

CROWDSOURCING INNOVATION: A PROPOSAL FOR A BROKERING ARCHITECTURE FOCUSED IN THE INNOVATION NEEDS OF SMES

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Abstract: Crowdsourcing is evolving into powerful outsourcing options for organizations by providing access to the intellectual capital within a vast knowledge community. Innovation brokering services have emerged to facilitate crowdsourcing projects by connecting up companies with potential solution providers within the wider 'crowd'. Most existing innovation brokering services are primarily aimed at larger organizations, however, Small and Medium Enterprises (SMEs) offer considerable potential for crowdsourcing activity since they are typically the innovation and employment engines in society; they are typically more nimble and responsive to the business environment than the larger companies. SMEs have very different challenges and needs to larger organizations since they have fewer resources, a more limited knowledge and skill base, and immature management practices. Consequently, innovation brokering for SMEs require considerably more support than for larger organizations. This paper identifies the crowdsourcing innovation brokerage facilities needed by SMEs, and presents an architecture that encourages knowledge sharing, development of community, support in mixing and matching capabilities, and management of stakeholders' risks. Innovation brokering is emerging as a novel business model that is challenging concepts of the traditional value chain and organizational boundaries.

Keywords: Crowdsourcing innovation. Broker architecture. Collective memory management. Risk management. Knowledge repository.

CROWDSOURCING INNOVATION: UMA PROPOSTA DE ARQUITETURA DE SERVIÇOS DE MEDIAÇÃO FOCADO NA INOVAÇÃO NECESSIDADES DAS PME

Resumo: O crowdsourcing está a evoluir para opções poderosas de outsourcing para as organizações, fornecendo acesso ao capital intelectual dentro de uma comunidade de vasto conhe-

cimento. Serviços de mediação de inovação surgiram para facilitar projetos de crowdsourcing, ligando-se empresas com fornecedores de soluções potenciais na maior 'multidão'. Os serviços de mediação de inovação existentes destinam-se principalmente em organizações maiores, no entanto, Pequenas e Médias Empresas (PME) oferecem um potencial considerável para a atividade de crowdsourcing, uma vez que são normalmente os motores de inovação e de emprego na sociedade, eles são tipicamente mais rápidos e ágeis para o ambiente de negócios do que as grandes empresas. As PME têm desafios e necessidades muito diferentes das organizações maiores, uma vez que têm menos recursos, um conhecimento mais limitado e base de habilidades e práticas de gestão imaturas. Consequentemente, a intermediação da inovação para as PME necessitam de apoio consideravelmente maior do que para grandes organizações. Este documento identifica as adaptações de serviços de mediação de inovação necessárias por parte das PME, e apresenta uma arquitetura que estimula o compartilhamento do conhecimento, o desenvolvimento da comunidade, combinando recursos e gestão de riscos das partes interessadas. Intermediação de Inovação está a emergir como um modelo de negócio inovador que está desafiando os conceitos da cadeia de valor tradicional e fronteiras organizacionais.

Palavras-chave: Crowdsourcing. Arquitetura de mediação. Gerenciamento de memória coletiva. A gestão de risco. Repositório de conhecimento.

1. INTRODUCTION

Crowdsourcing offers organizations a new way of outsourcing that draws upon a vast knowledge community embedded in social networking infrastructure and user practices. Crowdsourcing involves taking tasks that were traditionally performed by employees and then outsourcing them in the form of an open call to a large undefined group of people or social networking community (ADAMS; RAMOS 2009).

This paper focuses on crowdsourcing innovation, the needs of Small and Medium Enterprises (SMEs) and the development of innovation brokering support. There is a growing interest in innovation brokering services (ARORA; FOSFURI; GAMBARDELLA, 2002; CHESBROUGH; CROWTHER, 2006). The number of crowdsourcing intermediary companies has been growing and crowdsourcing innovation brokerage is emerging as a promising new business model in itself as well as providing key outsourcing support functions (WINCH; COURTNEY, 2007; VERONA; PRANDELLI; SAWHNEY, 2006; TORRÖ, 2007; TROMPETE; CHANAL; PELISSIER, 2008). Brokers facilitate the access to a vast open and global knowledge community, and provide support in integrating contributions, as well as managing and motivating the 'crowd' participants. Companies outsource part of their innovation processes to open and global knowledge communities, while also transferring many of the innovation risks to the brokering firms.

Using innovation brokering services seems a particularly interesting strategy for SMEs offering them the capability to participate in and accelerate innovation activity without incurring heavy investments (ADAMS; RAMOS, 2009; VRANDE et al., 2009). Companies such as Innocentive, yet2.com, Nine Sigma, IdeaWicket, IdeaConnection and YourEncore are well known examples of crowdsourcing innovation brokers. They help in creating a global market for scientific knowledge, where everyone can contribute with the ideas and the own developed technology. These brokers have been studied and are key players in the crowdsourcing innovation brokering for medium and large companies. However, existing innovation brokering support for SMEs is less well developed. Brokers would need to provide an extended support to innovation given the many challenges faced by smaller companies (VRANDE et al., 2009).

This paper presents an integrated proposal for a crowdsourcing innovation brokering architecture focused on the specific innovation needs of SMEs. In section 2, the innovation challenges faced by SMEs requiring adequate responses by the broker are presented. The architecture of the brokering service is presented at section 3. Motivation and memory aspects of the knowledge community are presented in sections 4 and 5. The management of the broker's risks is a key aspect to ensure the service success and the overall strategy proposed by the authors is described in section 6.

