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Manufacturing strategies and financial performance—The effect of advanced information technology: CAD/CAM systems☆

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Abstract

Nowadays, the business environment is characterized by great uncertainty and variability. In this environment, information technology (IT) has proved to be an important strategic ingredient for the creation of competitive advantage. This role of IT has been widely accepted during the past few years [Feeny D. Creating and sustaining competitive advantage with IT. In: Earl M, editor. Information management the strategic direction. Oxford, 1990; Ives B. Wingtip Courriers, Southern Methodist University Case Study #SMY/MIS/90-01, Edwin L. Cox School of Business, Dallas, TX, January 1990].

In the new era of production, strategic priorities rather than a cost contained focus have proved to be important for competition, namely: quality, dependability, flexibility, customer service, after sale service, supply chain management, etc. IT proved to be vital for successful competition as it can facilitate the attainment of these strategic targets.

In this paper, the impact of IT on financial performance for the different types and levels of business strategy is examined. After the clustering of firms according to their strategic priorities, the effect of IT on financial performance is estimated. To do this a cross-sectional study was held in the field of Greek manufacturing firms that apply advanced IT, in order to explore which, how and in what level manufacturing priorities have been adopted. For that purpose, cluster analysis and VACOR algorithm were used, to distinguish clusters of firms and estimate the effect of IT on financial performance, for each type and level of strategic choice. Return on invested capital (ROIC) has been used as a criterion of performance in order to incorporate the effect of cost, revenues and profits. It was found that the effect of IT on financial performance was observed to be greater for firms which emphasize the higher level of flexibility strategy and the middle level of cost strategy. On the contrary, the effect of IT on performance was observed to be greater for firms which emphasize a lower level of quality and innovation strategy. Further discussion of these results and conclusions were drawn.

Keywords: Information systems; MIS; Flexible manufacturing; Statistics; Cost benefit analysis

1. Introduction—literature review: manufacturing strategies

The qualitative saturation in demand resulted in a turnaround, from mass production to mass customization and niche market production [1–3]. New "models" of production emerged and were named

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as "post-industrial", "flexible specialization", "neo-fordism", "innovation-mediated production", "lean production", "mass customization", etc. [4–9]. Until 1980 many firms targeted at high profitability and efficiency, through competition on price, which was the most important strategic target [10,11]. Moreover, non-saturation in demand permitted enterprises to set cost as their primary competitive objective. The characteristics of the mass production model ruled before 1970 can be summarized as follows: fixed automation and dedicated machinery, mass consumption, homogeneous products and emphasis on quantity [6], price competition and internal scale economies [3], deskilling of labor [12], vertically Integrated production, just in case logistics, and continuous production line.

This mass production model was structured in a way, that prohibited innovation and quality, as both had a positive effect on cost and on the product's price. Because of this trade-off, these manufacturing priorities were superseded by cost [13,14]. Nevertheless nowadays, the necessity to be cost focused as well as innovative and quality oriented have altered this tradeoff.

After1980 the mass production model proved highly inefficient and the cost-quality trade-off, was criticized [15]. The high levels of inventory for the sake of security in production resulted in excess capacity and increased defects. This model became obsolete because of its rigid and inflexible character [1,9]. The characteristics of inflexibility were: the use of hard automation (dedicated machines toward one specialized task), production for mass markets, uniformity in design, deskilling of labor through specialization, vertical integration, just in case systems and a central assembly line (further details on these production models are given in Kenney and Florida [9]). But the diversification in demand increased the need for widening the range of production. Thus, products needed to be produced in more variety and in fewer quantities. Fast changes in the design of products produced, increased the need for flexibility [1]. Scale economies were supplanted by scope economies, thus the cost of producing separately different quantities is higher than the cost of joint production: $C(q_1, q_2) < C(q_1, 0) + C(0, q_2)$ [16–18]. Design variability and scope economies can be attained by the implementation of computer aided design systems through the widening of the range of production. In this new production model, cost was not the main strategic target, instead higher priority was given to strategies like quality, flexibility, customer service, just in time supply management, etc.

A new set of management and information technology (IT) toolboxes: FMS, TQM, QFD, OWMM, GT, CIM [19], served the needs of the new production. Consequently, a need has emerged to revise manufacturing strategy and manufacturing targets so that they would be prioritized in a different way [10,20,21].

The role of IT in relation to strategy, within these production models, is given by Bart et al. in Luftman's book on competing in the information age [22]. Mass customization uses IT to enhance relationships but results in task deskilling. Invention uses IT to enhance relationships and skills, mass production uses IT to deskill tasks and focuses on processes rather than relationships and continuous improvement uses IT to enhance skills, but focuses on processes rather than relationships as well. Research on how these models are related to IT and the alignment model, can be found in Boynton et al. [23].

In this context the need to investigate the manufacturing strategy is increased. A first step was made by Skinner [24, p. 78, 80, 88], Swamidass and Newell [25], Adam and Swamidass [26] and Swink and Way [27]. Accordingly, the manufacturing dimensions of cost and price are no longer first in the list and manufacturing strategy cares about quality and innovation more than ever before. The priority of these strategic targets according to Skinner [28], Buffa [29] and Wheelwright [30] is:

1. *Cost*: The ultimate purpose is to gain advantage through price drops, via rationalization and minimization of operational and maintenance expenses, labor cost, raw and intermediate materials (cost of supplies), investment rationalization, etc.
2. *Quality*: Aims to gain advantage by stabilizing the quality of the product at a predetermined level according to competition, by statistical control of supplies and production, quality circles, formalization and standardization of processes (quality manuals), etc.
3. *Flexibility*: The purpose is to respond to demand variations fast. This target can be achieved by shortening the production lead-time, decreasing the inventory levels, fast and concurrent design targeting at specific needs [1,19,31].
4. *Dependability*: The target is to create tighter relation to customer through delivery speed, after sales service and products reliability, etc.
5. *Innovation*: The aim is to innovate techniques of production and management as well as products of premium value for the customer.

Other strategic priorities are: color range, product range, design, brand image, technical support