J. Eng. Technol. Manage. 29 (2012) 468–488

Contents lists available at SciVerse ScienceDirect

Journal of Engineering and Technology Management

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

The front end in non-assembled product development: A multiple case study of mineral- and metal firms

Johan Frishammar [a,*], Ulrich Lichtenthaler [b,1], Monika Kurkkio [c,2]

[a] Luleå University of Technology, Entrepreneurship & Innovation, Center for Management of Innovation and Technology in Process Industry, SE-97187 Luleå, Sweden
[b] University of Mannheim, Schloss, D-68131 Mannheim, Germany
[c] Luleå University of Technology, Center for Management of Innovation and Technology in Process Industry, SE-97187 Luleå, Sweden

ARTICLE INFO

JEL classification:
O32
Keywords:
Front end
Product concept
Non-assembled products
Process firms
Case-study
Ideation
Idea Management

ABSTRACT

We conceptualize the front end in non-assembled product development to be iterative and experiment-based, consisting of three sub-phases: informal start-up, formal idea-study, and formal pre-study. Although some key activities are shared with the front end activities in assembled product development, literature reviews, anticipating requirements of customers' production processes, analysis of raw materials, anticipation of scale-up problems, and tests in bench-, pilot plant-, and full scale production represent unique activities. In addition, product concepts were frequently developed in parallel, requiring specification of physical, chemical and structural properties. These findings have implications for increasing the success and quality of front end efforts.

Introduction

Innovation in different types of products seems to follow different logics and development paths. For assembled products, product development typically enjoys an early wave of innovation, but over time the rate of product development innovation subsides in favour of a growing rate of process innovation (Utterback, 1996). For non-assembled products, Linton and Walsh (2008) suggest that product and process innovation co-evolve over time. For services, a reverse pattern could be expected,

* Corresponding author. Tel.: +46 0920 491407.
E-mail addresses: johan.frishammar@ltu.se (J. Frishammar), lichtenthaler@uni-mannheim.de (U. Lichtenthaler), monika.kurkkio@ltu.se (M. Kurkkio).
[1] Tel.: +49 0621 181 1604.
[2] Tel.: +46 0920 491 865.

0923-4748/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.jengtecman.2012.07.001

starting with process improvements, moving on to process innovation, which eventually leads to product innovations through new types of services (Barras, 1986).

These differences in logics, paths and key activities may very well extend to the front end of the innovation process, defined as the period between when an opportunity for a new product is first considered, and when the product idea is judged ready to enter formal development (Kim and Wilemon, 2002). The front end is a crossroads of complex information processing, tacit knowledge, conflicting organizational pressures, and considerable uncertainty (Florén and Frishammar, 2012). In addition, the front end is often ill-defined and characterized by ad-hoc decision-making in many firms (de Brentani and Reid, 2011; Montoya-Weiss and O'Driscoll, 2000). Due to these characteristics, the foundations for ultimate product failure often seem to be set at the very beginning of development (Cooper, 1988; Oliveira and Rozenfeld, 2010).

To this background, the front end has attracted considerable attention from prior scholars. It has been studied conceptually (Chang et al., 2007; Kim and Wilemon, 2002; Reid and de Brentani, 2004) and in the context of both services (Alam, 2006) and assembled products (e.g. Khurana and Rosenthal, 1997, 1998; Murphy and Kumar, 1997; Verganti, 1997; Verworn et al., 2008; Veryzer, 1998; Veryzer and Borja de Mozota, 2005). However, prior research on the front end has mainly been conducted on assembled products and, to a limited extent, on services. To the best of our knowledge, however, research on the front end in non-assembled product development is non-existent. This research deficit is surprising in light of the specific contingency characteristics surrounding non-assembled product development. Therefore, it appears worthwhile to conduct an in-depth investigation of the front end of non-assembled product development.

Specifically, these contingency characteristics raise the question of whether prior research results on the front end can be transferred to the domain of non-assembled product development. Consequently, we engaged in an empirical study to explore the front end in non-assembled product development. The purpose of our article is to increase theoretical and empirical knowledge about the front end in non-assembled product development. In addition, we seek to study how front end activities in non-assembled product development differ from activities reported in prior studies on the development of assembled products. We addressed this purpose by performing 36 semi-structured interviews with R&D professionals over the course of 20 months and augmented these interviews with observations, informal conversations, group meetings, and studies of documents.

Although our study highlights similarities with prior research, it also provides new important contributions because several of our findings diverge from prior findings on the front end in assembled products or services. We conceptualize the front end in non-assembled product development to be iterative and experiment-based, with a primary focus on anticipating future product and process parameters. Multiple non-assembled product concepts were frequently developed in parallel, requiring clear specification of physical, chemical and structural properties. Key activities include anticipating requirements of customers' production processes, analysis of raw materials, to anticipate scale-up problems, and various tests in bench-, pilot plant-, and full scale production. Moreover, we present a conceptualization of the front end applicable to non-assembled products, and we highlight central managerial challenges arising in this domain. Finally, we underscore critical differences and similarities between the front end in non-assembled and assembled product development. Thus, this article provides new conceptual and empirical insights that are equally relevant to academics and industry professionals.

The remainder of the article is organized as follows. First, we review prior literature to root our findings theoretically. Next, the research design is described, leading to a section which provides key results. The article ends with discussion, implications and an outlook.

Theoretical background

There are important interdependencies between product and process development in firms developing and producing non-assembled products. For example, new product concepts frequently require changes to the production process, thus calling for process development. Conversely, process development often changes features of the final product (Lager, 2010; Linton and Walsh, 2008). To acknowledge these interdependencies, our conceptual framework combines literature on managing