Mashup Enabled Dynamic Capabilities in the Fuzzy Front-End of Innovation

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Abstract. Innovation is today a widely used buzzword in the enterprises environments, because it is seen today as the support for long-term surviving and a lever for the creation of new and differentiated products or services. The Fuzzy Front-End of Innovation (FFE) is often experimental, involving strong interaction with the end-users. This enables the knowledge transfer from users, communities or Collaborative Innovation Networks to organizations. Enterprises may master a set of Dynamic Capabilities in order to manage, learn and integrate that shared knowledge. Today, using Web 2.0 applications, users are able to easily join together, share ideas, catalog information, spread and share their knowledge in a variety of ways. This paper presents a model to enable those Dynamic Capabilities using a Web 2.0 Mashup in the FFE of innovation.

Keywords: Innovation, Knowledge Management, Dynamic Capabilities, Web 2.0, Mashups.

1 Introduction

Today, innovation is a key point and a hot issue in business environments. The innovation processes have become increasingly important within companies, since innovation is seen today as a support base for their long-term survival in an increasingly volatile and demanding market, and a lever to the development of new and differentiated products and services.

The innovation processes include methods and techniques that differ on their approach and required competences [1]. They can be classified as «hard» - quantitative, empiric or numeric; or «soft» - qualitative, based on experience or reflecting tacit knowledge. Another classification consists on the assessment of such methods and techniques that tend to be normative – starting the process with a clear perception of the future needs; or exploratory – starting the process through the extrapolation of the present technological capacity. Given that innovation depends on

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information and knowledge, it is necessary to consider that an organization may not be autonomous in the innovation process, because the sources of ideas, information and knowledge can be internal or external [2]. Thus, this process is interactive and results from the contributions of many economic and social agents (users, customers, business partners, etc), owners of different type of information and knowledge. The combination and management of several sources of ideas, information and knowledge is an important challenge for companies in order to innovate and build capacity to cope with changes, since most of the problems (especially technological problems) involve the use of knowledge at various levels.

2 User Involvement in the Innovation Process

According the Product Development and Management Association (PDMA), the innovation process is divided in three areas [3]: the Fuzzy Front End of innovation (FFE), the New Product Development (NPD) and the Commercialization phase. The FFE also known as "Phase 0" or "Stage 0" [3], [4], designates the initial period of the New Product Development. The FFE includes all the initial phases from the formulation and selection of the initial ideas to the final concept definition, and must be considered as an essential part on the NPD. Although doesn't usually have high costs associated with it, it may consume 50% of the development time [3]. The FFE is often a non structured process, chaotic, from experimental nature, and involving a huge interaction between the NPD team and the user/customer. The PDMA has introduced the concept of New Concept Development in order to structure the activities developed at the FFE, which includes, among others, five key elements: (1) Idea Generation and Enrichment; (2) Idea Selection; (3) Opportunity Identification; (4) Opportunity Analysis; and (5) Concept Definition. The Concept Definition element is the unique gate to the NPD stage.

2.1 Listen the Voice of Customer

Innovation aims to create new and differentiated products and services that will help to create added value for end-users. Especially in industries where the innovation is driven by technology push (*e.g.* Information and Communication Technology), there is a risk that the innovation team creates any product or service that will fulfill the needs or expectancies of few customers/users. Thus, listening the Voice of Customer [3], [5], [6] in the innovation processes is extremely important, in order to identify unarticulated customer needs.

In [5] the authors proposed the Human-centered-design approach (HCD) in order to describe and classify the different ways used by the NPD team, to interact directly and constructively with users in their innovation projects. Fig.1 illustrates the six moves on HCD identified by [5]. Even thought stereotyped, in practice they can be combined. All these moves aim to obtain and apply end-users knowledge. However, there are differences between them in whose knowledge is leading the development and how knowledge is being transferred.

