Technical Components and Requirements Model for Supporting Collaboration in the Product Technology Transfer Process

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Abstract. During the product technology transfer process, the high level of communication, coordination and cooperation among the members involved in this activity is necessary. Making use of a collaborative environment is essential for managing this process and the project. In this sense, the paper presents the technical components and requirements model to support developing this environment and assist the collaboration and product technology transfer. The Enterprise Knowledge Development (EKD) methodology was used to develop the model. The proposed model was based on literature and in seven case studies conducted in small and medium-sized high-technology firms. As a result, this paper shows a group of functional and non-functional requirements as well as the goals that the information system should have to allow the communication and the exchange of information in transfer projects involving collaboration. Furthermore, this research contributes to the information system development that supports these projects.

Keywords: product technology transfer; collaboration, technical components and requirements model

1 Introduction

Collaboration is considered an important instrument for the development and success of the entrepreneurial firms by providing competitive advantage, given that the links between the enterprises are knowledge and technology transfer factors which support innovative processes [1], [2].

Participating in a collaborative network is an organizational solution for those firms that do not have certain skills or know-how to develop a new product. According to [3], acquisitions and use of new technologies from an external source can contribute to the operational success of the firms.

One mechanism to obtain this expertise is the product technology transfer process. This process involves a range of technological knowledge, scientific basis for specific processes, knowledge and competences through and interactive process in which different stakeholders absorb, assimilate and exchange knowledge in a social or physical context [4], [5], [6]. This iterative process not only transfers knowledge

between organizations, but also facilitates the creation of new knowledge and product solutions [7], [8].

The technology transfer is not an easy activity due to the risks and problems that may arise during the product development, committing the time to market, generating excessive costs and functionality issues [9], [10]. Throughout the process is necessary to have a high level of interaction among stakeholders in terms of communication, coordination and cooperation [11]. This interaction reduces the chaos in the innovation process increasing the probability of developing a successful innovation [12] However, according to [13], the communication and the coordination of the activities are some challenges of this environment, requiring different project management methodology from traditional approaches and a much more robust information system (IS) to support the project [14]. In this way, the paper purposes a technical components and requirements model that supports a collaborative environment to transfer technologies.

This paper is organized as follows: Section 2 presents the literature review on collaborative networks and product technology transfer. Section 3 describes the research methodology. Section 4 presents the technical components and requirements model proposed by this research. Finally, Section 5 provides the conclusions and futures researches.

2 Literature Review

Collaborative Networks. A collaborative network is an alliance formed by several entities that are autonomous, geographically distributed and heterogeneous with regard to the operating environment, culture, social capital and goals, but they share information, resources and responsibilities to jointly plan, implement and evaluate the activities in order to achieve common and compatible objectives [15], [16]. Besides, the members of networks use information and communication technology to coordinate and support the activities [17].

Collaborative networks promote technological development through the creation, generation and dissemination of knowledge, supporting the learning between Organizations, the sharing of technological skills, allowing firms to transfer knowledge and technology that they would not be able to develop [18], [2]. These networks are already recognized as a way for firms to survive in dynamic environments, where technology, society and markets are constantly changing. Collaborative networks are considered a way to create value because they generate new capabilities for dealing with uncertainty, need for innovation, competition and mass customization [16].

According to [19], these networks allow the individuals involved in the knowledge transfer develop a common understanding required for the receiver fully understands the function of knowledge provided by a source. Social ties can help a firm to explore new scientific and technological knowledge.

Product Technology Transfer. The product technology transfer is a process that manages the acquisition, handling, and incorporation of tangible and intangible objects originating from external product-based sources, in order to commercialize an innovation or meet the needs through the synergistic combination of resources.

The integration of different technologies into products at the end of the technological development represents the interface between technology and product development [20]. This interface is a critical activity because it can affect the scope of the project, lead-time, cost and quality of a new product [10].

