



COMPUTER-BASED SOLUTIONS FOR OPEN INNOVATION PROCESSES

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Abstract: *Innovation management has significantly changed, especially towards approaches for supporting the innovation process and gathering ideas from outside the organization. In the advent of Web 2.0 these approaches have become increasingly computer-based enabling access to large user communities. This article provides an overview of existing concepts and approaches on computer-based solutions for innovation focusing on creativity support systems relevant for the idea generation phase of the innovation process. Individual as well as group-related aspects are discussed. A case study of an Open Innovation platform showing the results of an interdisciplinary research project exemplifies the practical application of the described concepts.*

Key Words: *Computer-Based Solutions, Web 2.0, Creativity Support Systems, Open Innovation*

1. INTRODUCTION

Managing innovations is crucially important in a time when innovation is a necessary survival strategy [6]. But having the right innovations at the right time is not so easy to achieve as it requires effort from the organization – strategy and climate, stable economy, and – most important – the right idea. The right idea at the right time can save a company. Even though the research on the processes and methods to arrive at the right idea is not new, there are many aspects that are left open for further research and development of new fields of discussion. One of the open questions on which, most probably, no one has the right answer is: Which are the most effective idea sources and which methods can provide the best idea generation? However, there are many successful attempts for designing of a method that would at least help the pre-development phase of the innovation process [5], [22], [23] within an organization. When we talk about ideas and innovations it is useless to continue any discussion without thinking on the “fuel” of the process – creativity. Even though there are many definitions of what creativity is, which for the

researchers is seen as a problem [17], we accept as a working version the definition given by Sternberg and Lubart [34]. They see creativity as: “*The ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive concerning task constraints)*”. Creativity has been observed from many different aspects, and many empirical studies, concepts, observations can be found in fields such as arts, social sciences, psychology, business etc. There are many methods designed to support creativity. These methods are of special interest for the business world. For a long time businesses were interested in so called face-to-face methods or traditional methods like brainstorming [25]. Lately companies have a tendency to improve their innovation processes by using computer - based solutions that ease collaboration, knowledge management and idea generation. The focus has fallen on creativity support systems which can help not only the communication and the knowledge sharing but also the idea generation (ideation for product innovation).

In this paper we first give a historical overview of the recognized computer-based systems for groups, primarily designed to foster communication during meetings. Then we describe the background for the development of computer-based solutions for creativity. In the third part we give an example of a web-based Open Innovation platform called Neurovation showing the results of an interdisciplinary research project.

2. COMPUTER-BASED SOLUTIONS

2.1. The trend of computer-based meetings – searching internal ideas

Looking back in the history organizations invested many financial resources on technologies and on implementation of computer-based solutions such as decision support systems, collaboration systems, data flow etc. Unfortunately very few experiments are made with respect to the impact of creativity resulting from the use of group support solutions including computers and web - based platforms [13].

For more than a quarter of a century research has been conducted on group support systems (GSS) [14]. They are defined as: *“A set of techniques, software and technology designed to focus and enhance the communication and decision making of groups”* ([24], p.357), and treated as solutions that could overcome the process losses during group meetings. GSS were meant to support a variety of tasks following a similar sequence of events. The early systems from the 80^s were designed to support system analysts and users in the constriction of information systems [6]. Later on they were used as support methods for almost every meeting. At such group support meetings there were a leader and facilitator that developed the agenda for the meeting and selected the group systems tools to be used. The participants on the meeting used their computers to give comments and the results were integrated and displayed on a large screen in the front of the room. In that way the communication between the participants was assumed to be eased. In the years that followed these meetings were also supported by more internet enabled applications such as Groove, MSN Messenger, Yahoo, Chat, ICQ, Lotus Notes and other Web applications to enable members to communicate [6] and to support meetings with geographically distributed members. On the other side there was a significant interest on decision making and idea sharing accomplished by computer networks [36]. These computer - based tools which supported idea generation were based on the brainstorming face-to-face method [24] and are called Electronic Brainstorming Systems (EBS) [36]. Electronic Brainstorming Systems have received significant attention by researchers. There was an optimistic belief that computer - based brainstorming systems will overcome the problems of inefficiency and low productivity in idea generation group meetings [15], [16].