2. BRIDGING SMES AND THE CROWD: THE INTERMEDIATION CHALLENGE

To examine the range of issues and challenges that brokers of crowdsourcing innovation activity for SMEs have to deal with it is useful to consider an illustrative example. Take the situation of company X that has a R&D task that would traditionally take a team of say 5 skilled people 1 week to do, i.e. 5 people at 40 hours a week, a total of 200 hours of work – say at a cost of employment of \$50 or 50 Euros per hour, a total of \$10,000 or Euros. A crowdsourcing solution may consist of X providing a \$5000 or Euros prize, say attracting 1000 responses with the crowd respondents contributing an average of 1 hour each on the task. The corporate customer clearly has a potential win situation here with the access to 1,000 hours of intellectual capital (compared to 200 hours) from a wider range of expertise and at the same time paying half the amount of money. In this situation only one of the crowd participants receives any reward, with the majority receiving no reward.

The long term success, of both the crowdsourcing innovation business model and the innovation broker, will require getting continued buy-in and participation from both the corporate customers and crowd participants. Repeat business from both is needed, and for that there has to be fair mechanisms for rewarding contribution and ensuring the quality of responses from the crowd participants. Developing such fair mechanisms is at the heart of the main challenges for the crowdsourcing innovation brokers.

In the example of X company, the 'prize' reward model used only rewards the winning participant(s) leaving the majority of the crowd participants down on the deal – they have contributed their time and effort for no (monetary) reward, which will likely leave them less willing to participate in future crowdsourcing activities. Similarly, if a 'sharing' reward model is used then it would result in the \$5000 or Euros prize being shared thinly by the 1000 crowd participants – not a very attractive return for the expertise and time spent for the majority of the crowd participants and also leaving them less willing to participate in future crowdsourcing activity. In addition, there is less motivation to come up with the 'best' idea because there is no premium for that.

Company X could offer more substantial reward for a solution to be shared out among the participants – say that every participant gets a minimum reward, however, this could be a very large expense if there are many respondents, and it would be an unknown quantity (i.e. don't know how many respondents there will be) – both of which would be unattractive for company X. The larger the crowd response then the less they have to share between them. However, increasing the size of the crowd will result in an increase in access to intellectual capital and likely increase the quality of the solution, but would produce more problems in fairly rewarding participants and containing costs for the company.

Developing fair reward and pricing systems becomes more of a challenge when one considers the quality of responses. A reasonable assumption is that the crowdsourcing participants are not going to provide an equal quality of response or level of participation. The quality of the responses is likely to range from 'poor' to 'ok' to 'excellent'. The spread

of response quality may be similar to something like a normal distribution, or possibly a beta distribution with either more responses in the lower or higher quality ranges. For the company X example, there was an average contribution of 1 hour from each participant; however, actual engagement in the tasks would likely vary considerably in time spent on the tasks, say ranging from a few minutes to several days. There is also likely to be variation in the task expertise of the respondents. Further, there is no guarantee that the best responses will come from the participant(s) that committed the most amount of effort/time or that it is from the most expert participant(s) – for instance a non-expert to the task area may be able to provide some very fruitful new perspectives on the problems. Indeed, crowdsourcing examples such as the “Goldcorp Challenge” project to identify likely areas for gold deposits (Tapscott and Williams, 2006) or the Galaxy Zoo project (<http://galaxyzoo.org/>) to classify galaxies show that the general public and non-experts can provide equally good responses as experts and professionals. Not all responses would attract equal reward, or equal price, so there is considerable challenge in developing a fair mechanism to recognize involvement and quality of contributions.

Over time, the crowd participants could improve their skill-set and expertise in participating in crowdsourcing assignments, resulting in improvements in the quality of responses. This could be improved with active management from the brokers, and indeed could be a main business aim for an innovation broker. An example of such active management would be uTest (see <http://www.utest.com/>) which claims to be the world’s largest marketplace for software testing services with a global community of over 18,000 testers from more than 150 countries. A tester signs up to join the uTest community and participate in whichever project or stage they want to and have the right skills for. A Pay-for-Performance reward model is used where companies pay for defined bug fixes, the completion of test scripts or usability surveys undertaken. uTest’s model for a fair reward mechanism that recognizes involvement and quality of contribution is to use a grading systems where testers earn grading points for each reported bug and recommendations, with higher grades attracting more money per bug. For testers there is also a training element, effectively by participating testers undergo training and keeping skills up to date on a current testing projects. uTest provides forums and online meeting facilities to develop the sense of community for the testers. This also includes ‘gaming’ type activity such as their ‘Bug Battle’ testing assignments. For instance, in “March 2009: uTest announces the results of its second Bug Battle: Facebook vs. LinkedIn vs. MySpace. In all, 1,119 uTesters from 64 countries around the world competed to find bugs in the three top social networking platforms” (<http://www.utest.com/>). Therefore, sustaining a knowledge community associated with the innovation crowdsourcing activity is a powerful mechanism to motivate involvement and improve quality of contributions.