According to [21], the transfer of technology provides some benefits such as: opportunity to place students in industry, access to industry for both fundamental and applied research, improvement in new technology implementation, new product development and spin-offs, cost savings, access to the university's physical facilities and the expertise of its staff, gained technical knowledge, quality improvement, new markets and, manufacturing and lead time reduction.

For technology transfer through collaboration be successful is necessary communication, sharing information, developer-user partnerships and early user involvement, credibility of parties, capacity to transmit and receive information [22].

3 Methodology

This research was developed in three phases: the literature review, the case study and the information system modeling.

Phase1: the literature review was conducted on collaborative information system and product technology transfer inserted in the areas of inter-organizational networks and management of technology and innovation. The databases used were: Science Direct, Web of Science, Compendex, and Emerald.

Phase 2: the case study was based on seven Brazilian small and medium-sized high-technology firms, according to classification criteria of the European Observatory for SMEs (1995). This research investigated small and medium-sized high-technology firms because they have been considered important to the technological and economic development of countries worldwide, as well as the revitalization of outlying regions [23], [24], [25].

Semi-structured interview with Research and Development managers was used as an instrument of data collection. E-mail communication was also used to clarify doubts and supplement the model. The interview script aimed to understand the characteristics of the firms and the information system used to support the collaboration and the product technology transfer. Some of questions were: 1- which markets does the firm serve? 2- how many products were launched in the last five years? 3- what are the goals of the system? 4- Which are the important requirements regarding functional and non-functional requirements?. This paper is part of a larger research that was conducted between August 2011 and September 2012.

The case study allowed us to understand the information system used by them and also identify the requirements that the system should have. Furthermore, opportunities for information system improvements were identified. These improvements came from literature review. This phase helps to develop the proposed model.

Phase 3: the information system requirements modeling was based on the EKD (Enterprise Knowledge Development) methodology. In this phase, the data of the firms and the literature review contributed to the development of the proposed model. For this, the data was arranged in a table allowing identifying information presented by firms and that have not been referenced in literature. The opposite also occurred.

EKD provides a systematic and controlled way of analyzing, understanding, developing and documenting an enterprise and its components, by using Enterprise Modeling [26], facilitates learning and organizational communication, develops a structured description of the business for analysts to discuss, determines the objectives and requirements of the systems, and produces a document called a knowledge repository which can be used to reason about the business, to discuss changes and components of the information system and, to trace the decisions [27].

4 Proposal of Technical Components and Requirements Model

The Technical Components and Requirements Model presents properties that should compose a future information system and clarify the potential of the information technology to improve business process. According to [27], the components of this model consist of the information system goals (measurable or non-measurable properties, focus, views, or directions); functional requirement (functional property information system) and non-functional requirement (political constraints, operations, information security etc.). Figure 1 shows the technical components and requirements model which guides the product technology transfer.

The information system plans and controls the project development (Information System – IS Goal 1.4), improves communication (IS Goal 2), supports management decisions (IS Goal 3), acquires information (IS Goal 4), exchanges information (IS Goal 5), keeps people updated on the project (IS Goal 6), provides information to the customer (IS Goal 7), manages data and information (IS Goal 8), manages production (IS Goal 9), accelerates the information identification (IS Goal 10), develops collaborative platform (IS Goal 11), ensures communication among the teams (IS Goal 12), and manages project portfolio (IS Goal 1) in terms of managing time (IS Goal 1.1), and human (IS Goal 1.3) and financial resources (IS Goal 1.2).

To manage the project portfolio (IS Goal 1), the system should enable visual management (IS Functional Requirement 5), send e-mail notification (IS Functional Requirement 3), allow the use of different project management methods (IS Functional Requirement 4), enable documentation of system functionality (IS Functional Requirement 6), and generate indicators (IS Functional Requirement 1) which support project progress evaluation (IS Functional Requirement SI 2).

