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The co-evolution of product, production and supply chain decisions, and the emergence of manufacturing strategy

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Abstract

In this paper, adopting the necessary evolutionary economics perspective, we investigate how manufacturing strategy emerges as a result of a coordinated search in the three correlated fitness landscapes of product, production and supply chain decisions. In a complex evolving systems view, product, production system and supply chain requirements, which are used to define manufacturing strategy performance objectives, are also thought to constitute, in a dialectic fashion, decision variables for achieving these objectives. Using a system dynamics simulation model of a resource-based view of operations-driven competition, we have investigated the effect of two contextual variables (underlying pattern of interaction among tasks/decisions, and limits of managerial ability), and three organisational structure ones (tasks/decision decomposition, incentives system, and degree of vertical hierarchy) on the efficiency and effectives of the overall manufacturing strategy process. The contribution of the paper is twofold: first, simulation results justify empirical views and provide new insights on the effect of organisation in the manufacturing strategy as an evolutionary process, and secondly, by combining complex systems science with the resource-based view of strategic management, it presents a novel methodological stance for investigating complex issues involved in this area.

Keywords: Manufacturing strategy process; Organisation modelling; Capabilities; System dynamics

1. Introduction

1.1. A resource-based perspective of manufacturing strategy

In the academic literature, as well as in practice, there is more or less consensus in what constitutes the content of manufacturing (or more broadly, operations) strategy. Manufacturing strategy objectives are defined around the generic areas of cost, flexibility, quality, dependability (on-time-delivery) and speed (Hill, 2000; Mills et al., 2002; Slack and Lewis, 2002; Acur et al., 2003). Decision areas and related activities for achieving these objectives have been categorised by Hayes and Wheelwright (1984) into *structural* (amount, timing and type of *capacity*, size, location and specialisation of *facilities*, direct process *technology* (equipment, level of automation, linkages), and level and type of *integration*

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(vertical–horizontal, forward–backward, extent, balance)) and *infrastructural*, i.e. *human resources* (skills, wages policies, social environment), *quality* practices (systems and control), production *planning and control* procedures (decision rules, indirect process technologies, centralisation), as well as general *organisational* attributes (structures, roles, interfaces and interconnections). The majority of manufacturing strategy scholars adheres to this list, sometimes with some additions and modifications, in proposing/prescribing (their own) manufacturing strategy formulation processes, or in describing processes identified by empirical research (Joseph, 1999; Quezada et al., 1999; Hill, 2000; Avella et al., 2001; Mills et al., 2002; Demeter, 2003).

The basic structure of the content of manufacturing strategy has survived the paradigm shift that occurred over the last years in the field of strategic management. In the move from "market-based" to "resource-based" competition, the role of manufacturing/operations as the basis of competitive advantage has been augmented since the development and leverage of resources depend on operational capabilities deeply anchored within business processes and organisational routines (Gagnon, 1999). Resources, capabilities and core competences are now, directly or indirectly, associated with the traditional operational objectives and linked to the above decision areas which were originally connected with the market perspective. Nevertheless, the association of the resource-based view (RBV) to organisational knowledge assets and processes implies a different, more important role, for the organisational attributes of the manufacturing function and its periphery.

In the resource-based view, organisational attributes are not only the outcome of manufacturing strategy. They are also the link that connects the content to formulation processes. As Slack and Lewis (2002) point out, organisational design is both output and input of the strategy process. The outcome of the process determines the internal organisation of resources, whereas, at the same time, the organisation's structure provides the mechanics by which strategy is formed. In other words, the organisational design provides the context in which manufacturing and operations strategy is formulated. Organisations, including manufacturing functions, are complex entities composed of tightly interdependent and mutually supportive and/or conflicting elements (Miller and Friesen, 1984) exhibiting systemic properties. As a result, the effectiveness and the efficiency of managerial processes rely heavily on the degree of understanding of the systemic nature of organisational design (Rivkin and Siggelkow, 2003; Siggelkow, 2003).

1.2. The organisational attribute of manufacturing strategy

So far, the role of organisation in manufacturing strategy has been undermined and such issues have been considered only as secondary "organisational infrastructure" decisions (Gagnon, 1999), usually treated at the operational level, i.e. only as outcomes of decision process (e.g. Mertins and Jochem, 2005). As far as the strategy process is concerned, a limited number of research efforts have concentrated on micro-level analyses of "rational"/analytic processes and their organisational attributes, where project management and collaboration issues prevail (Joseph, 1999; Platts et al., 1996, 1998; Hill, 2000; Mills et al., 2002; Tan and Platts, 2004; Karacapilidis et al., 2006). The lack of research on macro-level considerations, in both time and scope, may be attributed to historical reasons, since in the past organisations were simpler and manufacturing strategy was mostly dominated by the "pure" production function's requirements. However, the shift of interest in competition and economic growth from prices to product innovation, on the one hand, and the globalisation of sourcing and supply on the other, have increased the importance of the innovation/new product development (NPD) and the supply chain management functions, respectively, to the same level with production. Although all three functions could be put under the same umbrella of operations, structurally they constitute autonomous organisational entities and their strategic management, in the framework of resource-based competition, implies the development and leverage of distinct resources and capabilities, frequently by executing restricting and/or conflicting organisational processes. As a result, the overall manufacturing strategy process becomes a much more complex coordinated process.

The complexity of strategic processes in the new forms of organisation has been recognised in the domain of strategic management and new more dynamic and eclectic (evolutionary and organic) approaches that divert from rational unitary actor models have been introduced (Nelson and Winter, 1982; Beinhocker, 1999; Farjoun, 2002).