Facing with the fast changing economy companies started to require and search for computer - based solutions not only for group meetings support but also that could foster their knowledge management activities and collaborations. A new social technologies embedded in the so called “Web 2.0” has appear on the market. These technologies were originally used to describe consumer technologies that enable groups to organize and share information and media [9]. According to Eastwood [9]: *“Enterprises quickly caught on the value of these easy to use tools for capturing and sharing ad hoc information that may be otherwise not documented”*. Having this on mind IT enterprises had to respond to the requirements of their customers with solutions that contain features for collaborative working across regions, knowledge capture, and community and brand building outside the firewall [26]. This led to a creation of new and improved, more holistic tools called Social Enterprise Applications that would enable the “next wave of knowledge worker productivity” (term coined by Oracle company in 2008). The use of the technologies associated with Web 2.0 has implicated the opportunity for companies to literally think outside the “box” by searching for new product ideas outside the organization. By this the Creativity Support Systems have been developed further in order to support the so called Open Innovation approach. Restrictions which previously

occurred using internal, closed platforms have been removed by the Web development [11]. It is interesting to mention that most of the computer-based solutions for innovation almost never include all phases of the innovation process but are focused only on one phase where actions from that phase can be separately developed and communicated via given platform. There are several software solutions that can be found under the Stage-Gate Inc. Ready Certified solutions which are based on Cooper’s Stage-Gate model [4] which almost supports all phases of the innovation process. Other commercial software solutions pay more and more attention to the collaboration segment within the innovation process (CollabNet). Many simple solutions provide the use of (collaborative) mind maps (e.g. Mindmeister.com) and brainstorming features for creative decision support. Some are based on the logic of existing methodologies (e.g. TRIZ) which can be described as systematic innovation methods.

Some tests with computer - based collaboration creativity techniques are identified which resulted in the creation of new solutions for creativity support within groups [11]. As said before only few solutions include the idea generation phase and even fewer are capable for Open Innovation. According to Cooper and Edgett [3] there is a lack of popularity of traditional methods for Open Innovation, but they find that the reason is that some Open Innovation approaches are relatively new. This signifies that there is a lot work to be done in this field.

2.2. Background for creating computer-based solutions for creativity support

The roots of the methods for supporting creativity, face-to-face or computer based, are based on creativity process models. Even though scientists have been discussing for a long time if the creativity processes are a product of only intelligence [8] unconscious process [28], conscious and problem solving process [38], [17]. there is an obvious consistency about the sequence of two distinctive phases occurring in the creativity processes [37]: a divergent phase, where ideas are generated and collected, followed by a convergent phase, where the ideas are discussed, evaluated and discarded or selected. In more complex process models these pattern can be repeated several times. Tools to support creative process should therefore provide means to support both divergent and convergent phases of the creative process (for the divergent phase there should be means to input and visualize ideas, and for the convergent phase there should be functions that enable the user to organize, discuss, select and rank ideas) [11].

As it was discussed earlier in the text, it can be concluded that most of the creative activities within organisations have been carried out by groups. Understanding the group interactions necessarily pools understanding of the individual behavior. For example in the literature there are recognized factors that affect creative performance. Rhodes [29] has proposed a categorization into four factors affecting the creative performance also known as 4Ps: person, process, product and press. For every category there is a list of factors that

define the creative capability. For the category person the factors are antecedent conditions like the history of the person or personality data [32], [33]; the category “product” focuses on the outcomes and those things that result from the creative person [30], the “process” category involves the mental processes at work in creation (humor, communication, creativity methods); an “press” refers to the relationship of human beings and their work environment including aspects such as leadership or reward.

The conditions for group creativity have been researched from several aspects: group composition, group characteristics, group process factors. King and Anderson [18] listed leadership, cohesiveness, group longevity, group composition and group structure as antecedents of group creativity. In examination of the effectiveness of research teams, Payne [27] identified resource availability, leadership, group size, cohesiveness, communication patterns, and group diversity as crucial factors in creative performance.

In the literature on creativity support systems sets for functional requirements creativity computer - based solutions have been defined [19]. Various tests using face-to-face methods have shown that group-related problems occurred more often which initiated researchers to see how group support systems impact for instance efficiency, effectiveness, communication, decision quality, productivity, satisfaction, usability of the solution etc [13]. Group support systems, especially those computer support systems, have shown to reduce many of the problems which are present when face-to-face methods are used [11],[13],[14]. These considerations lead to the initiation of the research project “Neurovation” as explained in the following section.

1. THE OPEN INNOVATION PLATFORM »NEUROVATION«

The Open Innovation platform Neurovation¹ is the result of a research project which started in 2005. The overall aim of the research project was to combine innovation and knowledge management on a psychological and neurophysiologic basis in order to improve the innovative capability of organisations in the long run. Based on the findings obtained in the course of the research project as well as on the insights from existing literature a focus has been made in favour of the first phase of an innovation process so called “fuzzy front end”, in particular the idea generation activity. Consequently a set of tools has been developed focusing on different aspects of creativity support and creativity promotion for so called “knowledge workers” within organizations. This initial concept has then been extended and adapted to be suitable for an Open Innovation process involving the integration of external stakeholders such as customers, interest groups or suppliers.