To manage time (IS Goal 1.1), human (IS Goal 1.3) and financial resources (IS Goal 1.2), the system should generate reports in pdf (IS Functional Requirement 11).

To plan and control the project development (IS Goal 1.4), the system should control the deadlines (IS Functional Requirement 7), register tasks (IS Functional Requirement 8), re-plan the deadlines (IS Functional Requirement 9), enable project progress evaluation (IS Functional Requirement 10), and keep people updated on the

project (IS Goal 6).

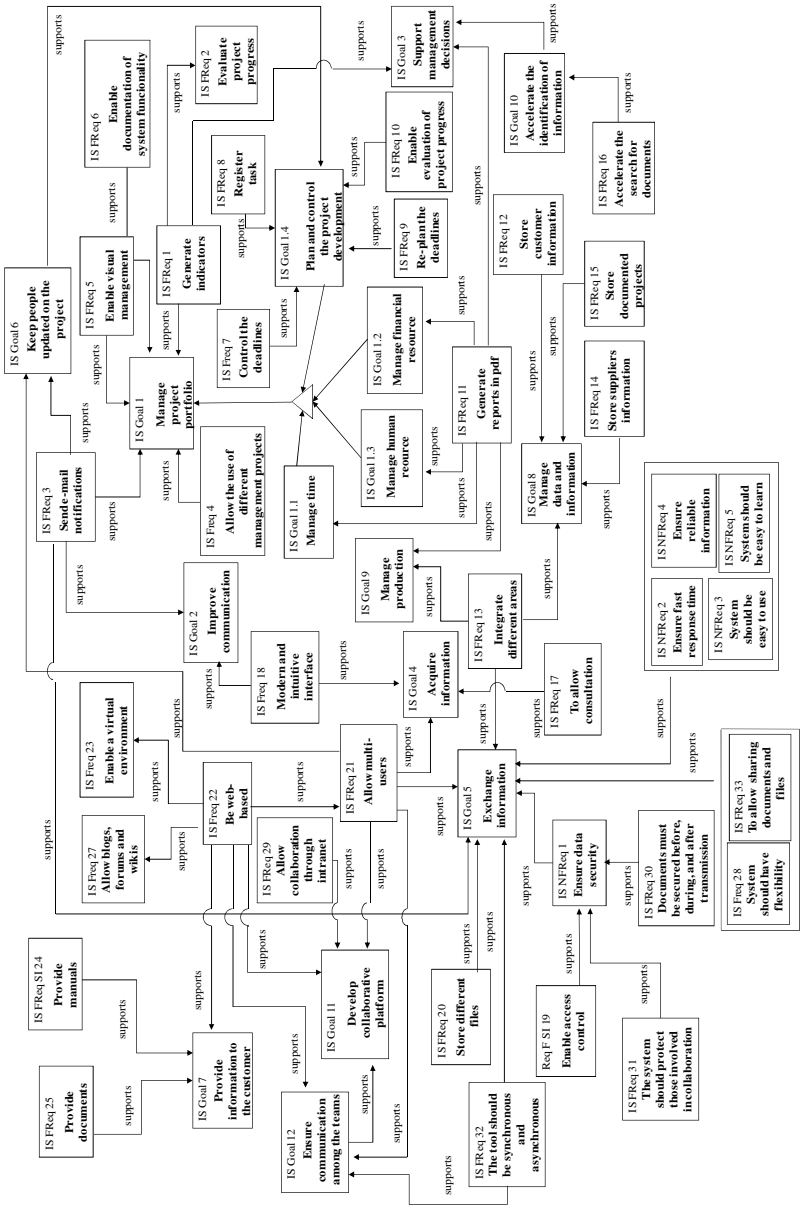

Fig. 1. Technical components and requirements model

To improve communication (IS Goal 2), the system should send e-mail notification (IS Functional Requirement 3) and have a modern and intuitive interface (IS Functional Requirement 18).

