WEB-BASED INFORMATION SYSTEM FOR INNOVATION MANAGEMENT IN A BRAZILIAN ELECTRICAL COMPANY

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ABSTRACT

In recent years, there has been growing government pressure for increased R&D investments in the Brazilian electrical power industry. The resulting surge in innovation activity, in this sector, however, was not accompanied by improved innovation management capabilities by Brazilian power companies. Usually, firms in this industry are characterized by informal and ad hoc innovation processes and a general lack of unified approaches to innovation management. In order to cope with these issues, some firms have developed web-based information systems to facilitate and organize idea generation, evaluation, prioritization, and implementation as innovation projects. This paper reports the development of such a system, a web-based corporate-level information system for innovation management at the Compania Estadual de Distribuição de Energia Elétrica (CEEE-D), an electrical power company situated in Southern Brazil. The system uses the organization's Intranet and is based upon a revised and improved innovation process map. The paper describes the inner workings of this system, focusing particularly in the transitions between innovation ideas, proposals, and projects, and the evaluation mechanisms.

Key words: innovation management; web-based information system; electrical power industry; innovation process.

INTRODUCTION

The recent changes in Brazil electrical sector regulation impose to utilities the challenge to provide high-quality services with low energy prices. As new and disruptive vendors, technologies, and business models enter the market, many utilities are unsure about what their role is or should be. This new scenario requires the engagement of all company employees to enhance the utility process at all levels. The innovation has an important key at this effort since it is crucial for organizations to survive and compete (Chesbrough, 2003; Desouza et al., 2009; Drucker, 1986; Porter, 1990) and have become one of the most important competencies that companies have to master (Jaruzelski & Dehoff, 2010; Pohle & Chapman, 2006; Rubera & Kirca, 2012).

The success of an organization's ability to innovate is directly linked to their ability to leverage ideas and to manage information (Wong & Chin, 2007). Knowledge Management (KM) involves processes of generation, coding, coordination and transfer of knowledge within an organizational context (Davenport, 2001). KM directly influences the competitiveness of enterprises.

No Knowledge Management System (KMS), no matter how fine designed, will succeed without the input and cooperation of users. Facebook, Twitter, Wikipedia and other online social networking and information tools succeeded since people liked and have personal satisfaction using it. To maximize the value of a KMS, companies will need to encourage as many of their workers as possible to join and contribute to content production. Administrators will need to demonstrate their desire to learn and place themselves as model to other colleagues and also to indicate their desire for promoting a knowledge-sharing culture (O'Dell & Hubert, 2011). O'Dell and Hubert (2011) also claim that online social networking tools are reinvigorating KM by conceiving this simpler for workers to engage in knowledge production by borrowing ideas from system like Facebook and Twitter. And since a majority of employees are already familiar with the features of such tools, companies benefit from using similar mechanisms in their productivity information systems.

Innovation depends intensively on the availability of information and knowledge. The complexity produced by the richness of information has to be identified and controlled to ensure successful innovation. Knowledge management has an important relationship with innovation and is imperative that we recognize the role of KM the innovation process (Lorna Uden, Marja Naaranoja, 2011). To intensify competitiveness, enterprises attempt to create innovative information approaches in order to improve performance. Consequently, knowledge management capabilities and knowledge innovation have become important topics for improving business performances (Tsai-Mei Lin et al., 2010).

In order to cope with these issues, some firms have developed web-based information systems to facilitate and organize idea generation, evaluation, prioritization, and implementation as innovation projects. This paper reports the development of such a system, a web-based corporate-level information system for innovation management at an electrical power company situated in Southern Brazil. The system allows a collaborative work on innovation process. With the system, employees can propose innovation that became with a brief description of an idea and becomes a project. Project in this context mean temporary organizations with specific objectives, landmarks, time constraints and budget (Disterer, 2002). Among the unusual features of the project, it includes the use of multidisciplinary teams and cross-functional work and, in some cases, external agents (individuals or firms) participating, in a logic of open innovation.