1.1. Rationale for developing Neurovation.net

Supporting the very first phases of an innovation process is of relevance to any organisation as the creation of new knowledge constitutes an important part of knowledge work. According to a study conducted in the course of the research project APOSDLE [1] more than 30% of knowledge work is associated with the generation of new knowledge.

Moreover, studies show that in particular the quality of execution of the first phases of an innovation process (i.e. also the idea generation phase) significantly influence the success or failure of an innovation process [35].

In the course of the first research activities the Institute of Psychology at the Karl – Franzens - University of Graz conducted an EEG study [12]. In the course of this study the test persons had to generate as many creative ideas as possible to a given challenge within a certain time span. Apart from the control group all participants were interrupted after three minutes by a so called “intervention”. The effect of this intervention has been assessed with respect to the development of the idea rate curve. The results showed that positive affect (i.e. humour) and idea sharing have proven to be the best means for preventing the idea rate to go down, i. e. for stimulating persons to generate ideas. The results and conclusions from this study were included in the conception and development of a web-based modular creativity tool named “Idea Generator” targeted at the individual.

In a later phase the prototype of the Idea Generator has been further developed based on a feedback phase including persons from 30 different organisations. In the course of a dissertation the Idea Generator has been empirically evaluated. The aim was to evaluate to which degree the Idea Generator is suited for supporting the creative process and for fostering creative achievement of individuals ([19], [20]). Although the test persons of the Idea Generator considered the tool to be useful and user friendly (as opposed to the control group using paper and pencil), the control group generated more creative ideas. This might be due to the non - familiarity with the Idea Generator and the high degree of novelty of such a tool. However, the so called “humour intervention” evoking positive affect lead to a significantly higher creative achievement [19]. Great potential is seen with respect to idea sharing which has not been integrated as the tool focused on the individual person. Therefore the ongoing developments concentrated on supporting idea sharing, the collaborative (asynchronous) generation of ideas and the opening of the idea generation process.

Trends such as Web 2.0 and Open Innovation [2] strongly influenced the research and development works in this later stages of the project. The Open Innovation approach gives stakeholders and relevant communities the opportunity to play an active role in different phases of an innovation process. This integration enables firms to better tailor their innovations in terms of products, services or markets to the needs of the relevant stakeholders and potential customers. Letting these “external” stakeholders become an active part in the

¹ Neurovation is a combination of the terms »NEUROscience« and »InnoVATION«

innovation process can be facilitated through the use of open Web 2.0 technologies – in particular the possibilities today's Web provides with respect to getting access to large groups of users and communities, user collaboration (harnessing collective intelligence) and user generated content.

From an application point of view, the idea generation phase is not very well supported on the Web. Most of the available tools and applications exclude the idea generation phase. They rather support the process that begins with the enunciated idea and focus on the matching between idea seekers and problem solvers (e.g. Innocentive, Mechanical Turk etc.) [21]. Due to the increasing tendency of idea competitions staged via the Web a great potential can be assumed in supporting the idea generation phase.

The Open Innovation platform Neurovation has been further developed based on the above-mentioned findings and identified trends. In the course of these developments usability designers have been included to simplify and improve the workflow process on the platform, and a system has been developed to enable the community of users to not only develop their ideas via the tools on the platform, but also to submit their ideas to idea competitions.

A case study of an idea competition with offline and online components illustrating the features of the platform Neurovation.net as well as the online activities carried out to promote the offline event are explained in the next section.

1.2. Case Study: Open Innovation via the platform Neurovation.net

The basis for the idea competition on Neurovation.net was an offline event called »Braintwister«. This event was supported by an initiative from the Austrian Federal Ministry of Economy, Family and Youth called "Evolve" - the Creative Industries Austria. The aim was to assemble the various creative sectors in Austria, such as design, graphics, media, PR, advertising, multimedia, music, fashion, film, photography, architecture and art.

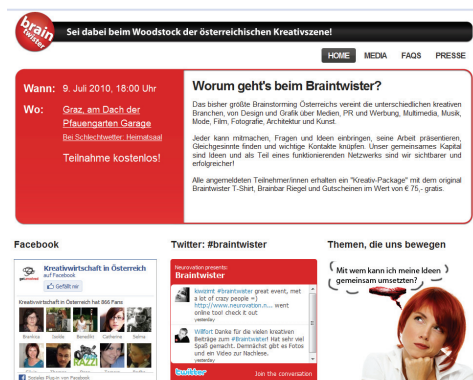


Fig. 1. The Braintwister webpage informing about the offline event preceding the online idea competition using social networking tools such as Twitter and Facebook

Braintwister was designed to be the biggest public brainstorming event in Austria. To promote the event and to increase the awareness level of the evolve initiative

Web 2.0 functionalities have been actively used. Figure 1 shows the webpage for promoting the Braintwister.