A financial reward model may work well for basic tasks, however, when the tasks cover innovation and the development of intellectual property (IP) then other reward mechanisms may be needed. A complementary approach is to provide some access to any IP produced. For instance, the winning solution provider from the crowd responses could have a share in the IP produced. This would limit the initial financial outlay and risk by the company, at the same time the winning participant(s) share the longer term risks and financial rewards but accept a reduced initial reward. This mechanism may also encourage the more efficient knowledge transfer from the people involved in producing the innovative idea or technology to the company implementing it into a commercial innovation.



There is much potential for encouraging participation from SMEs in such innovation crowdsourcing activity (RAMOS et al., 2009). SMEs are typically the innovation and employment engines in society since they are typically more nimble and responsive to the business environment than the larger companies (DICKEN, 2007). They are also likely to consist of talented people, entrepreneurs with particular skill sets. However, SMEs may lack the full range of skills or capabilities to complete large assignments or fully commercialize innovative solutions.

Consequently brokering services must address different support needs than those provided by the brokers specialized in the innovation needs of large companies. On one level the service must be flexible, accessible, preferably in close proximity to served companies, and must be trustable (KOLODNY et al., 2001). Crowdsourcing Innovation brokers can help SMEs to access external ideas and solutions, structured knowledge repositories and networking along different stages of the value chain. Indeed, crowdsourcing innovation brokers have further challenges in dealing with SMEs, such as providing support to fill any gaps in expertise and reach the full commercial potential of a crowdsourcing innovation activity. Part of this support may include providing collaborating partners to facilitate knowledge and technology transfer – a mix and match capability. It may also include training activity, handling the development of IP and commercializing ideas. Clearly, this requires a strong trusting environment for the SMEs to operate.

There are risks for the corporate customers, for instance, the crowdsourcing innovation activity may not result in a ‘correct’ or useful solution to their problem. It is new territory for corporate customers as they contend with the traditional Service Level Agreement (SLA) mindset of outsourcing involving defined requirements, costs, service provision and remedies if requirements are not met (AALDER 2001; GOO 2008; GOO; HUANG; HART, 2008). They may also open up their intellectual property to the wider business operating space and potential competition. Innovation brokers will need to provide some mechanisms to limit such risks to corporate customers.

The brokers have to deal with their own set of Risks. They are stuck in the middle between the corporate customers and so, potentially, will attract criticisms from both. They have to manage the crowd participation to encourage both repeat activity and quality of responses. The brokers are likely to have a role in managing the IP from both the crowd suppliers and corporate customers. They may even have some call upon the IP especially if they have played an active role in mix and matching skill sets from SMEs and other parties to address a business problem.

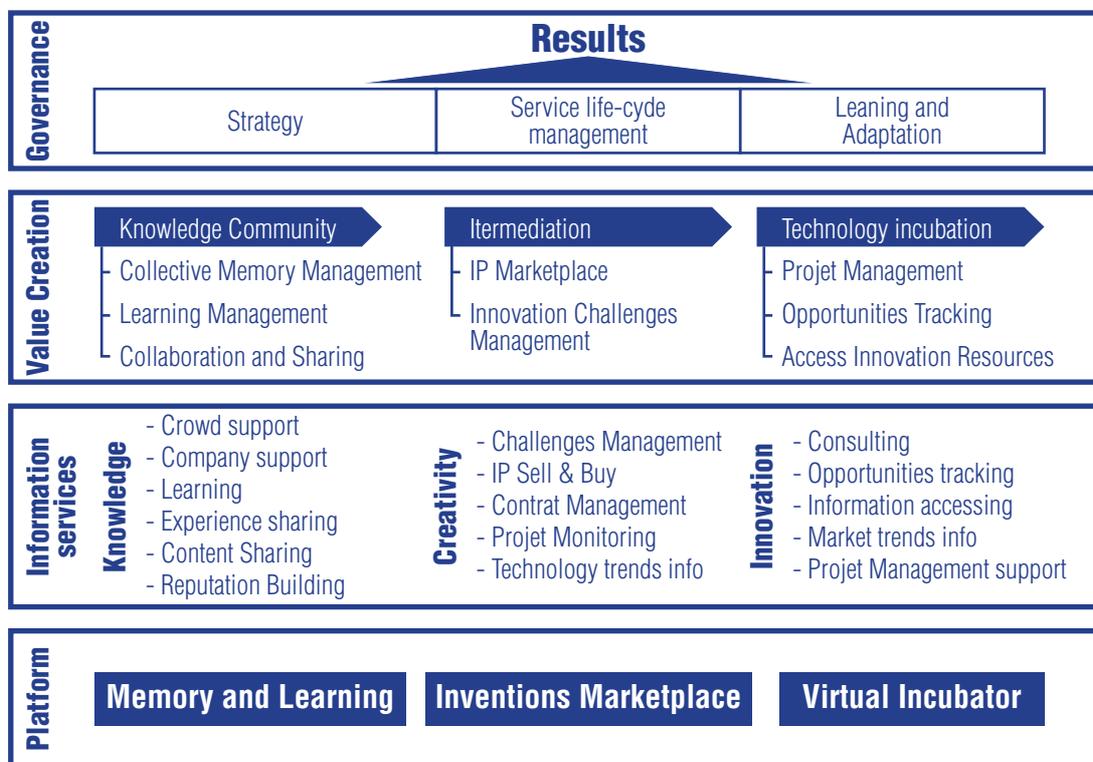
In traditional outsourcing activity SLAs have been used to manage risk, such as mitigation strategies in sharing the risk with outsourcing partners or in containing costs (BEULEN; FENEMA; CURRIE, 2005; AALDER, 2001). In crowdsourcing activity, especially involving innovation type tasks, the crowdsourcing innovation brokers are performing much of the risk management roles. Conflict resolution and code of practices will need to be developed in this new and promising business arena. These will include explicit rules and procedures so that participants are clear about what is on offer and what is expected of them. The base of these should be working out fair mechanisms for rewarding contribution and recognizing the IP of the stakeholders.

