



# Embeddedness and path dependence of organizational capabilities for mass customization and green management: A longitudinal case study in the machinery industry

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## ABSTRACT

A growing number of firms today have to cope with the twofold challenge of mass customization (i.e., combining high performance in product customization with high performance in cost, delivery and quality) and green management (i.e., integrating environmental-sustainability principles into businesses). Research on this joint challenge, however, is still limited in the literature. To narrow this gap, we empirically investigate the interconnectedness of mass customization and green management on the level of their enabling capabilities. Through a single longitudinal case study in a machinery manufacturing organization that, during the period of observation, succeeded in developing both mass-customization capabilities and green-management capabilities, we find overlaps and path dependences between such capabilities. Pragmatically, these findings indicate synergies that firms pursuing a green mass customization strategy may leverage in order to alleviate the difficulty of implementing that strategy. From an academic standpoint, these findings contribute to the debate on the relationship between the environmental pillar of sustainability and its economic pillar and, at the same time, add both to the body of the literature on mass customization and to the one on green management. Limitations of the present study and the related opportunities for future research are, finally, discussed.

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## 1. Introduction

As global competition intensifies and customers become more sophisticated, a growing number of firms face the challenge of fulfilling each customer's idiosyncratic needs without substantial trade-offs in cost, delivery and quality (Squire et al., 2006; Huang et al., 2008). The ability to do this has been called in literature mass customization (MC) (e.g., Pine, 1993; McCarthy, 2004; Liu et al., 2006). At the same time, more and more companies nowadays, due to increasing regulatory pressure and stakeholders' environmental consciousness, are challenged by the need for integrating environmental-sustainability principles into their businesses (Kleindorfer et al., 2005). This integration has been named in literature green/environmental management (GM) (e.g., Gupta, 1995; Angell and Klassen, 1999; Wiengarten and Pagell, 2012; Wiengarten et al., 2013). As a result of these two concomitant trends, a growing number of firms today have to cope with the joint challenge of MC and GM.

Studies that focus on this combined challenge, however, are still scarce in the literature. Academe has promptly reacted to the growing importance of both MC and GM for the business community by multiplying the studies on GM in a variety of areas, such as supply

chain management (Sarkis et al., 2011) or human resource management (Renwick et al., 2013), as well as the studies on MC (Fogliatto et al., 2012). Previous research, however, has typically focused on either MC or GM, without addressing their possible interrelations. The only exceptions are a few mostly conceptual studies which suggest that some well-known MC enablers, such as product modularity or form postponement, may have positive effects (Nielsen et al., 2011; Pedrazzoli et al., 2011; Petersen et al., 2011), but also negative effects (Petersen et al., 2011), on a firm's environmental performance. None of these few works, however, explore the relationships between MC and GM with a focus on organizational capabilities, even though organizational capabilities play a fundamental role both in MC (e.g., Salvador et al., 2009) and in GM (e.g., Hart, 1995).

The present paper aims to narrow this research gap by empirically investigating the interconnectedness of MC and GM on the level of their enabling capabilities. To that purpose, we conducted a single longitudinal case study in a machinery manufacturing organization that, during the period of observation, succeeded in developing both MC capabilities (MCCs) and GM capabilities (GMCS). As a result of this study, we find overlaps and path dependences between individual MCCs and individual GMCS. Pragmatically, our findings indicate synergies that companies faced with the twofold challenge of MC and GM may leverage in order to alleviate the difficulty of that challenge. From an academic standpoint, our results contribute to the debate (e.g., Montabon et al., 2007; Gimenez et al., 2012; Seuring, 2013) on the relationship between the environmental pillar of sustainability, which requires GMCS, and its

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economic pillar, which requires MCCs if a firm faces both highly heterogeneous demand and intense competition (Pine, 1993; Bardakci and Whitelock, 2003; Huang et al., 2008). Moreover, our results add to the body of the literature on MC as well as to the one on GM.

## 2. Literature review

### 2.1. Organizational capabilities

Organizational capabilities are often depicted in the literature as combinations of routines characterized by a recognizable organization-level purpose, such as the development of new products or services (Parmigiani and Howard-Grenville, 2011; Salvato and Rerup, 2011). In turn, organizational routines are commonly defined in the literature as repetitive patterns of interdependent organizational actions (Feldman and Pentland, 2003; Parmigiani and Howard-Grenville, 2011; Felin et al., 2012). Such recurrent patterns have both ostensive (cognitive) and performative (behavioral) aspects (Feldman and Pentland, 2003; Salvato and Rerup, 2011). The former aspect captures “the abstract idea of the routine” (Feldman and Pentland, 2003: 95) and includes, for instance, standard operating procedures for new product development (NPD) or an NPD team’s collective interpretation of how new products are or should be developed (Salvato and Rerup, 2011). Instead, the performative aspect captures the enactment of a routine in specific places and at specific times (Felin et al., 2012). As such, it includes behavioral regularities, rather than abstract patterns or understandings shaping and guiding organizational behavior (Salvato and Rerup, 2011). Organizational routines are described as having a context-dependent nature, where the context “is seen as a kind of ‘external memory’ and as a source of inputs to actions” (Dosi et al., 2008:1166). A customer database, for instance, might be a contextual requisite of some of the organizational routines supporting a marketing capability (Dosi et al., 2008). As emphasized by Winter (2000), routines, and capabilities even more so, require not only information flows and information processing, which are their nervous system, but also key inputs from their bones and muscles. In line with this view, we define organizational capabilities as the organizational knowledge of how to repeatedly organize a number of inputs in order for the organization to obtain a desired output (Grant, 1996; Dosi et al., 2008). It is worthwhile noting that this conceptualization of organizational capabilities, which is typical of the strategic-management literature, differs from the conceptualization that is common in the operations strategy research. In the latter body of the literature, capabilities are generally seen as “business unit’s intended or realized competitive performance or operational strengths” (Peng et al., 2008: 730) and, accordingly, are measured through indicators such as delivery time, conformance quality or costs (e.g. Ferdows and De Meyer, 1990; Flynn and Flynn, 2004). The operations strategy view of capabilities, in other terms, focuses on the outcome a capability is supposed to enable, rather than on the “means” or pathways to achieve that outcome (Swink and Hegarty, 1998; Peng et al., 2008).

