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Integrating Sustainability and Manufacturing Strategy into a Unifying Framework

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ABSTRACT

The direction of current literature in addressing sustainability issues in the manufacturing sector highlights some models and approaches that are usually based on the concept of the triple-bottom line. However, as a functional unit in a manufacturing organization, the role of the manufacturing function in creating competitiveness has been outdone by the current demands of sustainability such that integrating sustainability and competitiveness remains a significant gap. This paper proposes a unifying framework in formulating a manufacturing strategy which espouses sustainability with due consideration of the manufacturing's internal and external competitive functions. The proposed framework integrates the features based on the classical theories of manufacturing strategy and the other features that must be considered to transform a firm's manufacturing strategy into a sustainable manufacturing strategy. This framework serves as a guide for decision-makers in identifying policies in various manufacturing decision areas that would comprise a sustainable manufacturing strategy. Results of recent empirical studies that are based on the models generated from the framework are reported in this paper.

KEYWORDS

Conceptual Framework, Manufacturing, Multi-Criteria Decision-Making, Strategy, Sustainability

INTRODUCTION

Skinner (1969) laid down the foundation of manufacturing strategy as a field that requires attention in research and practice. The main argument of Skinner (1969) can be formally stated as follows. Manufacturing strategy is linked vertically to the business strategy and business strategy is linked to the corporate strategy in a hierarchical fashion. The channel of influence is top-down such that consistency of corporate and business goals is achieved by manufacturing strategy (Hayes & Wheelwright, 1984). Over several decades, this argument is considered as the blueprint of any manufacturing organization and various extensions have been introduced by different domain scholars, e.g. Hayes &Wheelwright (1984), Wheelwright (1984), Kotha & Orne (1989), Hallgren & Olhager (2006). Wheelwright (1978) later emphasized that a manufacturing strategy could only support business strategy if a sequence of decisions over structural and infrastructural categories is consistent over a significant amount of time. Structural decisions, e.g. process technology, facilities, capacity and vertical integration, initiate long-term impacts to the organization and require huge amount of investments while infrastructural decisions, on the other hand, e.g. organization, manufacturing planning and control, quality, new product introduction and human resources, are usually strategic and requires less investment at implementation but when in place, reconfiguration seems to be too costly.

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When policies are consistent across these categories, the manufacturing strategy eventually develops and leads to a set of manufacturing capabilities over time which must, in theory, be aligned to the competitive advantage put in place by the business strategy (Wheelwright, 1984). These capabilities create opportunities in the market (Wheelwright, 1984). The set of competitive priorities carried out by the business strategy is a careful integration of both corporate strategy and market position intended to gain advantage over its competitors. Ocampo and Ocampo (2015) observed that this theory has been established and tested over decades of research and practice. However, with current demands of addressing environmental degradation, resource consumption, pollution and other socio-economic issues, the hierarchical framework of Skinner (1969) failed to address the sustainability of manufacturing. This requires a framework that holistically addresses manufacturing strategy and the issues of sustainability.

Sustainable development is defined as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Considered as a key aspect to sustainable development is the manufacturing industry (Rosen & Kishawy, 2012). Hassine et al. (2015) pointed out that the energy consumption of manufacturing industries account for 30% of the global energy demand and manufacturing sector contributes 36% of the global carbon dioxide emissions. This consumption and emission generation imply adverse environmental impact and degradation of natural resources (Hassine et al., 2015). As a consequence, manufacturing processes and the resulting products pose adverse immediate impact to the community. For this, a more focused approach coined as sustainable manufacturing has been recently introduced (Joung et al., 2013). Currently, the literature on sustainable manufacturing could be identified as two main groups: hard and soft. Hard sustainable manufacturing involves the development of techniques and approaches that address materials, energy and wastes (Yuan et al., 2012; Despeisse et al., 2013; Smith & Ball, 2012). On the other hand, soft sustainable manufacturing includes systems approaches such as environmental collaboration in the supply chain (Zailani et al., 2012), product life cycle assessment (Heijungs et al., 2010), eco-design (Rosen & Kishawy, 2012), environmental purchasing (Zailani et al., 2012), among others. Despite on the recent advances of sustainability approaches, the integration of sustainability manufacturing with the work of Skinner (1969) on manufacturing competitiveness shows a significant gap.

The gap that is advanced in this paper is the lack of an integrative framework that holistically integrates sustainability into the classical competitiveness agenda of manufacturing. This paper attempts to develop a framework that integrates sustainability and competiveness of manufacturing at firm level. Central to this careful integration is to bring in the concepts of Skinner (1969) and Wheelwright (1984) on manufacturing strategy and competitiveness together with the emerging issues of sustainable manufacturing. This integration is highly significant as addressing them individually one at a time may provide counterintuitive results. This enables firms to identify salient features that must be simultaneously addressed to develop a sustainable manufacturing strategy. The ultimate function of the proposed framework is to guide manufacturing decision-makers to determine the decisions that must be made in order to address both competitiveness and sustainability. The contribution of this work is in proposing a framework which is able to identify the decisions that comprise a sustainable manufacturing strategy.

In developing the proposed framework, a literature review is conducted in the next section to perform the following steps: (1) mapping of different models, (2) categorizing these models into manufacturing strategy and sustainability along with their intended functions, (3) defining some operational terms of these two fields, and (4) analysing critically and synthesizing the gaps of these models. The framework section is introduced to integrate these concepts of manufacturing strategy and sustainability along with the gaps identified in the previous section. This is followed by a section that highlights a review of empirical results of the proposed framework. This paper ends with a concluding section.