Collaborative Product Pre-development: an Architecture Proposal

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Abstract. Nowadays, designers usually interact with teams of distributed stakeholders using information and communication technology, aiming time/cost reductions and quality improvement. However, a lack in collaboration and knowledge management support mechanisms persists, especially in the product pre-development. Best practices for product pre-development are still ill-defined because information available for designers in this phase are still instable and too abstract. Portfolio management highlights reasons, restrictions, tendencies and impacts, using competitive intelligence concepts insights on a knowledge management perspective, in order to classify project proposals in accordance with the organizational strategy. An agreement about what is really important to organizational strategy, along with a right team appointment, can contribute to empower portfolio management decisions. To achieve such an agreement, it is necessary to understand the different viewpoints in the negotiation process, to reduce impositions and the dependency from senior professionals with consecrated skills. The proposed architecture can contribute to portfolio management commitment, increasing the rate of right decisions and the support for these decisions, enabling coherence on similar situations. A collaborative product pre-development can extend the organizational capacity to obtain competitive advantages, because a consistent pre-development results in minor deviation on subsequent phases of the new product development.

Keywords. Product pre-development, collaborative portfolio management, collaborative knowledge management.

1 Introduction

Globalization and the technology evolution urge for adaptive organizations. Product lifecycles are increasingly reduced, requiring more agility and flexibility from project teams in new product development (NPD). The great challenge is how to make feasible the collaboration in early NPD phases, when vague and incomplete information make collaboration hard [1].

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First stages in the product definition are insufficient supported by computer tools [2] because they are nonfigurative processes, and it is difficult to model the concept generation. Great impact decisions are taken without the right comprehension of the context, by experience absence or even by ideas imposition.

It is in the pre-development that the relationship between ideas is established. Engineering, sales, directors, distributors, as well as call centers are involved. Ideas are evaluated in terms of money, technologies and competences, and also risk management; considering financial, production, human and market capacity; is performed. Usually it's difficult to evaluate and quantify some parameters in portfolio management, such as the project links with organizational strategy, to define how many information is necessary to decision making, to suppose how will be the marketplace, and to understand the customer tendencies.

Empowered decisions with effective involvement are linked to the different viewpoints comprehension. To minimize impositions and dependences, it is required a full understanding about how people collaborate and also by discovering performance measurements that transform intangible in tangible.

This article presents a preliminary architecture proposal intended to improve collaboration conditions in the product pre-development, by using Fuzzy Logic, Intelligent Agents and Web Services on product innovation management and collaborative knowledge management processes.

2 Collaboration, CSCW and Groupware

The idea behind the collaboration concept is to add efforts, competences and abilities, aiming a determined goal; for example, to obtain a product innovation. Some projects could be only feasible with an effective collaboration between interested people, inside or outside the organization.

Computer Supported Cooperative Work in Design (CSCW-D) involves studies about the use of computer technology to support collaboration between project teams, distributed or not, in order to create a favorable environment to quality improvement, conflicts resolution, and to reduce time and money spent on NPD.

Environments that enable all people to fully express their creative potential, making them feel part of a shared intention (social dimension), will increase the knowledge creation (collaborative knowledge) and will obtain the economic benefits from the achievement of the goals (business dimension) [4]. Many efforts have been conducted to develop computer mechanisms in order to support teamwork. Important initiatives in collaborative product development adopt Web technology as Collaborative Engineering infrastructure, because it provides favorable conditions for information sharing between distributed project teams [2].

CSCW systems can improve the efficacy on collective decision-making, offering facilities to information retrieve, share and use, which stimulate interactions, reducing problems as disorganized activities, member's domination, social pressure, and inhibition [5]. The term groupware is used to describe the technology resulting of CSCW researches. These resources make ideas sharing more efficient and accurate, simplifying processes and supporting parallel tasks execution, increasing knowledge and expertise sharing on teamwork [6].

2.1 HCC Consideration in CSCW Systems

Human-centered Computing (HCC) approach is an interdisciplinary knowledge field that tries to adequate computer technology insertion in human context. HCC is going to improve personnel capacities regarding perception and cognition during interaction between computer systems and people, in a way that technology development focus human needs, and do not try to adapted people to technology.

Groupware tools were presented like adequate mechanisms for overcoming obstacles that exists in work environments. However, many of those obstacles are due to human characteristics, and justify more attention in their management, for example: low performance in group activities; work processes ill-documented; nonexistence of data from everyday definitions; rejection of new truth; difficulties in the communication and the expression of ideas; concerns about function loss (strategic competence preservation); concerns about opportunities loss (facts suppression); absence of a vision about the benefits in sharing.

Frequently the user doesn't think something is quick to learn, easy, efficient, or even helpful regarding his objectives [7]. In any system, clear metaphors should be prominent used to permit that users quickly learn and do your own deductions using a pre-existing knowledge. Some systems are designed with all possible and imaginable functions, remaining to the user the responsibility to adapt the application context to achieve his objectives and satisfy his needs and expectations.