3. DESIGNING THE SERVICE

Crowdsourcing innovation brokers can help SMEs to access external ideas and solutions, to take advantage of structured knowledge repositories and to support their networking efforts along the value chain. These brokers can also foster intellectual property markets where SMEs can sell their own ideas and technologies. However, taking into account the specific challenges that innovation pose to SMEs, these brokers must be flexible, accessible, in close proximity to served companies, and trustable (KOLONDRY et al., 2001).

Clearly innovation brokering aimed at SMEs requires more support in mixing and matching capabilities. Such a system is being implemented at the University of Minho, in Portugal, and is represented in Figure 1 (RAMOS et al., 2009).

Figure 1: PERCEPTUM – Crowdsourcing innovation brokering architecture



Source: The authors, 2009

The broker's architecture as displayed in Figure 1 was developed taking into account the innovation challenges that many SMEs face as well as the challenges specific to crowdsourcing innovation intermediation. The concepts and architectures are being developed by a team of 5 PhD researchers and the development of the pilot system is being planned for 2010, in a research collaboration with one of the most important business associations in Portugal. The service will be mainly offered via the web integrated three value creation processes:

- **Sustaining a knowledge community.** Community building involves integrating and motivating individuals willing to provide their knowledge and skills to develop solutions for innovation challenges provided by companies. At the community level the interaction will be independent of any innovation activity. The broker



will make available learning and socialization opportunities in order to sustain a sense of a learning community. The financial rewards are complemented by recognizing contribution, building reputation within the community and providing opportunity for external impact and recognition for contributions.

- **Intermediation.** The service involves fostering an innovation marketplace, both for challenges delivery and IP commercialization. Companies can receive support in defining clear challenges; they can be assisted in evaluating solutions and other IP taking into account scientific and technological development trends. The service will also assist in IP negotiation and contracting between the corporate companies and the solvers.
- **Technology incubation.** The service will provide assistance in developing the acquired IP into an organizational or commercial innovation. This assistance includes specific consulting (filling skill gaps), tracking of funding and partnerships opportunities, making information on market trends available, and supporting the management of innovation projects for the corporate clients.

The intermediation of crowdsourcing innovation is being researched at University of Minho having the above architecture as the starting point of several research projects designed to develop scientific knowledge and useful tools for entrepreneurs willing to succeed in this business area.

The next three sections provide details into three of those research projects, one developing organizational memory within the ‘crowd’, one covering refining the brokering architecture, and one developing risk management methodology to support stakeholders. These projects are being carried out by the KMOWL research team at University of Minho (www.kmowl.org). Companies and business associations have been involved, namely Primavera BSS (innovation and risk management – www.primaverabss.com), Mota-Engil (knowledge repositories – www.mota-engil.pt), AHP (organizational memory – <http://www.hoteis-portugal.pt/>), ANETIE (crowdsourcing innovation – www.anetie.pt/). The overall project is supported by the Portuguese Ministry of Economy, Innovation and Development (secretary of state for energy and innovation) and the Portuguese Coordinator for the Lisbon Strategy.

4. LEARNING AND MEMORY SUPPORTING THE CROWD

The success of crowdsourcing innovation brokers is strongly connected with the creativity and motivation of the crowd. The brokering service must find an effective way of having a large number of people, the crowd, motivated to provide solutions to innovation challenges and also interested in selling intellectual property (IP) online. The success of the broker depends of a continuous demand and supply of IP.

The crowd may be seen as a community or a network of people. Though many times put together, the concepts of community and network can be parted. Fiore refers to the difference between the tension that occurs within a community, towards homogenization and conservation, something that makes it a space of belonging; and the network

implying a tension towards differentiation, creative communication and also a space for competing (FIORE, 2007).

Crowdsourcing innovation requires the knowledge diversity implied in the concept of network and the sense of belonging implied in the concept of community. At present there aren't studies about the long range effects of nurturing a network or a community associated with the broker. In this paper, the authors assume that diversity of knowledge and skills can be ensured in a wide online community by providing its members with diverse and personalized learning opportunities, meeting their needs of skills development in order to feel empowered to be an active producer of high-quality IP.

The brokering service portrayed in Figure 1 provides a wide range of learning and socialization online activities designed to foster learning, community member's empowerment and inclusion, and a sense of belonging. This is achieved by sustaining a collective memory, the support of the collective intelligence.

Collective memory is commonly agreed to consist of mental and structural artifacts within a social context, namely a group, an organization, or a society (WEXLER, 2002). Most studies of collective memory are performed within the organizational context, therefore the concept of organizational memory is better developed.

