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Leveraging the benefits of modularity in the provision of integrated solutions: A strategic learning perspective

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ABSTRACT

The purpose of this study is to improve the current understanding of the ways a manufacturer can learn to leverage the benefits associated with modular solution designs in its transition to a solution provider. We find that a modular solution design acts as a key integration mechanism, allowing the provider to orchestrate actors in the supply network for simultaneous exploitation of resources related to the existing solution modules and exploration of new ones. Yet, to implement a modular solution design effectively, the provider needs to engage in strategic learning that improves its ability to explore customers' readiness to adopt new types of solutions, while it develops an ability to deploy the derivative solutions by utilizing the resources related to its core product business. Mastering the co-evolutionary processes of strategic learning that combine elements of explorative and exploitative learning facilitates a pursuit of the industrializer path to service-based growth. For managers, our findings demonstrate the ways a manufacturer may unlock the economies of scale in solution business by leveraging the benefits of a modular solution design.

1. Introduction

Management scholars have long argued that sustained competitive advantage requires from the focal firm the ability to capitalize on both opportunity-seeking exploration and advantage-seeking exploitation (Levinthal & March, 1993; March, 1991). However, in the solution business context, it appears difficult for manufacturers to manage the service transition process in a way that enables taking advantage of both explorative and exploitative learning. In particular, manufacturers often struggle to find effective ways to explore solution business-related market opportunities, while exploiting established manufacturing-based competences (Windahl & Lakemond, 2010). One of the reasons is noted by Benedettini, Neely, and Swink (2015), who suggest that service transitions change the manufacturer's relationship with its external environment, while causing internal frictions in integrating service processes, values, and competences into organizational practices.

The efforts of the scholarly community to address the challenges related to the service and solution-based business have resulted in several significant contributions, such as a special issue of *IMM* (Evanschitzky, Wangenheim, & Woisetschläger, 2011). Yet, the managerial impact of these contributions is arguably constrained by the tendency of marketing scholars to emphasize content over process (Martens, Matthyssens, & Vandenbempt, 2012). Thus, while it is well understood based on prior research *what* solution business is, less is known about *how* manufacturers learn to incorporate its key design principles into effective organizational practice.

To contribute to this gap in existing understanding, the purpose of this study is to develop a better understanding of how manufacturers learn to leverage the strategic benefits associated with modular solution designs. In doing so, we build on the idea that firms engage in strategic learning processes to facilitate the interpretation, implementation and dissemination of knowledge related to opportunity-seeking exploration and advantage-seeking exploitation (Kuwada, 1998; Sirén, Kohtamäki, & Kuckertz, 2012). Accordingly, we draw on nearly a decade of research, to explicate how in implementing a modular solution design, a provider of smart building solutions has engaged in a strategic learning process that has facilitated its ability to transition beyond project-based integration of solutions. In other words, through leveraging of the strategic benefits of modularity, the firm has developed an ability to deploy integrated solutions on an industrial scale as part of its core product operations. At the same time, it can flexibly integrate internal and external resources into tailored customer solutions. This facilitates its ability to both explore and exploit solution business-related market opportunities.

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Through an analysis of the strategic learning process tied to the implementation of a modular solution design in a longitudinal case study setting, we contribute to an organizational learning perspective on solution business, which is missing from prior research in the field that has relied on conceptual and static cross-sectional approaches. Our research demonstrates that the benefits of modular solution designs extend far beyond the avoidance of costs related to project-specific integration of solutions (Davies, Brady, & Hobday, 2006; Davies, Brady, & Hobday, 2007; Storbacka, 2011). In implementing a modular platform-based solution, the provider improves its ability to explore customers' readiness to adopt new types of solutions, while ensuring that the derivative solutions can be deployed utilizing organizational competences developed for the core product business. This ability is crucial for the "industrializer" path to service growth (Kowalkowski, Windahl, Kindström, & Gebauer, 2015), but requires a prolonged period of strategic learning during which the provider redefines its design process used to integrate solutions (Kuwada, 1998).

The paper is structured as follows. Section 2 presents the conceptual background for our research. Section 3 discusses the methodology. In Section 4, we present the case analysis and findings. The last section discusses the implications and conclusions of the study.

2. Conceptual background

A substantial body of literature concerning manufacturers' transition towards service-based growth has focused on explication of solution business. Prior research has conceptualized solution business as a type of service-based business model (Storbacka, 2011) that requires an ability to engage customers in relational processes during the various phases of the solution life cycle that precede and follow the integration of product- and/or service-based components into customized responses to complex customer needs (Evanschitzky et al., 2011; Tuli, Kohli, & Bharadwaj, 2007). A typical transition to solution business involves extending the manufacturer's scope of supply through seamless integration of previously disintegrated product-based components into functional systems (Matthyssens & Vandenbempt, 2008) and efforts to offer increasingly sophisticated forms of post-deployment support services to customers (Ulaga & Reinartz, 2011).