In parallel, virtual marketing activities have been staged via Facebook and Twitter. The respective widgets have been integrated into the Braintwister webpage to give interested people a community feeling and to inform them about current activities around the event. For instance, the Facebook group "Creative Industries Austria" which has been founded to promote Braintwister has almost 900 fans. Latest tweets give a first impression on what people think about the event and (after the event) what they experienced there.

More than 300 people finally participated in the offline event which took place in Graz. All generated ideas at the event have then been digitised and published via the Open Innovation platform Neurovation.net. The so called "Idea Pool" (figure 2) shows all public ideas and constitutes an important element for stimulating creative processes of other platform users. By this the effective principle of idea sharing has been realised. Furthermore, users have the possibility to get feedback from the community about their ideas when submitting them to an idea competition.

The online phase for Braintwister is tightly connected to the offline phase, i. e. on the platform Neurovation.net users find an idea competition called "Braintwister" including a detailed description on what the challenge is and what the conditions for participation are (prizes, end of competition, evaluation phase, and legal regulations).

Ideen in Feedback-Phase Braintwister (2)	Idea Pool	Titel	Kreativer Kopf	bearbeitet
kein Bild	Planet 007	Halo erstmal!!!!!!!!!!!! Ich wollte nur mal sagen Das es sich bei diesem Spiel um ein Denkspiel handelt, aber mit sehr viel Spaß zusammenh...	Di	10.07.2010
kein Bild	Move It!	Move It! ist ein virtuelles Spiel das zB mit Wii gespielt werden kann. Es gibt verschiedene Levels und es spielen mindestens 2 Spieler (oder auch...)	babi	09.07.2010
kein Bild	Prätes Poetry (Flash-Spiel)	VORGESCHICHTE Du bist ein Prät, der mit seiner Crew seit Jahren auf erfolgloser Suche nach der legendären Schatzinsel ist. Den Großvater hat dir...	tasky	09.07.2010
kein Bild	Idee1	In meinem Spiel sollte man Kaugummi kauen. Je mehr desto besser. Warum, werdet ihr euch fragen? Na ganz klar, weil nur so der Strich vom Punkt...	mutts_bester	08.07.2010
kein Bild	Die Jagd nach den Kaninchen XD	Mein Spiel Nr. 1: Man erstelle wunderschöne Umgebungen (Wälder, Wiesen, Gebirge,...) die sich nur durch klicken und ziehen ändern lassen.	alkockin	08.07.2010

Fig. 2. Getting inspired by other ideas – the effective principle of idea sharing has been realized in Neurovation's "Idea Pool"

Furthermore, they find the three latest submissions to the competition as a first stimulus for their own creative processes (figure 3).

Therefore detailed users tests have been made regularly at the different project phases (offline via paper prototypes or online in virtual test environments) to permanently improve the existing solutions. To make users feel comfortable and to give them a quick insight on what they can do on Neurovation.net an intro explaining the most important features has been

developed (figure 4). One important part of the Neurovation platform constitute the hands-on creativity tools actively supporting users in their creative processes by providing them with stimuli for new ideas.



Fig. 3. Idea Competition “BrainTwister” - online idea competition following an offline event

In particular the building of associations for linking previously unconnected areas or topics is fostered to provoke highly creative ideas.



Fig. 4. Intro at the Platform Neurovation – focus on collaboration with others when being creative

The illustration below (figure 5) shows the overview of the three creativity tools on Neurovation.net (these tools are undergoing a redesign at the moment – therefore they are currently not available online).

The tool “MindMonkey” requires the user to enter one word relating to her/his challenge or the topic she/he deals with. The technological background of MindMonkey is an associative index developed at Graz University of Technology. The result – near or far word associations – are visualised in bubbles on which the user can click in order to get associations, i.e. e. the user can swing from one area of bubbles to the next like a monkey swings from tree to tree.

On the contrary, the “SlotMachine” is a tool that does not require any user input. It simply provides the user with impressions (words combined with a picture) to stimulate creative thinking. One mouse click leads the user to the next word-picture-combination.



Fig. 5. The creativity tools on Neurovation.net

The third tool is called “InspirationMachine”. Similar to Google Search the user finds an entry field and a button “inspire me!” to start the tool (figure 6 below).