### 2.2. Green-management capabilities

Green management (GM) is a concept that emerged in the last decade of the twentieth century, when the term “eco-efficiency” was coined and organizations started to look for innovative ways to reduce materials use, to utilize renewable energy, etc. (Pane Haden et al., 2009). Since then, management scholars have become particularly interested in the organizational capabilities that support GM. Hart (1995) introduced this theme in the strategic-management literature by proposing three GMCs: namely, “pollution prevention”, “product stewardship” and “sustainable development”. The first is the capacity to abate the emissions, effluents and waste caused by an organization’s manufacturing processes by eliminating the sources of pollution in those processes, rather than by controlling pollution with end-of-pipe

technologies. “Product stewardship” is the capacity to design new products with minimal life-cycle environmental impact. Finally, “sustainable development” can be defined, using Judge and Douglas’ (1998) words, as the capacity of an organization to integrate environmental issues into its strategic-planning process and decisions, thus minimizing the environmental burden of the firm’s growth and development. A few subsequent studies in the same body of literature have drawn upon Hart’s (1995) capabilities to understand their antecedents and/or their consequences on a firm’s performance and competitive advantage (e.g., Russo and Fouts, 1997; Judge and Douglas, 1998; Marcus and Geffen, 1998; De Bakker and Nijhof, 2002). Other studies in the same strand of research have proposed additional capabilities a firm should deploy for GM, such as Aragón-Correa and Sharma’s (2003) “proactive environmental strategy” capability.

The notion of GMC has more recently been adopted in the operations and supply chain management field as well (e.g., Bowen et al., 2001; Miemczyk, 2008; Bremmers et al., 2009; Wong et al., 2012; Ji et al., 2014; Lai et al., 2015). While some studies in this research stream have focused on upstream or downstream supply chain operations, others have taken a more comprehensive perspective. In particular, Lee and Klassen (2008), adopting a holistic view of supply chain operations, propose the following five GMCs: “product environmental management” (i.e., the capacity to provide green products to the customer through environmental practices in the NPD process), “process environmental management” (i.e., the capacity to sustain manufacturing processes that meet or exceed environmental regulations), “organization environmental management” (i.e., the capacity to integrate environmental issues into an organization’s daily business routines by building an environmental-management system that clearly assigns environmental responsibilities within the organization and provides environmental training and education to employees), “supply chain environmental management” (i.e., the capacity to motivate suppliers to be environmentally responsible and to reduce the environmental burdens caused by logistics) and “relationship environmental management” (i.e., the capacity to sustain environmentally sound relationships with external stakeholders through various communication methods, such as environmental reporting or participation in environmental-conservation programs).

### 2.3. Mass-customization capabilities

As compared to the research stream on GMCs, the one on MCCs is more recent and relatively underdeveloped. The first authors to use the term “capability” in conjunction with the term “mass customization” were Tu et al. (2001), who define MCC as the organization’s ability to produce differentiated products without sacrificing manufacturing costs and delivery lead-times. Similar to the manufacturing capabilities studied in the operations management literature (Peng et al., 2008), Tu et al.’s (2001) MCC is conceptualized as a competitive performance, rather than as a combination of routines and related inputs that enable such a performance.

Conversely, Zipkin (2001) identifies three MCCs that are more in line with the “capabilities as routine bundles” view which is typical of the strategic-management literature: “elicitation”, “process flexibility” and “logistics”. These capabilities can be thought as the means that a company needs to employ to achieve Tu et al.’s (2001) MCC. “Elicitation” is the capacity to identify exactly what the customer wants, which can be hard since customers themselves “often have trouble deciding what they want and then communicating or acting on their decisions” (Zipkin, 2001: 82). “Process flexibility” is the capacity to innovate production technology to increase its flexibility. “Logistics”, finally, is the capacity to make sure that the right product ultimately reaches each customer.

By elaborating on Zipkin’s (2001) MCCs, Salvador et al. (2009) propose another three capabilities that support the organizational movement toward MC: “solution space development”, “choice navigation” and “robust process design”. “Solution space development” is the capacity to identify the product attributes along which customers’

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