Organizational memory involves the construction at either the individual or organizational level, of a structure capable of bringing to present knowledge from the past, in order to support current activities (WALSH; UNGSON, 1991; DESHPANDE; WEBSTER; FARLEY, 1993; DESHPANDE; WEBSTER, 1989; MARTIN, 1982; WEICK, 2000; ORR, 1990). Therefore, organizational memory can be understood as a "network of people and artifacts, experiences and processes, which interrelate developing a memory that is, simultaneously an artifact that keeps its own state and an artifact present in individual and organization processes" (ACKERMAN; HALVERSON, 2000) and its overall purpose is commonly defined as "the means by which knowledge from the past is brought to bear on present activities, thus resulting in higher or lower levels of organizational effectiveness" (STEIN; ZWASS, 1995).

In the case of the brokering service described in the section 3 of this paper, the collective memory that the authors suggest to be central for the successful sustaining of creativity and motivation have many contact points with an organizational memory but also several differences. The community memory also involves the construction of a structure capable of bringing to present knowledge from the past, both of individuals and of the whole community, in order to support current learning and creativity activities. This structure is created by community members activity and resources made available by the service. This network of interrelated people and artifacts, experiences and online processes creates a collective memory enabling lower or higher levels of creativity and motivation. Strategies and tools must be developed to foster a healthy collective memory, i.e., a memory that allows for high levels of creativity and motivation.

The emerging understanding of collective memory resembles more and more the understanding Neuroscience holds on human memory, one key element of human intelligence. In this context, bringing to the discussion knowledge developed in neurosciences claiming that "equating human memory with a storage and retrieval mechanism does not square with the idea of cognitive systems as constructing entities that do not passively process incoming data but actively construct information in the first place" (OYAMA, 1985; CLANCEY,



1991; RIEGLER, 2005), memory is now seen not only as a repository, but mainly as a dynamic constituent of the cognitive system. This knowledge can also inform new advances in our understanding of collective memory that should include the structure and dynamics supporting functions similar to human memory functions.

In this line of reasoning, the authors argue that the concept of collective memory should portrait a (more) active process, where experiences, procedures and all other sources of knowledge that constitute the collective memory may be contextually evaluated to support collective historical experiences. Considering remembering as a constructive act, “far more decisively and affair of construction than one of mere reproduction”, that is, seeing memory as an active element, where each information memorized or stored is framed independently from each action of recalling or remembering in the context of the activity it is supposed to enable, seems to bring a more faithful reading on the way information is initially produced and stored and, subsequently interpreted and understood by other people, in other settings, at other times (BANNON; KUUTTI, 1996). Integrating the dynamic dimension of memory as well as its ability to create new understandings from integrating recollections of past experiences seems to result in a more genuine view of the way knowledge is generated collectively both in individuals and organizations interactions in a continuous basis.

The basis for human creativity lies also in this memory capability of, independently of any conscious act of recalling, connecting past experience within present contexts of action to form new insights that so often solve problems that have been kept unsolved for a long time. The authors see here an opportunity to produce tools, technological and methodological, that can help emerge this “unconscious” capability in collective memory. In the next section, one such tool is described associated with the knowledge repository of the brokering service.

Memory dysfunctions have a negative impact in the ability of solving problems, interpreting experience and envisaging the future. Some examples of dysfunctions in human memory include difficulties to access long and short term memory, loss of knowledge of autobiographical experience, unstable identity and dementia. Therefore, if the concept “collective memory” is to be used in a consistent way, the first step that should be taken to ensure the sustainability and innovation capacity of a community is to know the maturity of its memory and be able to intervene to minimize eventual dysfunctions. To do so, a theoretical model of the collective memory must be developed. Only then, the methodological and technological tools to improve existing collective memories can be developed.

The authors are developing this model informed with insights provided from three theories:

- **Transactive memory** theory that intends to explain group cognition and details the relationship between the individual’s memory and the communication that occurs among those individuals and refers that people, in continuous interrelations, often develop a specialized division of work that respects the codification, storage and dissemination of information originated in different substantive domains (WEGNER, 1991). This theory provides a structural basis for the collective memory.
- **Structuration Theory** (AST) (DeSANCTIS; POOLE, 1994). This theory places a particular emphasis in the perceptions dynamically created, during the work of groups and organizations, about the role and usefulness of information tech-

nologies and the way these may be applied in organizational activities. This understanding will help us to examine the types of structures that are enabled by information systems used to support patterns of human action and interaction and to understand their influence in the evolution of collective memory.

- **Social capital theory** .Having the collective memory's dynamic structure defined by integrating AST in our study, we still need a theoretical support to guide our research in mapping the collective capacity of organizational members to share and re-construct knowledge (COHEN; PRUSAK, 2001). A theory such as the **social capital theory** according to which there is a set of rules, information and confidence present in informal social networks, developed by individuals in their daily life, in search of promoting the confidence and cooperation between people in communities and society in general... (DURSTON, 1999) seems to incorporate the support that is necessary to approach the weak links of collective memory, those that by continual construction and destruction allows us to understand how communities can reconstruct experience and arrive to out of the box thinking (ACKERMAN; HALVERSON, 2003).