Fig. 6. The input field of InspirationMachine – a meta search engine offering creativity-stimulating results

InspirationMachine is a meta search engine designed to stimulate the user's creativity in many ways by giving her/him a variety of results ranging from pictures to persons, audios, videos and products. The main difference to Google is that InspirationMachine does not show the most relevant results but results that are far from the entered term – again designed to stimulate the building of associations in the user's brain. Figure 7 shows an example for a result. The result changes and new inputs appear as soon as the user clicks onto the button “inspire me again”.

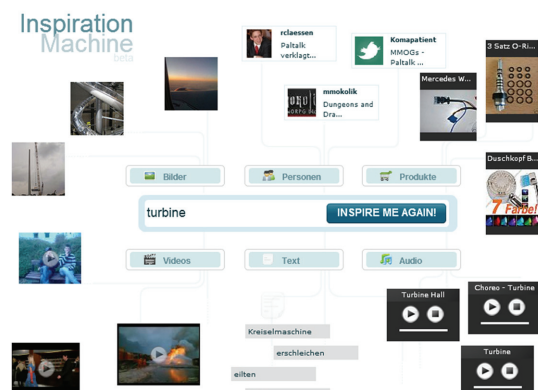


Fig. 7. The results the InspirationMachine shows for the term “turbine”

After getting inputs and stimuli from the creativity tools the user can go on to describe her/his idea. To do this she/he has the possibility to use the so called »idea board« on the platform. This idea board (shown in figure 8) contains a normal text field but also a drawing board to visualise ideas, to upload photos or to integrate videos.

To create a trusted and supportive environment a point and level system has been introduced on Neurovation.net. Every user can earn points for activity, creativity and trust. Points for activity can be collected by creating own ideas, by evaluating ideas of other users, or by extending one's network. Creativity points are allocated when a user collaborates with others, gives valuable feedback on ideas of other users or when other users like one's own ideas (expressed by a positive

rating). Points for trust can be collected by fair behaviour and by supporting other users.



Fig. 8. The idea board on Neurovation.net on which users can draw, design and describe their ideas individually

Depending on the number of points a user can reach the next level which enhances her/his possibilities and voting rights on the platform. A respective level is symbolised by a virtual badge shown with the avatar of the user. This, in turn, influences the user's visibility on the platform with respect to other users or companies looking for creative people. A so called "Idea coach" tells the user what to do for reaching the next level (figure 9).

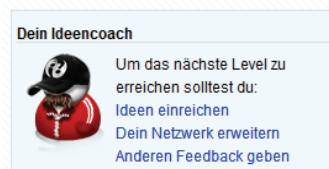


Fig. 9. The user's personal "idea coach" on Neurovation.net.

Ideas are a very personal and sensitive good. Therefore it is important to let users know who will be able to look at their ideas at which stage of the process. This has already been taken care of at the introduction on the platform (figure 10) as this is one of the first things users want to know when working with their ideas in a »public« environment.



Fig. 10. A user can choose by her-/himself who else is able to see his/her idea – symbolized by the idea safe

For a platform provider such as Neurovation, the main goal of an idea competition is to motivate many users to submit their ideas. On Neurovation.net the exploitation of ideas is symbolized by the "Market place" where ideas are visible for interested companies.

On the other hand, for users it is of interest what they get for submitting their ideas.



Fig. 11. Finally users have the chance to market their ideas via idea competitions

However, in the literature on Open Innovation and interactive value creation there are still differing views on how people are motivated and remunerated (intrinsically, extrinsically, or a combination of both) [31]. Neurovation organises idea contests for organisations and companies which benefit from the platform infrastructure and an existing community of currently about 2,000 creative users. Consequently the community generates ideas on various topics and areas. This variety makes it difficult to motivate users intrinsically, probably due to a missing long-term personal identification with a certain brand, product or service. Therefore the idea competitions on Neurovation.net primarily target extrinsic motivation by allocating prizes for the winning ideas.

4. CONCLUSION

The idea generation activity plays a crucial role for the success or failure of an innovation process. Computer - based solutions such as: creativity support systems, decision support methods, group support systems and other, have been developed for the use within an organization to facilitate the innovation process. With the advent of Web 2.0 new opportunities evolved for organizations in terms of opening the innovation process, in particular the idea generation phase. Integrating stakeholders (customers, interest groups, suppliers etc.) from outside to contribute their ideas and thoughts is facilitated by Web 2.0 elements such as user-generated content, collaboration and the possibilities to harness collective intelligence. In the course of the research project "Neurovation" a platform has been developed that follows this open innovation approach by focussing on the support of the idea generation phase. The case study described shows how online and offline phases of an open innovation process can be combined.

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