To support management decisions (IS Goal 3), the system should generate reports in pdf, (IS Functional Requirement 11), generate indicators (IS Functional Requirement SI 1), and accelerate the information identification (IS Goal 10).

To acquire information (Is Goal 4) the system must have a modern and intuitive interface (IS Functional Requirement 18) which allows multi-users (IS Functional Requirement 21) and performs consultation (IS Functional Requirement 17).

To exchange information (IS Goal 5), the system should store different files (IS Functional Requirement 20), the tool should be synchronous and asynchronous (IS Functional Requirement 32), allow sharing documents and files (IS Functional Requirement 33), have flexibility (IS Functional Requirement 28), send e-mail notification (IS Functional Requirement 3), and allow multi-users (IS Functional Requirement 21).

To allow multi-users (IS Functional Requirement 21), the system should be web-based (IS Functional Requirement 22) providing a virtual environment (IS Functional Requirement 23), blogs, forums and wikis (IS Functional Requirement 27), and should ensure data security (IS Non-Functional Requirement 1).

To ensure data security (IS Non-Functional Requirement 1), the system should enable access control (IS Functional Requirement 19), protect those involved in the collaboration (IS Functional Requirement 31), documents should be protected before, during and after transmission (IS Functional Requirement 30). Furthermore, the system should ensure fast response time (IS Non-Functional Requirement 2), reliable information (IS Non-Functional Requirement 4), be user-friendly (IS Non-Functional Requirement 3), and easy to learn (IS Non-Functional Requirement 5).

To keep people updated on the project (IS Goal 6), the system should send e-mail notification (IS Functional Requirement 3) and allow multi-users (IS Functional Requirement 21).

To provide information to the customer (IS Goal 7), the system should be web-based (IS Functional Requirement 22), provide documents (IS Functional Requirement 25) and manuals (IS Functional Requirement 4).

To manage data and information (IS Goal 8), the system should store suppliers information (IS Functional Requirement 14), store documented reports-projects (IS Functional Requirement 15), store customer information (IS Functional Requirement 12), and integrate different areas (IS Functional Requirement 13).

To manage production (IS Goal 9), it is necessary to integrate different areas (IS Functional Requirement 13) and generate reports in pdf (IS Functional Requirement 11).

To accelerate the information identification (IS Goal 10), the system should expedite document search (IS Functional Requirement 16).

To develop a collaborative platform (IS Goal 11), the system should be web-based (IS Functional Requirement 22), allow multi-users (IS Functional Requirement 21), and allow collaboration through intranet (IS Functional Requirement 29).

To ensure communication among the teams members, the system should be web-

based (IS Functional Requirement 22), allow multi-users (IS Functional Requirement 21), and be synchronous and asynchronous tools (IS Functional Requirement 32).

5 Conclusions and Future Research

Technology and innovation have been considered essential factors for the competitiveness of the most Organizations. In this way, the firms are under pressure to have the capacity to develop new technologies with lower cost and time-to-market. However, developing all skills and know-how to generate an innovation is increasingly difficult since the technologies change rapidly and firms often do not have the right person at the right time. Therefore, technology transfer is essential, mainly for SMEs, since they have limited resources and managerial competences. Furthermore, these firms tend to use external networks to leverage their resources.

Considering such scenario, managing information and knowledge, as well as interaction and communication are important factors for the success of the technology transfer and collaboration. One way to be efficient and effective at these points is using an appropriate information system. Based on this along with the needs of business research and literature, the paper presented the technical components and requirements model to support developing a collaborative environment and assist the collaboration and product technology transfer. Consequently, this paper contributes to improve the collaborative project management. The proposed model presented part of the reality and organizational need with regard to the requirement of a collaborative information system to manage the transfer of technology. Furthermore, the model considers practices recommended in the literature. The next step suggested by this research is that future researches develop and test the information system based on the model proposed in such a manner that the system can help firms use information and knowledge as strategic resources to create innovations and improve competitiveness.

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