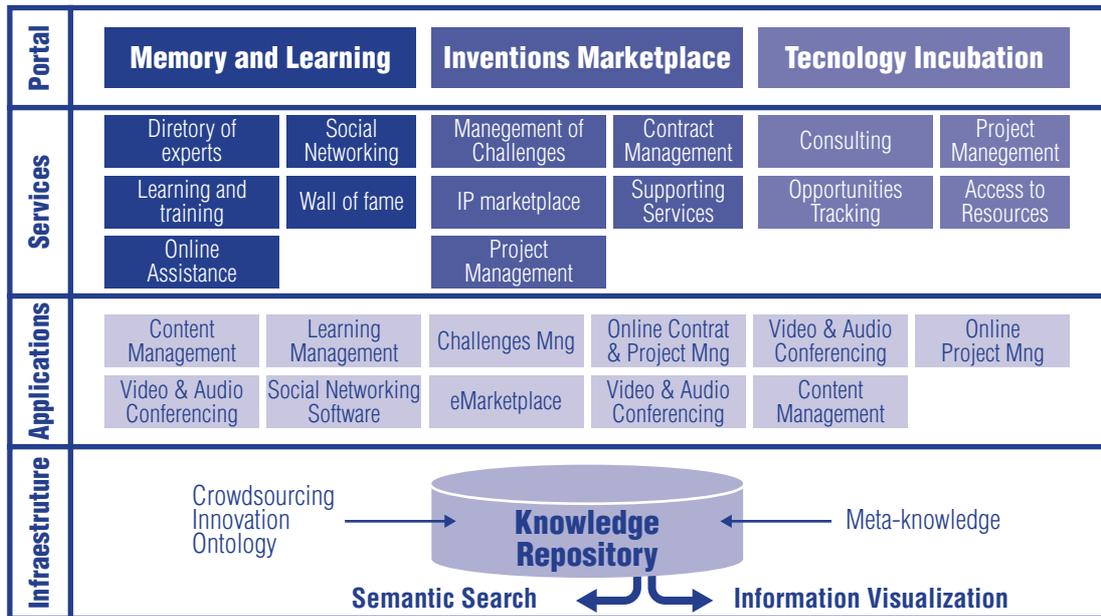
It can be argued that the collective memory of the “crowd” may be quite different from the collective of organizations since there are less clear boundaries and structural elements sustaining it. However, all kinds of memories should be similar. While the memory of the “crowd” may be more volatile and emergent than an organizational memory, it will have some structure enabling dynamic connections. Furthermore, the broker as conceived, in Fig. 1, provides a basic structure for knowledge creation, storage and retrieval, i.e., the basic functions of the collective memory of the “crowd”.

5. THE ARCHITECTURE OF THE SUPPORTING KNOWLEDGE REPOSITORY

A knowledge repository (KR) can be defined as an integrated, virtual holding area where tool-independent view of all kind of data from a variety of heterogeneous sources within an organization, could be related and accessed (KWAN; BALASUBRAMANIAN, 2003; LEMON; SAHOTA, 2004; STANISZKIS et al., 2004; TANNENBAUM, 2002).

A crowdsourcing innovation broker can benefit from a structured and integrated KR that allows managing information and knowledge created by the three value creation processes: knowledge community building, intermediation, and technology incubation. The KR will be both the enabler of the community's collective memory and the repository of the explicit knowledge captured and exchanged in the various learning and social activities online. It will capture explicit knowledge created and exchanged in the activities of intermediation, such as contract negotiation, project management, IP commercialization. Knowledge created and made explicit in the business process of technology incubation will also be stored in the KR supporting the service. Figure 2 shows a generic architecture of the portal supporting the brokering service as defined in section 3.

Figure 2: The web portal



Source: The authors

Many authors have emphasized that while KR can store large amounts of knowledge representations, i.e., information, retrieval technologies must be developed to make the access to that knowledge representations more effective and adequate to the moment-to – moment needs for knowledge (GRUBER, 2008; BOJARS et al., 2008).

Adequate visualization and search tools must be developed that can help gaining access and pre-processing large amounts of knowledge representations according to the specific needs of the community’s members as they participate in the various activities online. The aim is to empower them and creating a sense of belonging to an active and intelligent community (CANNATARO; TALIA, 2003; KELLER; TERGAN, 2005).

In addition, a tool must be developed to automatically combine knowledge representations into meaningful streams of knowledge delivered to community’s members according to patterns of online behavior and information exchange. This tool would match a very important human memory function responsible for human creativity and adaptability. Human memory possess this capability of connecting past memories without the need for a conscious act of recalling. We are bombarded by memories that we never asked for but that often are at the root of creative insights or unexpected solutions for problems that have troubled us for some time.

6. MANAGING THE RISKS OF THE SERVICE

Risk can be understood as a set of vulnerabilities that affect the goals that the organization can define and its ability to achieve them. The risk can define a threat or an opportunity. In this context, risk has not only negative meaning; not taking advantage of opportunities can be considered a risk as well (SOUZA; RAMO; ESTEVES, 2009).

The AS/NZS 4360 Standards-1999:2004 (Australian/New Zealand, 2004) defines risk as “the chance of something happening that will have an impact upon objectives and it is measured in terms of consequences and likelihood of an incident happening”.

Byrd and Brown (2003) provided a comprehensive approach to risk management in innovation processes. Their premise is based on the relationship between creativity and risk taking, which are combined in the following formula: innovation = creativity x risk taking.

