Technovation ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Technovation

journal homepage: www.elsevier.com/locate/technovation

Effects of standardization and innovation on mass customization: An empirical investigation

Zhiqiang Wang [a], Min Zhang [b], Hongyi Sun [c], Guilong Zhu [a,*]

[a] School of Business Administration, South China University of Technology, Guangzhou, China
[b] Norwich Business School, University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ, UK
[c] Department of Systems Engineering and Engineering Management, City University of Hong Kong, Kowloon, Hong Kong

ARTICLE INFO

Article history:
Received 30 September 2014
Received in revised form
4 January 2016
Accepted 8 January 2016

Keywords:
Standardization
Innovation
Mass customization capability
Delivery speed

ABSTRACT

Mass customization (MC) refers to the capability to produce customized goods for a mass market. Innovation can enhance the flexibility and responsiveness of a company, and standardization enables the company to achieve economies of scale and scope, both of which are necessary for developing MC capability. A conceptual model is proposed to explore the relationships among innovation, standardization, MC capability, and delivery speed. Hypotheses are tested using survey data from 204 manufacturing companies in China. The results show that standardization positively influences innovation. Innovation and standardization positively affect MC capability and are complementary in developing MC capability. Innovation significantly enhances delivery speed. However, the direct effect of standardization on delivery speed is nonsignificant. In addition, innovation and standardization indirectly affect delivery speed through MC capability. This study contributes to the literature by providing empirical evidence on the individual and interactive effects of standardization and innovation in developing MC capability and their joint influence on delivery speed. The results will help managers understand the roles of standardization and innovation in improving organizational capability and performance.

1. Introduction

Mass customization (MC) aims to offer customized products on a large scale and in a responsive manner so that nearly every customer can find products that satisfy their specific needs at a reasonable price (Anderson and Pine, 1997; Jiao et al., 2003). By aligning a manufacturer with its customer needs (Salvador et al., 2009), MC satisfies the demands for customization efficiently (Jitpaiboon et al., 2013; Kortmann et al., 2014). Mass customizers usually face the challenges of increasing product variety and process complexity (Duray et al., 2000; Salvador et al., 2009). Therefore, delivery speed, which refers to the extent to which a company promptly delivers products in response to customer needs (Calantone and Di Benedetto, 2000), is crucial for mass customizers to create and deliver value to customers (Jitpaiboon et al., 2013; Tu et al., 2001). The purpose of this study is to empirically investigate the roles of standardization and innovation in building MC capability and improving delivery speed. This study addresses the following two research questions. First, what are the individual and interactive effects of standardization and innovation on MC capability? Second, how do standardization, innovation, and MC capability jointly influence delivery speed?

MC capability enables a manufacturer to produce customized products rapidly at a cost comparable to the unit cost achieved with mass production (Tu et al., 2004). Implementing MC requires unique manufacturing systems and operational practices (Salvador et al., 2009). For example, studies have shown that MC capability can be developed through standardized modules (Peng et al., 2011; Tu et al., 2004) and innovative product and process designs (Jitpaiboon et al., 2013; Kristal et al., 2010). Standardization refers to the use of common parts, components, and platforms in research and development (R&D), production, and purchasing (Perera et al., 1999). Innovation is the practice of adopting, integrating, and implementing new knowledge and technologies in product and process development (Manu and Sriram, 1996; Wan et al., 2005). Standardization aims at growth through economies of scale and by increasing productivity and market share, whereas innovation aims at making a manufacturer more profitable and adaptive to market dynamics. Two competing views exist on the relationship between standardization and innovation (Thompson, 1965; Fixson and Park, 2008). Standardization emphasizes the similarity, uniformity, and continuity of behavior and encourages bureaucracy, which may hinder the generation of new and path-breaking ideas

* Corresponding author.
E-mail addresses: bmzqwang@scut.edu.cn (Z. Wang), M.Zhang1@uea.ac.uk (M. Zhang), mehsun@cityu.edu.hk (H. Sun), zhugl01@163.com (G. Zhu).

http://dx.doi.org/10.1016/j.technovation.2016.01.003
0166-4972/

and thus restrict companies to existing products or technologies (Thompson, 1965; David and Rothwell, 1996). Recently, some researchers argue that standardization allows employees to develop common languages and methodologies that facilitate knowledge distribution and combination, product and process development, and the adaptation of new technologies (Funk and Luo, 2015; Wright et al., 2012), thereby enhancing innovation. Because of the potential mixed effects of standardization on innovation and their major roles in MC (Fogliatto et al., 2012; Salvador et al., 2009), understanding the combined effects of standardization and innovation on MC capability and delivery speed can help manufacturers gain a competitive advantage.

This study can provide insights into the relationship between standardization and innovation and their roles in MC capability development. The results reveal that the interaction between standardization and innovation enhances MC capability and that MC capability carries the effects of standardization and innovation on delivery speed, thereby contributing to the MC literature. Thus, the findings can help managers in manufacturing firms to develop a more clear understanding of the effects of standardization and innovation on organizational capability and performance.