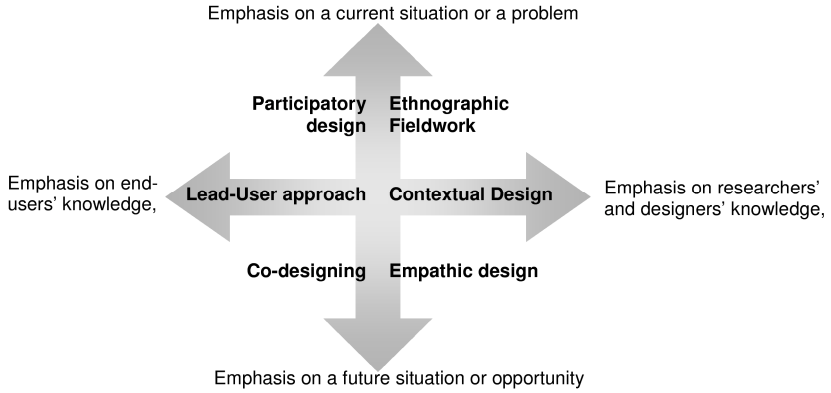

Fig. 1 Different human-centered design methods and practices [5]

3 Knowledge Sharing and Dynamic Capabilities

The concepts presented on the previous sections show that the early stage of the innovation process can be described as an interactive process of knowledge transfer between users and the NPD team. By definition, knowledge is defined as expertise and skills acquired by a person through experience or education [7]. Knowledge acquisition involves complex cognitive processes: perception, learning, communication, association and reasoning. In organizations, knowledge can be divided in both **tacit** knowledge - which involves senses, skills and intuition; and **explicit** knowledge - which is formulated and captured, existing thus in the form of books and manuals [8]. From an epistemological approach, the tacit/explicit knowledge definitions follow the ones from the knowledge management literature [9]. The tacit side of knowledge is the aspect of knowledge that is omnipresent, taken for granted, and affecting our understanding without us being aware of it. Ontology-wise, tacit and explicit knowledge is considered as existing on various levels: individual, group, organizational and inter-organizational [10].

The terms "knowledge" and "information" are often used interchangeably [11]. Information is tangible and appears in the form of items or objects outside the human mind, and can be defined also as knowledge that can be transmitted without loss of integrity [12]. Knowledge, on the other hand, is a much less definable entity. Information per se contains no knowledge, and both data and information require knowledge to be interpretable, in order to create new knowledge [10]. Knowledge and Information are not understood by all equally. Their absorption depends on cultural, vocabulary or own assumptions (tacit) and new understanding comes from reflection [13]. Reflection, in its whole modalities (action, dialog, etc.), can transform tacit understanding in explicit understanding. Therefore enables us to understand how to learn. In this context, information plays an important role as a catalyst for reflection that may, by reaching its consumer, expand or relocate his knowledge state.

3.1 Sharing Knowledge for Innovation

The knowledge creation process involves five steps: (1) sharing tacit knowledge, (2) creating concepts, (3) justifying concepts, (4) building a prototype and (5) cross-leveling knowledge [8]. Users have knowledge about some practices as well as the NPD team. They share their knowledge in order to make design decisions, refine ideas and to create new knowledge. In Human Centered Design [5] there are two main questions related with the knowledge shared: whose and which knowledge should be privileged. The first question is related with who initiates a project. If end-users initiate a project, their knowledge is leading and their knowledge is moved towards to NPD team [5], [14]. The second question is related with what kind of knowledge should be taken as a starting point of a new innovation project, or taken as a seed for the development of new ideas.

3.2 Distributed Shared Knowledge: Collective Intelligence and Swarm Creativity

Many innovations have emerged not from an individual inventor, or even from a large corporate research laboratory, but from the effort of collaborative thinking and competition of many individuals. This phenomenon is described in [15] and [16] as Collective Intelligence - a combination of individual intelligence [17], [18]. However as a complex adaptative system that is, it's more than the addition of individual intelligence. The Collective Intelligence emerges gradually as the adaptative actors act individually or mutually. In this context, also emerges the concept of the Wisdom of Crowds [19] that states that the aggregation of information in groups, results in solutions, that are often better than could have been made by any single member of the group.

