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Cognitive maps to analyze new product development processes: A case study

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Abstract

A few methods have been proposed in the literature to identify and address problems that arise during New Product Development (NPD). In this paper, cognitive maps are used to investigate such problems. In particular, the development of four new sofa models as performed in a company working in Southern Italy is studied. Based on direct observations and interviews with actors involved in the process, maps depicting the entire development process and the four examined cases are developed and analyzed. The analysis results show that some interpretative and cognitive issues are mainly responsible for the problems caused in NPD. Moreover, cognitive maps reveal a powerful tool to analyze and study the NPD process.

Keywords: Cognitive maps; New product development; Interpretative problems

1. Introduction

The importance of models, techniques and tools to improve the management of the New Product Development (NPD) process is broadly recognized in the literature (Wheelwright and Clark, 1992; Maylor, 2001). The adoption of structured methodologies allows problems to be more easily identified and alternative modes to perform the process be simulated and compared. Yet, only a few tools have been proposed to specifically address problems associated with cognitive issues that often arise during innovation development. Such problems are particularly crucial for NPD, which can be thought of as a sequence of cognitive processes (Kline and Rosemberg, 1986; Kessler et al., 1998; Nightingale, 1998). The knowledge-intensive nature of NPD makes cognitive processes such as knowledge creation, knowledge transfer, codification and learning very critical. In particular, interpretative barriers can emerge among the actors that are involved in the process. These actors usually interpret both the process goals and the working procedures by adopting their own thought worlds without developing a shared view of the process, so making the exchange of communications and coordination very hard (Dougherty, 1992; Heller, 2000).

The goal of this paper is to study problems (e.g. long lead time, low product quality, re-works) that emerge during NPD and their causes. Specific attention is devoted towards cognitive problems. To this end we adopt cognitive maps. Cognitive maps are graphic tools used to represent concepts and ideas that individuals associate with some specific issues and the relationship among them (Eden and Ackermann, 1992; Langfield-Smith, 1992; Pidd, 1996).

In this paper, cognitive maps are used to analyze a case study carried out in a firm that works in Southern Italy. The firm is specialized in the production of leather sofa. The case study includes the analysis of four new sofa model development processes. We develop, analyze and compare the cognitive maps associated to the processes in order to identify the crucial problems that occurred during the development and the way they affected the NPD performance. A map associated with the main actors involved in NPD is also developed and studied. The analysis of the different cognitive maps allow us to identify the different perspectives and some interpretative barriers that emerge during the development.

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The paper is organized as follows. We start by providing an overview of the NPD process and the cognitive problems that arise during it. Then, we briefly discuss cognitive mapping, describe and discuss the NPD case and develop the attendant cognitive maps. Based on the analysis results, some conclusions about problems emerging during NPD and methods to address them are finally drawn.

2. New product development process: An Overview

NPD is a complex process. Unlike most business processes, each instance differs from the previous ones (at least at a macro-level of analysis), its output is not clearly ex ante defined and many of the activities to be accomplished are knowledge intensive. Among them, idea generation, product design, prototype and engineering are the most relevant (Carbonara and Schiuma, 2004). These activities involve a sequence of problem-solving cycles, which are typical of every knowledge creation process.

NPD performance depends not only on the effectiveness and efficiency of activity accomplishment, but also on the degree of integration among them. The integration requires the adoption of mutual adjustment coordination mechanisms, lateral communications, and repeated problem-solving techniques. Most importantly, the actors involved need to share the vision about the process and agree about their role and contributions. They should thus adopt a process-based view. However, in many organizations a departmental logic often prevails on a process-based view. In such a context, interpretative and cognitive problems frequently arise. Many studies indeed stress the fact that each department often interprets its role differently from the others, thereby providing not requested output and/or receiving inputs different from what was needed. Also, departments develop their own cognitive schemes and thought worlds (Dougherty, 1992), so making inter-departmental communication and collaboration hard. The use of different rationales and vocabulary make the involved actors filter information or misunderstand them. Organizational routines can also make the process more complex. Dougherty (1992) identifies three dangerous routines: actors' habit to work within their role and communicate with the same persons, the use of predefined definitions of the market/technology relationship and the use of standards and working methods (such as the pay back period, return of investments, etc.) not coherent with NPD.

The degree of integration among the different NPD activities is also related to the effectiveness and efficiency of the knowledge transfer processes activated within NPD. The literature on knowledge management points out that knowledge transfer efficiency is mainly related to the uncertainty level that characterizes the process whereas its effectiveness can be associated with the process ambiguity level (Cohen and Levinthal, 1990; Conner and Prahalad, 1996; Daft and Lengel, 1986; Kogut and Zander, 1992; Albino et al., 2000). The uncertainty level, in turn, depends on a set of qualitative and quantitative aspects associated with information (neutral and codified knowledge) transfer (Daft and Lengel, 1986). In particular, knowledge transfer is uncertain if the transferred information is affected by noises and/or is insufficient to represent the transferred knowledge. Then, uncertainty is strictly related to the information transfer process and it can be reduced by increasing the amount of exchanged information. Ambiguity is rather related to the interpretation of the transferred knowledge, process that involves the knowledge recipient. When actors involved in a knowledge transfer process do not share the same cognitive schemes, higher ambiguity levels are likely to occur. In that case the cognitive interaction is characterized by multiple and conflicting interpretation of the exchanged information. Common cultural background, cognitive framework and technical expertise usually reduce amibiguity levels (Albino et al., 2000). Uncertainty and ambiguity thus depend on four main factors, namely the actors involved in the transferring process, the context in which it takes place, the transfer content and the adopted media (Daft and Lengel, 1986). They can be reduced by adopting specific knowledge management processes. In particular, knowledge codification allows one to increase the knowledge transfer speed and the quantity of exchanged information, as well as to make a clear definition of the content of the transfer process. Knowledge codification can be a means to reduce uncertainty whereas face-to-face interactions and socialization processes should be activated to reduce ambiguity levels (Albino et al., 2000).

Knowledge transfer processes carried out within a NPD process are characterized by different levels of ambiguity and uncertainty, as they may involve different actors, context, content and media. Therefore, the NPD process performance can be improved by levering on knowledge codification (when possible) and socialization processes.

Also, NPD can be improved by identifying approaches and tools to support the creation of shared mental models. In the literature, few studies deal with methods and tools to support NPD (Presley et al., 2000). Quality Function Deployment (QFD) and Design To Manufacturability Charts have been, for example, proposed to support the design of new products and, in particular, to take into account the needs of customers (upstream) and anticipate eventual problems with manufacturing (downstream). Stage models have been proposed to support planning and execution stages and project management techniques have been defined to properly manage the process, assess its advancements and communicate them to customers (Rosenau and Moran, 1993; During, 1986).

In this paper, we investigate the problems that occur during development processes. To this aim we adopt cognitive maps. As explained in the following sections, cognitive maps represent a useful tool not only to study NPD processes and, in particular, to point out cognitive