Journal of Purchasing & Supply Management 15 (2009) 79–88

Contents lists available at ScienceDirect

Journal of Purchasing & Supply Management

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

Preserving the link between R&D and manufacturing: Exploring challenges related to vertical integration and product/process newness

Daniel Olausson, Thomas Magnusson, Nicolette Lakemond *

Department of Management and Engineering, Linköping University, SE-58183 Linköping, Sweden

A R T I C L E I N F O

Article history:
Received 3 June 2007
Received in revised form
14 December 2008
Accepted 19 December 2008

Keywords:
Vertical integration
R&D–manufacturing coordination
Role of purchasing

A B S T R A C T

Adopting a contingency framework, this paper explores consequences of manufacturing outsourcing and product/process newness for R&D–manufacturing coordination. Based on case-study findings, the following coordination challenges are outlined: accessing manufacturing competence and understanding suppliers' processes (outsourcing of manufacturing and high newness); receiving feedback from suppliers and motivating suppliers (outsourcing and low-medium newness); exploiting manufacturing competence and establishing close working relations (internalization of manufacturing and high newness); early involvement of manufacturing and suppliers, and reducing variability in supplier performance (internalization and low-medium newness). The paper further elaborates on how the role of purchasing may change in order to address these challenges.

1. Introduction

In recent discussions on vertical integration, much attention has centred on the question as to whether manufacturing should be internalized and conducted in-house or outsourced to external contract manufacturers. Several studies have investigated the pros and cons of such strategic decisions (e.g. Arnold, 2000; Dabhilkar and Bengtsson, 2008; Rothaermel et al., 2006). For example, Berggren and Bengtsson (2004) describe how the two mobile network system providers Ericsson and Nokia opted for different strategies. While Ericsson separated R&D and manufacturing by outsourcing volume production, Nokia retained R&D and volume manufacturing within one organizational entity (i.e. both activities were conducted either by Nokia or by systems suppliers). Through this arrangement, Nokia was able to maintain a high level of manufacturing competencies, which was necessary for new product development (NPD). Critical voices within Ericsson raised concerns about the lack of relevant production skills in-house, which made it difficult to assess and select suppliers and manage the transfer from prototypes to volume production. This concern is supported by Veugelers and Cassiman's (1999) findings that firms with no in-house manufacturing have problems making good use of a supplier's manufacturing skills in the NPD process. In the end, Ericsson decided to retreat from a strategy where volume production is fully outsourced.

The above example concerns a complex product, but NPD is also challenging when developing less complex products (Ettlie, 1992; Rosenthal and Tatikonda, 1992). Several studies stress the need to consider the linkage between R&D and manufacturing for NPD performance (Barton et al., 2001; Kessler and Chakrabarti, 1999; Swink, 1999). However, despite the fact that many problems in NPD can be traced to a lack of R&D–manufacturing coordination (Sehdev et al., 1995; Swink, 2003), few studies have actually examined the consequences of different degrees of vertical integration for R&D–manufacturing coordination. Thus, the purpose of our study is to develop a tentative model including both R&D–manufacturing coordination and purchasing challenges that are connected to different degrees of vertical integration and different kinds of development tasks.

We use a comparative case-study approach involving studies of NPD projects in four medium-sized engineering firms. The engineering industry was selected since R&D and manufacturing are often interdependent in this industry to the extent that each is constrained by the decisions or actions of the other, or has information that the other needs to meet its specific responsibilities (Susman and Dean, 1992). Thus, in terms of NPD, coordinated actions are required. For example, design decisions on product tolerances often affect the required manufacturing processes and equipment. Coordination is often associated with the timing, monitoring and controlling of activities, as well as communication and establishment of mutual goals (Baccarini, 1996; Frishammar and Hörte, 2005; Swink, 2003). Coordination involves the use of both formal mechanisms such as flows of standard documentation (Frishammar and Hörte, 2005) and informal mechanisms such as interaction at the working level (Wheelwright and Clark, 1992). Wheelwright and Clark (1992) argue that coordination, at a basic level, involves the scheme of linking activities in time (e.g. early involvement) and, at a deeper level, it involves the process of exchanging real-time information

* Corresponding author. Tel.: +46 13 282525; fax: +46 13 281813.
E-mail addresses: daniel.olausson@liu.se (D. Olausson), thomas.magnusson@liu.se (T. Magnusson), nicolette.lakemond@liu.se (N. Lakemond).

1478-4092/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.pursup.2008.12.004

in order to identify and solve problems (i.e. mutual adjustments). In this paper, the term coordination refers to all informal and formal mechanisms that establish and integrate the roles of project participants and it involves the timing and frequency of activities that are required to meet the product goals with regard to quality, costs and lead-time parameters.

The remainder of the paper is structured as follows. First, in Section 2, the theoretical framework is presented. In Section 3, the research design is outlined and the four cases are described in Section 4. In Section 5, the empirical data are then analyzed, resulting in our tentative model. The paper concludes by discussing theoretical and managerial implications (Section 6), as well as suggestions for further research within this area (Section 7).