Despite the potentially important role that innovation brokers can play, there are a number of risks and possible drawbacks that have also been identified with regard to their functioning. (KLERKX; HALL; LEEWIS, 2009). Innovation brokers are especially useful because they can contribute to reduce uncertainty in the early stages of innovation processes when there is a high risk of failure, therefore discouraging companies, especially SMEs displaying the problems mentioned in previous sections of this paper, from innovating (JOHNSON, 2008; SAPSED, GRANTHAM; DeFILLIPI, 2007).

It is important to identify the interrelationships between risks factors and processes and structures of crowdsourcing innovation. When a business enterprise decides to open its innovation process to the crowd, it incurs in several risks, namely, the disclosure of its innovation strategy, the lack of control over the quality of solutions provided by the crowd, the weak contractual ties with the solvers, and the risk of intellectual property loss.

One popular method for identifying risk factors has been the use of checklists (SCHIMIDT et al., 2001). Many such checklists can be found in the software project management literature or in the information systems implementation literature. Souza, Ramos and Esteves (2009) listed some risks that could affect the main value creation processes of the innovation brokering service presented in section 3 of this paper.

Knowledge Community Building integrating all activities performed required to sustain a community of creative people with diversified skills and knowledge that are motivated to answer the innovation challenges posed by SMEs. An illustrative list of risks grouped by five risk sources (rows) includes the following risks of the value creation processes that are included in Table 1 (columns).

Table 1: Risks of crowdsourcing innovation

	Knowledge community	Intermediation	Technology incubation
1. Risks related with People:	<ul style="list-style-type: none"> • Not enough skill diversity; • Not enough motivation; 	<ul style="list-style-type: none"> • Solvers do not deliver good ideas/inventions; • Inability to find the right skills for a challenge; 	<ul style="list-style-type: none"> • “Not-invented-here” culture at the seeker organization; • Lack of knowledge and resources at the seeker organization;
2. Risks related with Business Processes:	<ul style="list-style-type: none"> • Insufficient access to knowledge resources; • Not being able to build strong reputation; 	<ul style="list-style-type: none"> • Inability to provide adequate support to formulate a challenge; • Difficulty in evaluating the quality and relevance of a solution; 	<ul style="list-style-type: none"> • Weak consultancy skills in specific technologies; • Inability to find the resources that the seeker needs to implement the innovation;
3. Risks related with Technology:	<ul style="list-style-type: none"> • Difficult to use technology; 	<ul style="list-style-type: none"> • Security breaches leading to disclosure of IP; 	<ul style="list-style-type: none"> • Seekers don’t feel at ease using the online resources of the broker;



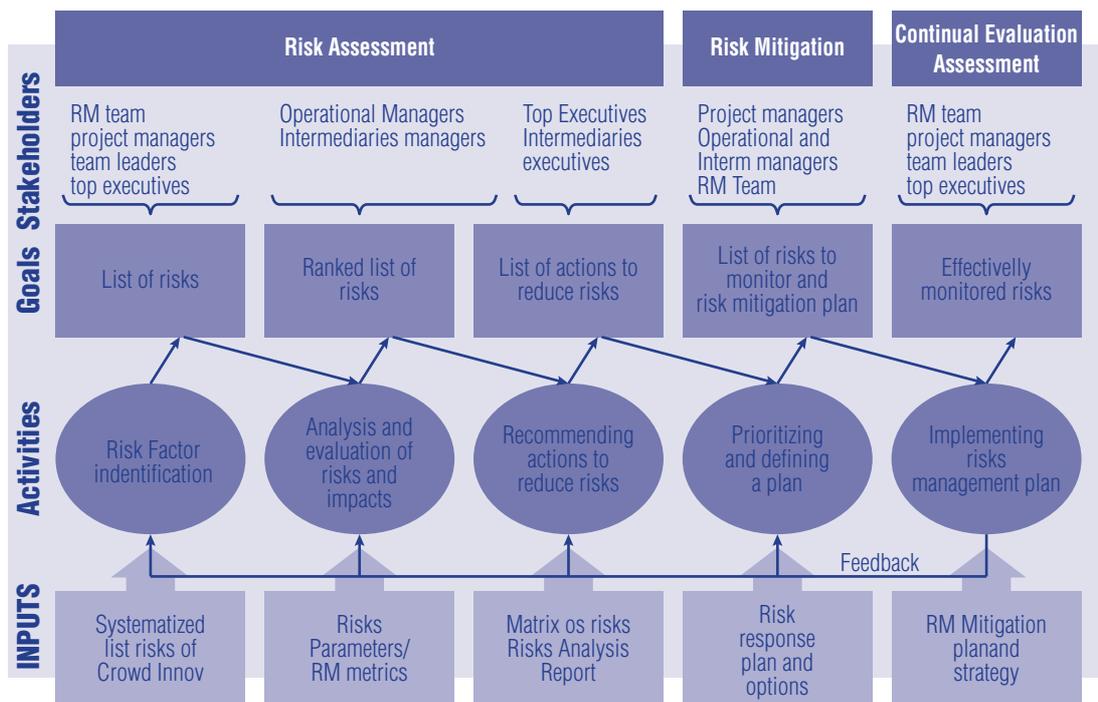
4. Risks related with Legal Aspects:	<ul style="list-style-type: none"> Information security breaches; 	<ul style="list-style-type: none"> Non compliance with contractual clauses; 	<ul style="list-style-type: none"> Transferred IP owned by a third party;
5. External Sources:	<ul style="list-style-type: none"> New and stronger competitors 	<ul style="list-style-type: none"> Changes in market leading to devaluation of a solution. 	<ul style="list-style-type: none"> Changes in science and technology lowering the innovation value.