With the advent of Internet and Information Technologies (ICT), and specially the Web 2.0, Collective Intelligence and the Wisdom of Crowds concepts, have their own characteristics emerging on virtual environments, as blogs, social networks, wikis, etc. People are aggregating, sharing, selecting, modifying and tagging information, information flows and knowledge. This originates a mass of shared knowledge. In this context emerge the Collaborative Innovations Networks (COINs) – cyberteams of self motivated people with a collective vision, enabled by Internet and ICT to collaborate in creating a cool trend (an innovation) by sharing ideas, information, knowledge and work [20], [21], [22]. COINs are powered by swarm creativity [20] - the creativity unleashed by groups of humans, which swarm together in the same creative and innovative direction to produce the trends that are most interesting. Detect COINs inside or outside the boundaries of an enterprise is a complex task. In [22], the author states that future successful companies will be those that have skills of **Coolhunting -** the ability of searching and finding COINs which self-organize among intrinsically motivated people around creative ideas; and **Coolfarming -** the ability to getting involved in the actual creation of new trends by seeding, nurturing and cultivating new ideas. This practice of distributed innovation is described in [23] as Communities of Creation, that are grounded in the concept of "*ba*" [24]. It is suggested by the authors, that the diverseness of knowledge required to compete, specially in

technology markets, is increasing. Simultaneously, firms are increasingly reducing their knowledge base in an effort to specialize and focus. In those environments firms may become unable to produce knowledge autonomously, so they must co-operate with their business partners and customers to create new knowledge. Knowledge co-creation, and especially knowledge co-creation with customers, is at the heart of knowledge-based NPD [25], [26]. To achieve an efficient co-operation in these turbulent environments, firms must develop and master a set of dynamic capabilities [23], [27], [28].

3.3 Knowledge Management and Dynamic Capabilities

In [26], the authors define dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. This reflects the organization's ability to achieve new and innovative forms of competitive advantage that depends on a set of enabling processes: Learning; Coordination and Integration [28].

Referring to customer knowledge co-creation, in [29] are stated the following set of dynamic capabilities:

- **Absorptive capacity**, *i.e.*, the aptitude to learn from customers;
- **Organizational Sharing capacity**, *i.e.*, the ability to integrate the customers knowledge, and reproduce it internally;
- and **Deployment capacity**, *i.e.*, how a firm acts upon the customer knowledge.

For customers, there are some requirements to fulfill in order to enable their participation in knowledge co-creation [29]:

- They **must speak the same language of the firm** in order to contribute with their knowledge;
- They **must deeply trust in the firm**, *i.e.*, any information they share, may not be used against their own interests;
- They **must be motivated** to take part in the knowledge creation process.

Regarding the co-creation through inter-firm partnerships, in [30] is proposed a model with a set of corresponding capabilities:

- **Absorptive capacity**, *i.e.*, the aptitude to learn from partners;
- **Coordination capacity**, which reflects the ability to sync tasks and resources;
- and **Collective mind,** the integration of contributions, representations and subordination into a collective system.

The concept underlying the dynamic capabilities clearly depends on the learning process and the supporting learning functions. Learning is indeed a critical process, because it has an impact in the ability to acquire new knowledge.

4 Enabling Dynamic Capabilities

Today's technologies, as Web 2.0, enable the realization of the eight essential learning functions that the learning process depends on [31]:

- **Ubiquity**, that provides independent temporal and spatial access to information (*e.g.*: Instant Messaging, Web Mail);
- **Deep Learning**, that fosters high order thinking, takes place when people are stimulated to analyze primary sources and digitalizes artifacts, which evolves navigation, sort, organize, analyze and make graphical representations (*e.g.*: tagging, Web 2.0 mind maps, etc.);
- **Making things Visible and Discussable**, that provides sharing ideas and conceptualization (*e.g.*: digital maps, multimedia elements, etc);
- **Expressing Ourselves**, **Sharing Ideas**, **Building Community**, that provides a social media (*e.g.*: Blogs, wikis and virtual worlds, tagging information and sharing tags);
- **Collaboration**, that helps people to learn and teach together, find experts and plan virtual meets (*e.g.*: wikis, Google docs, podcasts, webinars, VoIP, survey tools);
- **Research**, that can improve information quality and organization (*e.g.*: social bookmarking and tagging tools, citation engines, tag clouds);
- **Project Management**, which helps planning activities, time and resource management (*e.g.*: calendars, to-do lists, etc.);
- and finally **Reflection** and **Iteration**, that occur when someone examines his ideas from all sides and from others viewpoints, especially when supported by tools that support reflection and iterative development (*e.g.*: Blogs and wikis).

