance.

We do not purport the manufacturing practices (MPs) and dimensions in this study to be "best practise" (the paradigm par excellence of research into manufacturing in the nineteen-eighties and -nineties (e.g. Wheelwright and Bowen, 1996)). In addition, it is our opinion that practices adopted in imitation of high performers might contribute to achieving competitive parity though not competitive advantage. MPs could not and, in fact, due to contingency (context), cannot be generally recommended for any and every plant, so a review of manufacturing strategy is required, as each practise, or combination of practices, could be appropriate for different environments. Better performance might be achieved if key MP features are conscientiously analysed and their concepts adopted (and adapted) and carefully incorporated, there being different ways of achieving the same results in different environments (Sahin, 2000). In this regard, the typical way of measuring MPs impact on competitiveness is usually through the comparison of some type of performance with the competition, whether it be financial (e.g. return on asset (ROA), return on investment (ROI), return on equity (ROE)) or operations-related (quality, cost, etc.).

The following selection of dimensions and practices is neither comprehensive nor exclusive to this research, but they are representative of MPs, operational performance and plant context in the OM literature and currently in widespread use in plants, and they are also appropriate for presenting theoretical arguments.

2.1. Operational performance

Manufacturing plants do not directly control measures of performance indicators such as profit, sales or market outcomes, because they are mainly cost centres and do not have specific accounting records of this kind at the plant level; therefore, the use of financial measures may be inappropriate, except in the case of plants which are profit centres. Therefore, this research uses basic production measures controlled at the plant level, such as the competitive priorities: costs, quality, delivery (speed and dependability) and flexibility (see Hayes and Wheelwright, 1984; Ferdows and De Meyer, 1990; Ketokivi and Schroeder, 2004).

Specifically, this study will make use of some of the plant competitive performance indicators from the OM literature (Skinner, 1969; Hayes and Wheelwright, 1984; Schroeder and Flynn, 2001), such as unit cost of manufacturing, standard product quality, on-time delivery, fast delivery, flexibility in changing the product mix and flexibility in changing volume, etc. These six indicators represent different measures of the four above-mentioned basic production measures (Skinner, 1969; Ferdows and De Meyer, 1990) and can be measured from two perspectives: internal and external. The *internal perspective* represents measures which are useful for the control and internal management of the production process, whereas the *external perspective* entails customer-related dimensions. We will use a combination of both types.

To conclude this sub-section, some remarks are made on the basic goals/dimensions and on the six measures which are used in this paper. In general terms, the measures selected are those which are most frequently used in an OM (see Skinner, 1969; Hayes and Wheelwright, 1984; Ferdows and De Meyer, 1990; Cua et al., 2001; Schroeder and Flynn, 2001; Ahmad et al., 2003).

Cost: for many authors, the most important of all the operational performance measures is cost performance (e.g. Schroeder and Flynn, 2001; Slack and Lewis, 2002; Hallgren, 2007). This research focuses on unit cost of manufacturing.

Quality: although quality is a very broad term, in production operations, the most influential measure is conformance, which means the process' ability to manufacture products which conform to predefined reliability and consistency specifications (Garvin, 1987; Ward et al., 1996; Slack and Lewis, 2002; Hallgren, 2007). This research therefore focuses on product conformance with specifications.

Delivery: the two basic delivery measures are reliability and speed (Berry et al., 1991; Ward et al., 1996; Hallgren, 2007). This study focuses on both: the former through on-time delivery (i.e. the ability to complete the delivery as planned), and the latter through fast delivery.

Flexibility: flexibility has many measures, but the two most influential in the operations area are the ability to change volume and product mix (Slack, 1983; Olhager, 1993; Hallgren, 2007; Hutchison and Das, 2007), and both are included in this study.

2.2. Manufacturing strategy

More and more companies are recognising production as a potential source for gaining a competitive advantage and as a way of differentiating themselves from competitors. Despite the importance of defining and clearly implementing manufacturing strategy, there is not much broad empirical research in an OM literature documented (and even less in an international HPM research) addressing the impact of manufacturing strategy on the plant performance.

There are clear signs that manufacturing strategies play a fundamental role in the assessment of new technologies (Bates et al., 1995; Pretorius and Wet, 2000), as an analysis of appropriate technology can eliminate many risks, given that high performing technology is a key factor in global competitiveness.

In other regards, according to the classic conception defined in the strategy literature, which distinguishes between processes and content (e.g. Swamidass and Newell, 1987; Weir et al., 2000;