Source: The authors

In addition to the risks associated with the value creation processes, the brokers will also face risks related with to the two supporting processes: governance and infrastructure management.

To mitigate risks like these, we propose the following Risk Management Methodology (Figure 3), consisting of three phases, to increase the success rate of a crowdsourcing innovation brokering service. Each activity is interlinked and designed to build support and trust as the collaboration develops.

Figure 3: Overview of the Risk Management Methodology for Crowdsourcing Innovation



Source: SOUZA; RAMOS (2009).

The first phase is the **Risk Assessment**. This phase consists of identification and evaluation of risks and risk impacts, and recommendation of risk-reducing measures.

Risks must be identified before they can be managed. This phase consists mainly of identifying what, why and how problems can arise as the basis for further analysis. In this phase controls will be identified and risks will be analysed in terms of the consequences and likelihood in the context of those controls. Consequence and likelihood may be combined to produce an estimate of the level of risk. The estimation of the risk level will permit to separate the risks that the decision maker decides to accept with no plan to mitigate them

from the major risks that require careful control and mitigation plans. Then a plan to minimize the effects of the risk event should follow. This consists of comparing the estimated level of risk against the pre-established criteria. This enables risks to be ranked to identify management priorities and recommend actions to reduce risks.

Three methods of control should be considered: avoidance, mitigation and acceptance. Possible actions to downgrade the risk include eliminating the root cause of the risk event, reducing the exposure to the risk by passing it on to another area, or assigning a project team member to actively reduce the characteristics of the risk event. Alternatively the consequences of the risk event can be accepted by developing and implementing a specific management contingency plan. For instance where the risk event does occur the manager should consider getting a fund to face the consequences. The main goals of this phase are the production of a list of risks, ranking the list and listing the actions to reduce the risks.

The second phase is the **Risk Mitigation**. This phase consists in prioritizing, implementing, and maintaining the appropriate risk reducing measures recommended from the risk assessment process.

The last step in managing risks is **Continual Evaluation Assessment** phase. This last phase consists in implementing a risk management program and getting feedback to improve the methodology. The risk manager, throughout the crowdsourcing innovation intermediation life cycle, must monitor each identified potential risk event. Actions need to be taken to eliminate the risk or to downgrade the risk. This is, to monitor and to review the performance of the risk management system and make the necessary changes.

7. CONCLUSIONS

Crowdsourcing is emerging as an interesting outsourcing option for organizations enabling them to draw upon a wider set of intellectual capital than can be achieved internally or through traditional outsourcing arrangements. Tasks that were traditionally performed by employees, or outsourced to an outsourcing company, can be ‘outsourced’ by an open call to a large but undefined group of people. There are both cost and quality of solution drivers towards the crowdsourcing option, particularly with innovation and problem solving tasks.

However, the crowdsourcing option represents a paradigm shift in management thinking around outsourcing: Traditional outsourcing is dominated by the SLA mindset of well-defined requirements and level of service provision, detailed costs and legal remedies if requirements or service levels are not met – all of which are less relevant to crowdsourcing activity. Key to the success of crowdsourcing activity is the development of brokerage facilities that operate as a middleman between the organizations and the open ‘crowd’ of potential contributors. There are considerable challenges in crowdsourcing activity. Innovation brokers have to set in place a fair and robust operating environment for the stakeholders (organizations, solution providers from the open community and the broker themselves) to participate in crowdsourcing activity. Normal business models and rules are stretched to accommodate innovation brokering activity through crowdsourcing, such as traditional value chains and organizational boundaries.



Several existing innovation brokering services have emerged, such as Innocentive, yet2.com, Nine Sigma, IdeaWicket, IdeaConnection and YourEncore and others, however, these are primarily targeted at the larger organizations.

An examination of the characteristics of SMEs show that they have very different needs to those of larger organizations and also that they hold much potential for participation in crowdsourcing activities: SMEs are nimble and responsive to the needs of the business environment and are usually the innovation and employment engines in society. However, innovation brokering support for SMEs is less well developed than for larger organizations. This paper has addressed this limitation by developing architecture for innovation brokering aimed at the needs of SMEs and applying this to develop an innovation brokering service based around a University in Portugal.

As with the development of any novel support structure in a dynamic environment, the operating aspects have to evolve as they are applied in practice. The initial developed innovation brokering architecture captures aspects of organizational memory within the 'crowd' and aspects of risk management to support the SME stakeholders. The paper makes further contribution by developing knowledge of crowdsourcing innovation and the economic and social impact of brokers within the SME environment, and develops methodological and technical tools that will support managers decisions and interventions. In addition, the business and operating model developed aims to ensure the sustainability of the brokering services.

Innovation brokering is emerging as a novel but challenging business activity that takes advantage of the powerful Web 2.0 technologies and growing expertise and user practices across the global web. Innovation brokering aimed at meeting the needs of SMEs has extra challenges in providing trusted collaborative market place, mix a matching of skills and tailored support to help innovative ideas to germinate.

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