Functional characteristics in CSCW applications that can be easily perceived by users are determinant success factors: important functions that are forgetful, are incomplete, or inaccessible, increase the chances of system failure [5]. As user requirements are not properly considered in the conception of computer systems, continuous changes in the system are required by the users [8]. Even though the system conception is linked to user needs, the lack of knowledge by the designer about implemented requirements can cause problems [5]. These aspects show the importance to consider HCC in the CSCW environments implementation.

3 Collaborative Product Development

Collaborative product development has been considered by researchers and professionals on industry as the key for cycle time reduction and improvement related to product quality and reliability [5]. It's a systematic approach that associates the collaboration in new product development context and a consensus making strategy to satisfy more fully user needs. Some success factors in this area involve teamwork, communication improvements, project management, information sharing and consistency [2].

Analyzing some kinds of advanced manufacture systems, as product data management, supply chain management, enterprise resource management, manufacturing execution system, customer relationship management, demand chain management, among others, it's possible to perceive that such systems do not consider adequately the collaboration support needs during product lifecycle, because they aren't designed according to the current business requirements, and they focus specific activities in the companies [9].

Several models have been proposed to identify those requirements in business environment, but just for certain collaborative functions, including product portfolio management, collaborative product customization, collaborative product development, collaborative product manufacturing, collaborative component supply, and also extended product service. Although each one of those models involves a certain collaboration function, they don't act in an integrated way on product lifecycle context [10]. Beyond the difficulty to model, project, integrate, automate, monitor and optimize processes in product lifecycle management, the ability to support collaboration in different levels is a challenge to be pursued [9].

There is a perception that a large amount of collaborative effort is required from project teams during product lifecycle, but these efforts should start before the beginning of the development phase, already in pre-development. And the intangible nature of the pre-development requires from CSCW-D researchers an even more attentive regard.

4 Product Pre-development

The product pre-development is characterized basically by the definition of the projects that will be developed in the organization. The pre-development mission is [3] to guarantee that strategy direction, stakeholder's ideas, opportunities and restraints, can be systematically mapped and transformed in a project portfolio.

In the product innovation management, portfolio management represents [11] the business strategy expression, defining where and how resources will be put in the future. Project selection can involve value measurement approaches as well as other decision criteria – for example, a competence creation in a strategic area that can be important for the organization to survive [12]. The complexity involved in the product pre-development requires know-how and wisdom accumulation, and making tools that can adequately support designers in the initial phases of new product development is highly desirable [2]. The portfolio management efficacy can be improved using collaborative systems in product innovation, by overall visibility offered in decision-making, or by the stimulus to share ideas, increasing commitment and minimizing domination.

5 Architecture Overview

A system for collaboration support in product innovation management should have its focus on portfolio, and be able to prepare a dynamic structure to incentive the generation and capture of abstract ideas, whose expression can be concrete functional specifications [6]. It should have a universal workspace, accessed via Web, with integrated resources to project management, document management, project agenda and calendar [5], among others. The problems solution should not occur only in a reactive mode, but also in an active one. Beyond to support portfolio management, the architecture should incorporate techniques and best practices aiming to stimulate the project goals alignment, the effective knowledge

and information use, and the increase on decision-making ability [6]. Figure 1 illustrates a general view of the proposed architecture.

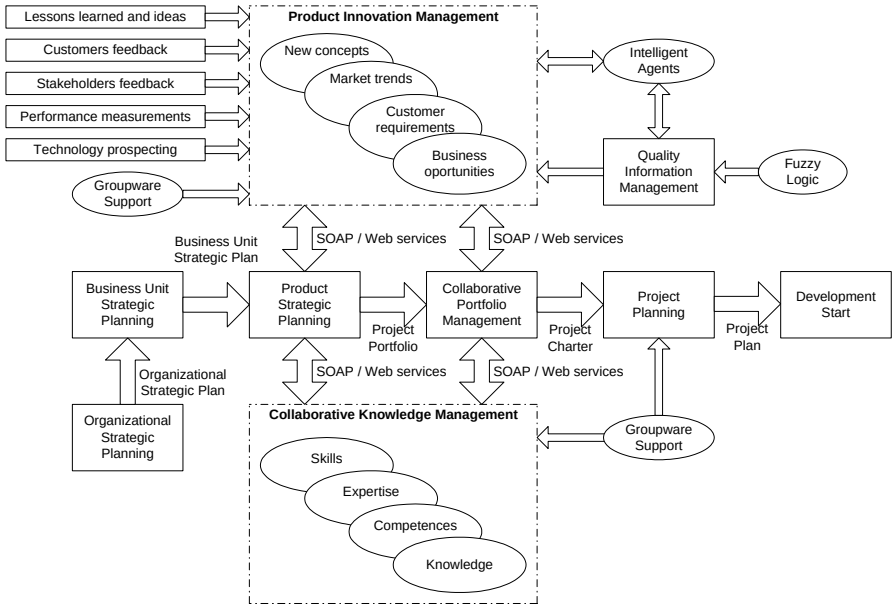

Figure 1. Architecture for collaborative product pre-development

The proposed architecture is based in Web technology, it is modular and service orientated, incorporating best practices in groupware systems. It was considered that SOA (Service Oriented Architecture) approach is indicated to Web resource sharing in collaborative product development [1]. An SOA application has several small modules of specialized software, which can be implemented in any programmation language; it is distributed, remotely accessible, interoperable, and reusable, by adopting standardizations [13]. SOAP, or Simple Object Access Protocol, is a standard protocol to exchange messages between computer programs, used in Web Services creation. Messages SOAP are XML documents based on W3C specifications.