2. Literature review

2.1. Standardization

Standardization is a voluntary process for developing specifications based on the consensus of companies with their stakeholders (Saltzman et al., 2008). Standardization can be investigated at different levels (David and Rothwell, 1996; Perera et al., 1999; Tamura, 2013). As this study investigates the roles of standardization along vertical value chains, a micro-perspective is adopted (Baud-Lavigne et al., 2012). Therefore, this study focuses on company standards at the organization level instead of committee standards at the national level. Company standards emerge with many different formats in organizations and can influence the entire product and process development cycles, ranging from idea generation to product or process launch (Perera et al., 1999; Wright et al., 2012).

This study focuses on the company standards on product components and platforms (Anderson and Pine, 1997; Jiao and Tseng, 2000). These standards can be used to facilitate coordination among internal departments and with external partners (Perera et al., 1999; Baud-Lavigne et al., 2012). Company standards allow a manufacturer to decompose complex products into submodules, which can be shared, swapped, and used in multiple product lines (Fixson and Park, 2008), reducing transaction costs and fostering specialization (Funk and Luo, 2015). The standards enable a manufacturer to achieve economies of scale and scope and reduce costs by customizing one component without changing the overall product design or the designs of other components of the product (Baud-Lavigne et al., 2012). By maximizing the number of standard components, creating standard interfaces among them, and using product platforms, a manufacturer can produce compatible modules concurrently and reassemble or modify the modules into different functional forms (Peng et al., 2011; Tu et al., 2004). Standardization thus can benefit manufacturers by simplifying operations and reducing production complexity and inventory levels (Fredriksson and Gadde, 2005; Jiao et al., 2003). Researchers have argued that standardization can improve MC capability by facilitating the implementation of modularity-based manufacturing practices (i.e., product modularity, process modularity, and dynamic teaming) (Tu et al., 2004) and product configurator (Peng et al., 2011) and by mitigating the negative effects of product variety on internal operations (Duray et al., 2000).

2.2. Innovation

Innovation refers to new applications of knowledge, methods, and skills that can generate enhanced products and processes to meet customer demands and market needs (Kim et al., 2012; Wan et al., 2005). Innovation enables manufacturers to transform value propositions and improve agility and flexibility (Tongur and Engwall, 2014), and therefore, the manufacturers can quickly respond to changes in environments and benefit from market dynamics, which are fundamental for their competitiveness (Manu and Sriram, 1996; Lim et al., 2013). Innovations can take different forms such as upgrades, extensions, and major changes in existing products and processes (Kim et al., 2012).

This study focuses on product and process innovation. Product innovation refers to changes at the end of providing products, whereas process innovation is defined as changes in the methods of producing products (Kim et al., 2012). Product and process innovation require manufacturers to learn and develop new knowledge (Lin et al., 2012; Nonaka, 1991). Researchers have argued that innovation has a major role in MC because new products and processes allow a manufacturer to efficiently manage a wide variety of products (Da Silveira et al., 2001). For instance, Kristal et al. (2010) propose that continuous improvement is a prerequisite to and the solution for improving the operational competence in MC. Jitpaiboon et al. (2013) discover that process innovation can provide variety, custom fit, high-performance, and speed that customers expect and therefore enhance MC capability.

2.3. MC capability

MC capability can be defined as the ability to offer a relatively high-volume of product options for a relatively large market that demands customization, without substantial tradeoffs in cost, delivery, and quality (Huang et al., 2008). MC capability has four aspects: (1) customizing products while maintaining high-volume, (2) customizing products without substantially increasing costs, (3) responding to customization demands quickly, and (4) customizing products with consistent quality.

High-volume customization refers to the ability to aggregate individual customer needs into the large-batch production of common parts (Tu et al., 2001). As markets become increasingly segmented, mass customizers must aggregate customer demands to produce high-volumes of products across their fixed asset bases to achieve economies of scope and scale (Peng et al., 2011). Customization cost efficiency refers to the ability to provide customized products at a price similar to the unit price achieved using mass production (Tu et al., 2001). MC considerably increases operational uncertainty and complexity. Controlling operation costs is a challenge for mass customizers (Jiao et al., 2003). Customization responsiveness refers to the ability to reduce the total lead time for product customization (Huang et al., 2008). In general, customers must wait longer if they want personalized products. Increasing the agility of a production process is a major concern for mass customizers. Customization quality refers to the ability to manage and guarantee the quality level of every customized product (Huang et al., 2008). Mass customizers usually face the challenge of ensuring consistent quality when product variety increases considerably. Thus, manufacturers must implement advanced and innovative technologies and systems for delivering products that meet individual customer needs at nearly mass production efficiency (Salvador et al., 2009). For example, researchers have found that MC capability can be developed through time-based manufacturing practices (Tu et al., 2001), organizational learning (Huang et al., 2008), quality management (Kristal

Please cite this article as: Wang, Z., et al., Effects of standardization and innovation on mass customization: An empirical investigation. Technovation (2016), http://dx.doi.org/10.1016/j.technovation.2016.01.003