2. The importance of linking R&D and manufacturing

2.1. Vertical integration: internalization and outsourcing of manufacturing

The degree of vertical integration in this paper is regarded as the extent of consolidation of manufacturing into the same legal entity. A similar definition has been used by authors such as Ulrich and Ellison (2005), who identify two broad options: internalization and outsourcing. Rothaermel et al.'s (2006) longitudinal study of over 3500 product introductions in the global microcomputer industry shows that firms can shift between internalization and outsourcing and that they need to carefully balance between the two options.

The decision to internalize or outsource manufacturing can be related to both transaction cost economics and core competencies/capabilities (Holcomb and Hitt, 2007). For example, Arnold (2000) concludes that manufacturing knowledge has become a commodity that can be purchased at a lower transaction cost in the market and, therefore, leading edge companies must focus on R&D and outsource all manufacturing activities. However, substantial evidence shows that it is difficult to separate R&D and manufacturing in technology-intensive industries (Fine and Whitney, 1999). In these circumstances, product development is likely to require concomitant process development and direct manufacturing involvement. For example, Wagner's (2003) industry-level analysis shows that technology-intensive industries (e.g. electronics, automotive and machinery) involve suppliers intensively in the R&D phase as well as the manufacturing phase. In contrast, process industries (e.g. chemicals, pulp and paper) do not involve suppliers intensively, either in R&D or in manufacturing.

Thus, as Kogut and Zander (1992) argue, although transaction cost theory provides important insights, a resource-based view is more useful when trying to understand what constitutes effective coordination between R&D and manufacturing (and suppliers). The resource-based view has been used to understand the impact of strategic outsourcing and several of these studies emphasize the importance of considering the link between competencies such as manufacturing and product development (e.g. Prahalad and Hamel, 1990; Teece et al., 1997; Wernerfelt, 1984). It has been argued that the link is often idiosyncratic and tacit, which means that outsourcing to suppliers must be accompanied by a competence overlap between the buyer and the supplier, particularly in innovative projects (Takeishi, 2002). The need for internal manufacturing competencies at the focal firm for ensuring coordinated actions with suppliers has also been identified in studies in the aero-engine industry (Prencipe, 1997) and the automotive industry (Sako, 2003).

To sum up, this section has highlighted the fact that further studies of vertical integration and coordination are needed. As the following section outlines, it is also necessary to consider the mediating effect of the characteristics of the development task.

2.2. Characteristics of the task: degree of product/process newness

Building on classical contingency frameworks on organizations (Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Thompson, 1967), several recent studies confirm the relevancy of contingency theory for NPD. Particularly the relation between the characteristics of the task and product development procedures has been highlighted (e.g. Liker et al., 1999; Shenhar, 1998; Tatikonda and Rosenthal, 2000). In short, the characteristics of the task affect the timing and effectiveness of different coordination mechanisms (cf. Zollo and Winter, 2002). Wheelwright and Clark's (1992) study illustrates the importance of considering the degree of product and process newness. As the degree of newness increases, it is generally necessary to improve coordination between R&D, manufacturing and purchasing by using a wide range of both formal (e.g. documentation) and informal mechanisms (e.g. interaction). Whereas projects involving significant performance improvements (e.g. breakthrough and platform projects) often require both significant product and process improvements, it is easier to decouple R&D and manufacturing in platform derivate and incremental projects as they require less concomitant product and process development.

Adler's (1995) study of interdepartmental interdependence and coordination supports the importance of considering the degree of product/process newness. The author concludes that the extent of direct interaction between actors depends on the novelty of the specific set of product/process fit issues. For example, Toyota tends to rely more extensively on formal mechanisms for coordination (Morgan and Liker, 2006). However, the development of the hybrid car Toyota Prius involved major product and process development that forced the firm to use a wide range of coordination mechanisms. For instance, in order to solve problems in the battery–vehicle interface, engineers were located at the supplier's site so that face-to-face contact was possible (Magnusson and Berggren, 2001).

2.3. R&D–manufacturing coordination: DFM and the role of purchasing

In order to improve coordination between R&D and manufacturing, several firms utilize design-for-manufacturing (DFM,) which in its broadest sense includes "any step, method or system that provides a product design that eases the task of manufacturing and lowers manufacturing costs" (Bralla, 1999, p. 9.30). In practice, DFM often refers to a series of design tools and methodologies that force the designer to simultaneously consider design goals and the constraints of the manufacturing system (Bralla, 1999; Herbertsson, 1999).

Design for manufacturability has been highlighted as a significant factor for explaining the difference between successful and unsuccessful technological innovations (Rothwell, 1974; Rothwell et al., 1974), since it addresses some of the problems that comes with lack of coordination (Susman, 1992). However, the literature on DFM has been criticized for focusing too much on design methodology and for paying too little attention to managerial and organizational factors (Herbertsson, 1999). For example, although outsourcing is highlighted as one of the more important trends that affect NPD performance (Priest and Sánchez, 2001), the literature on DFM generally assumes that