An important and classic feature of the Web 2.0 is the openness of their Application Programming Interfaces, which fosters the development of a large number of applications based on those exposed interfaces. A Mashup is a Web application that combines data and services from one or more sources into a single and integrated tool. Users can create mashups themselves, which make mashups as user-driven or user-centered micro-orchestrated [32]. Thus, within a mashup environment, users are provided with the tools to assemble the necessary data and services from various sources and to combine them according to their own ideas. In this context, they gather information and they combine it as needed, having as unique requirement the fulfillment of their own needs, the availability of the required data or service [32]. In fact, users, better than anyone, know what information they need, as well what services are needed and in which configuration. This virtual construction generates knowledge that can be shared with other users, and extended by these, starting thus a process of **collective learning** and **collective intelligence**.

4.1 A Mashup Based Conceptual Model to Enable Dynamic Capabilities

By their characteristics mashups can be used as a Knowledge Management Systems in security uncritical scenarios [32]. Based on the previously presented facts, we can

assume that mashup platforms are useful to enable the user involvement in the innovation process. They are user-centered and enable the dynamic capabilities required on co-innovation processes. In this context, we propose a mashup based conceptual model, in order to support co-innovation processes, involving both customers/users and inter-firm partnerships, as illustrates Fig 2. Our concept proposes that Mashups can take place as shared spaces where users can collaborate and express their ideas around a "cool" trend or share their experience. Users can develop communities of interest around innovative ideas, and generate Collaborative Innovation Networks (COINs) powered by swarming creativity and collective intelligence. These shared spaces can be closed or open. If closed, they are strict to the enterprise environment - only opened to enterprise employees' participation. If open, they allow the participation of customers, in the case of customer co-innovation processes, or allow the participation of employees of partner enterprises, in the case of inter-firm partnerships.

As stated before, speaking the same language is a critical factor [29]. To overcome or fulfill this requirement, the proposed model comprises two types of glossaries. On the enterprise side, the internal glossary [33] defines terms and states how concepts are developed and structured internally (see Fig. 2).

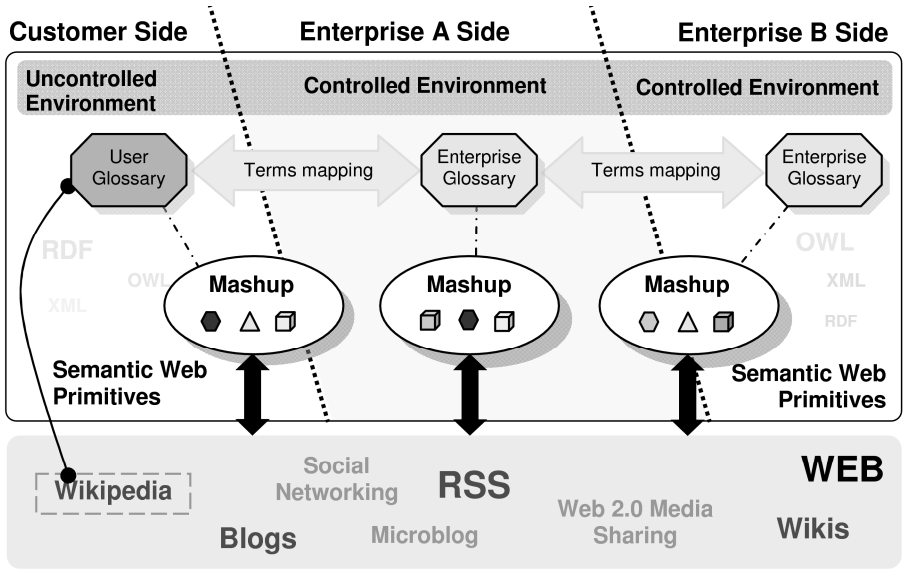

Fig. 2 - A mashup based conceptual model to enable dynamic capabilities

This enterprise glossary is extremely controlled, organization specific, and designed through a collaborative approach [34] by the members of the organization. On the user side, the model comprises a shared glossary supported by web dictionaries and encyclopedias of terms (*e.g.* Wikipedia, Wikinary, etc.). Developed interactively by users, aims to ensure a consistent usage of concepts in the description of the shared ideas in the Mashup. Whenever needed, the enterprise internal glossary may be mapped with the user glossary. This map will not change the user's view of