In many cases, solutions are developed ad hoc, in close collaboration with customers, requiring project-based efforts to manage technical application integration of the solution components (Brady & Davies, 2000; Kowalkowski et al., 2015; Matthyssens & Vandenbempt, 2008). However, to succeed in solution business, providers arguably must not only look for ways to develop more complex offerings through the integration of previously disintegrated subsystems, but also balance these efforts with standardization activities that lead to offerings that are more easily repeatable (Salonen, 2011; Storbacka, 2011). Pre-defined solutions require less project-specific efforts to integrate solution components into a functional whole, which lowers the costs and operational complexities related to provision of integrated solutions. Thus, efforts to limit variety through specification of pre-defined solution configurations enhances the provider's value appropriation capabilities and helps to unlock volume in solution business (Kowalkowski et al., 2015; Storbacka, 2011).

Development of industrialization capabilities is particularly important for solution providers following the "industrializer" path to service growth (Kowalkowski et al., 2015). Such firms seek to capitalize on the knowledge and experience gained from more complex projects by finding ways to downsize and standardize solution offerings (Ibid). While difficult to realize in practice, it is believed that key to pursuing the industrializer path to service growth lies in the adoption of a modular solution design consisting of a "basic modular system and its standardized components" (Davies et al., 2007, p. 186).

The modularity of a solution can be considered as a continuum describing the degree to which the components of a solution can be separated and recombined through predefined interfaces (Schilling, 2000), thus facilitating cost-effective customization of solutions (Davies et al., 2006; Davies et al., 2007; Roehrich & Caldwell, 2012; Storbacka, 2011). More recently, it has been suggested that solution providers leverage modularity to accommodate the growing complexity of solution networks (Eloranta & Turunen, 2016). In other words, given that solutions can be considered as bundles of knowledge-based components that are integrated by the focal firm into functional solutions (Valtakoski, 2017), the ability to orchestrate networks of actors in support of solution provision is thought to be an increasingly crucial task (Davies et al., 2007; Gebauer, Paiola, & Saccani, 2013; Jaakkola & Hakanen, 2013; Windahl & Lakemond, 2006). The more complex and extensive the offering, the higher the coordination costs and the greater the operational risks (Nordin, Kindström, Kowalkowski, & Rehme, 2011).

Research on applications of modularity principles in the service context is scarce. While some work has been done in the field of service modularity, this research focuses purely on service-based components (see e.g., Pekkarinen & Ulkuniemi, 2008). Here the task of developing standardized interfaces between the integrated components is likely to be easier than in cases requiring integration of physical component interfaces. The research stream that addresses complex product systems as integrated combinations of both physical and service-based components (e.g., Davies et al., 2007) assumes that conditions supporting modularity are present at the industry level (Schilling, 2000). However, given that manufacturing industries are not characterized by a similar degree of open standards as are, for instance, ICT-based industries, it can be expected that solution providers will struggle to design and integrate externally sourced product and service components into functional solutions for customers. Doing so is likely to require purposeful steps towards modularizing the solution offerings and the processes that link actors in these service systems (Van Liere, Hagdorn, Hoogeweegen, & Vervest, 2004; Vervest, Preiss, van Heck, & Pau, 2004). However, very little is known about how these processes translate into functioning organizational practice.

To better understand how manufacturers learn to leverage the strategic benefits associated with modular solution designs, we next discuss the generic principles of modularity and then introduce the central principles of Kuwada's (1998) strategic learning framework. This lays the basis for the analytical framework that we draw upon to understand the learning processes relevant for our study.

2.1. Characteristics of modular solution designs

The generic principles of modularity are well understood through work done in the field of operations management. Baldwin and Clark (1997, p. 84) define "modularity" as "building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole." Modularity can be analyzed at the level of products, organizations, and production systems (Sanchez & Mahoney, 1996; Schilling & Steensma, 2001).

The extent to which systems migrate towards increasing or decreasing modularity depends on the presence of multiple conditions that may reinforce each other (Schilling, 2000). For instance, the heterogeneity of both component inputs (diversity in technological options and differentiation in firm capabilities) and customer demands favors modularity at the system level. This effect can be amplified by environmental changes such as increased competitive intensity. A focal firm that is active in an industry not characterized by modular conditions will have to develop specialized interfaces that coordinate the functions among a set of components supplied by specialized vendors. (Schilling, 2000)

At the product level, the principles of modularity give rise to "platform thinking," an approach to new product development that focuses on the commonality of subsystems to diffuse them across projects (Gawer, 2014). Platforms use an architecture that designates core and peripheral modules with core modules embodying the company's