The merge between Internet and Web technology, known as Web services, has great potential to collaboration support [10,14,15]. It's a new paradigm in distributed systems, where tasks are performed through networked computers, each one dedicated to attend an objective, involving accessible remote programs using Internet protocols, encoded in XML, and platform independent [16].

In order to analyze the complexity involved in portfolio management, methodologies to evaluate inexact information related to product characteristics are needed. For example, Fuzzy Logic, that employs approaching and interpretation instead accuracy, permitting to incorporate subjective and linguistic values in decision-making criteria [17]. The Fuzzy Logic is based in the principle that human thinking is structured in object classes, and not in numbers. It permits to

capture intangible or inexact information, generally described in natural language, and convert them in a numerical format, that can be processed by computers. Therefore, its application in computer systems to collaboration support in product pre-development is promising, taking into account that in this context it is necessary to work with hardly quantifiable parameters, as the "information quality" available to decision-making, the project adherence into competitive strategy, the ratio in which the users are attended in their needs, the product market placement in relation to competitors, the market trends, among others.

Autonomy is the main characteristic of the intelligent agents. They possess an explicit representation, a model, in that decisions are taken by means of symbolic reasoning [18]. However, that kind of system is capable to perceive and do modifications in an environment. The advantage of using agents is the possibility to structure intelligent environments using abilities collection, and also the fact that their autonomy can make them work in independent way in any task, in a proactive posture, that differentiates them from systems based on client-server architecture [18]. Among several applications involving intelligent agents are finding, filtering and retrieving information, which can be presented in a format that facilitates the users' comprehension. This can be the case, for example, of the information manipulated in product strategic planning, or in the use of lessons learned in previous projects. Therefore, it's promising to apply intelligent agents in computer systems used to support innovation management.

Product strategic planning should be aligned with business unit strategy, which is backed by organization strategy. Product innovation management, collaborative knowledge management and project planning have groupware support, to improve collaboration and communication, which can be integrated using Web Services.

6 Related Works

[19] presents POPIM (Pragmatic Online Project Information Management), a collaborative management system to extended environment product development projects. Its structure offers a shared workspace to improve team communication, sharing, and collaboration on projects, accessing on-line information. The system supports collaboration and knowledge management during the project development phase, but does not contemplate the pre-development.

[17,20] involve computational systems based in Fuzzy Logic to establish criteria for project selection in portfolio management, but do not consider collaboration between the people on decision-making during the criteria ranking.

[21] adopts the collaborative knowledge approach on product innovation management to conceive the eProduct Manager, a Web system prototype for portfolio management. The authors claim that the final version will be built in a structure that integrates four modules: goals, actions, teams and results. Forms are used to store the organization goals, setting out knowledge that before was tacit, and also to record problems and ideas, in which the user does a strategic alignment ranking for each new product concept. In [6] is described its architecture main elements: controls (consumer requirements, strategic impulses and performance measurement); mechanisms (individuals, teams and revisers); entrances (ideas,

problems); and exits (project revisions, scorecards and exception reports). It seems that a new prototype would use intelligent agents and Web semantic.

[10] proposes a business model called "collaborative product services in virtual enterprise", based in Web Services, which is going to integrate the majority of the functions related to collaboration on product lifecycle. The authors defend the application of PLM systems to collaboration support during all product lifecycle, but don't clearly define the requirements of such a system (based itself in a classification of the nature of the collaboration process) and don't consider pre-development peculiarities.

[22] presents the WS-EPM (Web Services for Enterprise Project Management), a service oriented architecture to business projects management. In what it refers to the product pre-development, there is an operation to project prioritization named Prioritization Web Service (PWS), which considers, as criteria to conduct different projects coordination, the following factors: tangible value, intangible value, project scope, required time to market, convenience to develop the project inside or outside the company. The PWS appears graphically associated with all WS-EPM operations in product lifecycle, hinting that the system is used in the entire new product development process, and not only in pre-development.

7 Conclusion and Future Perspectives

This work highlights the importance of computer systems to support planning, accompaniment, control and decision-making processes that should be centered in the requirements of the collaboration among professionals involved in product pre-development, in order to facilitate the conversion of the experience acquired into structured knowledge for new challenges.

There is a lack of support mechanisms to stimulate collaboration in product pre-development and to improve the impartiality and the repeatability in the portfolio management. Efforts dedicated to solve this problem will result in effectiveness on competitive strategy.

A comprehension about how people can be able to collaborate, associated with investments on technology infrastructure, can help to transform intangible aspects in tangible. The proposed architecture should facilitate the understanding about different viewpoints, focusing in what is important on product innovation management: all the people involved on collaborative portfolio management, contributing to reach convergence on decision-making.

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