the external public glossary, but will offer the NPD team the tools to enable an easier discussion of the concepts being discussed in the public Mashup, by building the bridge between non-technical user language and the enterprise internal technical jargon. The same applies to inter-firm partnerships, where partners are provided with the means to map their own terms into each other.

4.2 Illustrating a New Concept Development Using Mashups.

As illustrates Fig. 3, two possible scenarios can happen in the co-innovation processes: the enterprise may foresee a market opportunity and seed a COIN with an idea; or the users/costumers start themselves the process in order to get some benefit and solve some problem/pain of their own.

Foreseeing a market opportunity, the enterprise NPD team develops a Mashup structure, combining several web resources such as feeds from twitter, blogs, flicker, etc, and shares it with the community of users seeding it with the core idea, starting thus a *coolfarming* process. Users swarm together around the seeded idea, in fact launched across several social networking platforms, sharing their experiences and ideas by combining, re-combining, annotating and integrating different services, information and media sources (videos, RSS feeds, Blogs, Mind Maps, etc.) in the seeded Mashup. During this iterative process users grow the Mashup with their contributions, supported by a tool that uses Wikipedia (for example) as a shared glossary, to ensure a shared meaning for all items and their relationships in the Mashup. This way we enable a semantic connection between all developed concepts (items) in the mashup. The new concepts are developed through an iterative process. In the second scenario, the process is similar, but users start themselves the process. Organizations use the infrastructure for *coolhunting* in order to acquire new product concepts. In both scenarios knowledge transfer and new knowledge creation is made by reflection on the shared information.

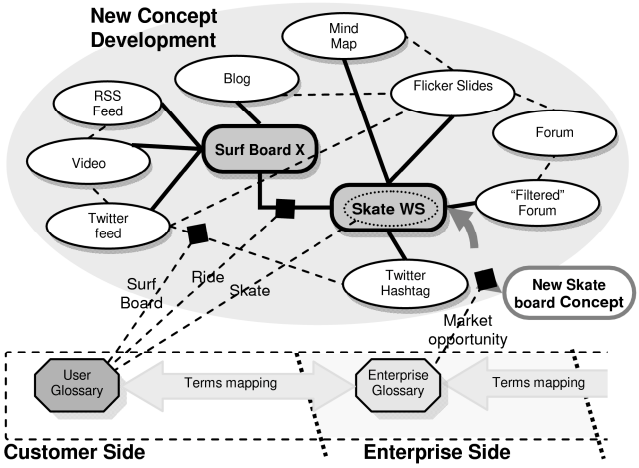

Fig. 3 - Example of a new concept development using Mashups

6. Conclusion

In today's globalized world, the markets are increasingly competitive and volatile. In order to respond to market demands, enterprises are looking at innovation as the answer to the development of innovative products/service, and involving users in the innovation processes. The first stage of the innovation process is characterized by strong interactivity and knowledge transfer between users and organizations. To acquire and apply new knowledge (in all its forms), enterprises must master a set of dynamic capabilities, which ones hugely depend on learning ability. The wide and heterogeneous set of the available Web 2.0 based applications enables the realization of the essential learning functions, and the openness of their Application Programming Interfaces, allows that different applications can be extended or mashed up into a single and new application. A major advantage of Mashups is their user-centric characteristic, enabling users to assemble and combine the necessary data and services from various sources, according to their own needs. The conceptual model presented in this paper proposes the use of mashups to enable the referred dynamic capabilities, which ones, seem to be an effective platform to:

- Enable the realization required learning functions and reflection;
- Enable interactivity;
- Promote collective learning and collective intelligence concepts.

The user glossary assures the establishment of a common language between users/customers, and the underlying enterprise glossaries between users/customers and the organization and between inter-firm partners.

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