THE INNOVATION MANAGEMENT SYSTEM

The innovation process that serves as the basis for the information system has five basic stages. The first stage is that of idea generation and capture. Next, ideas are jointly evaluated by a team of innovation specialists. The ideas are ordered according to their final scores and the top ideas are promoted to innovation proposals. These proposals go back to the original proponents for further development. A second evaluation round ensues, this time with different criteria given that the proposals are much more detailed that the original ideas. Innovation proposals are then ordered according to their final scores and prioritized in the context of the firm's constraints (budgetary, human resources, facilities available, etc.). Finally, financial resources, schedules, budgets, and staff are assigned to the best innovation proposals, and a project implementation and monitoring stage follows.

Different rules for submitting and evaluating innovation proposals can be customized, but the default configuration includes expected environmental, economic, and social costs and benefits to both the firm and the external community. The system allows the firm to manage multiple simultaneous calls of proposals, each with different rules and evaluation mechanisms.

A new idea becomes an actual innovation project after going through three main stages, which are subdivided in eight states. Any employee may register an idea in the system by filling a specific form. As long as the idea is not submitted, it remains in the state 'idea under development'; after submission, it assumes the state 'submitted idea'. Then, submitted ideas are evaluated and can be approved for further development (becoming innovation proposals and assuming the state 'innovation proposal under development') or rejected and archived in a knowledge repository for further reference. Evaluators' scores and feedback are forwarded to the proponent, who can use this information to further develop his proposal. Next, the now detailed innovation proposals are again sent to evaluation (and assume the state 'submitted innovation proposal'). After this evaluation, again the proposals can be approved (assuming the state 'innovation proposal awaiting implementation') or rejected, in which case they are archived for future reference in the knowledge repository. Approved innovation proposals are then detailed into innovation projects by the R&D management team to be implemented. Finally, the system allows monitoring the innovation projects, which can assume the states 'implemented innovation project' (for ongoing projects) or 'finished innovation project' (for concluded projects. The three main states and the main state changes can be seen in Figure 1.

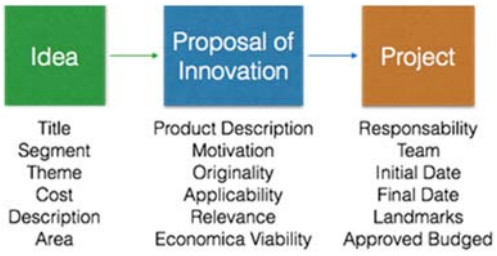

Figure 1: Innovation process at CEEE

Idea Submission Process

The system shows CEEE's innovation program summary in its first page. General performance indicators for the program such as number of submitted ideas per employee, percentage of ideas approved in the first stage (that is, from idea to innovation proposal) and percentage of innovation proposals approved to project stage are presented in a dashboard style, as illustrated in Figure 2.

Figure 2: System home page showing overall performance indicators

To submit a new idea, users must log in in the system and complete a form with the following fields (see Figure 3):

i. Title: a concise, simple title for the innovation idea.

ii. Team: who, among the internal and external collaborators, is responsible for the idea.

iii. Type: the author classified the idea as a potential technologic, marketing or management innovation.

iv. Segment: what main business benefits from the idea (Power Generation, Transmission or Distribution).

v. Main Topic: the idea should be classified in one among the different innovation topics provided by the Brazilian Regulatory Agency (e.g., Alternative Energy Sources, Energy Efficiency or Power Systems Operations);

vi. Description: a brief description (up to 1,000 words) of the idea.

vii. Estimated time: a brief explanation (up to 1,000 words) on how long the authors believe would take to implement this idea.

viii. Estimated costs: an overview of the overall costs to implement this idea (thousands R$).

ix. Estimated financial return: the authors' estimation on the overall financial returns the idea can generate.

x. Attached Files: the authors can attach .pdf files in order to better explain or justify some of the inputs (e.g., viability studies, project drawings, etc.).

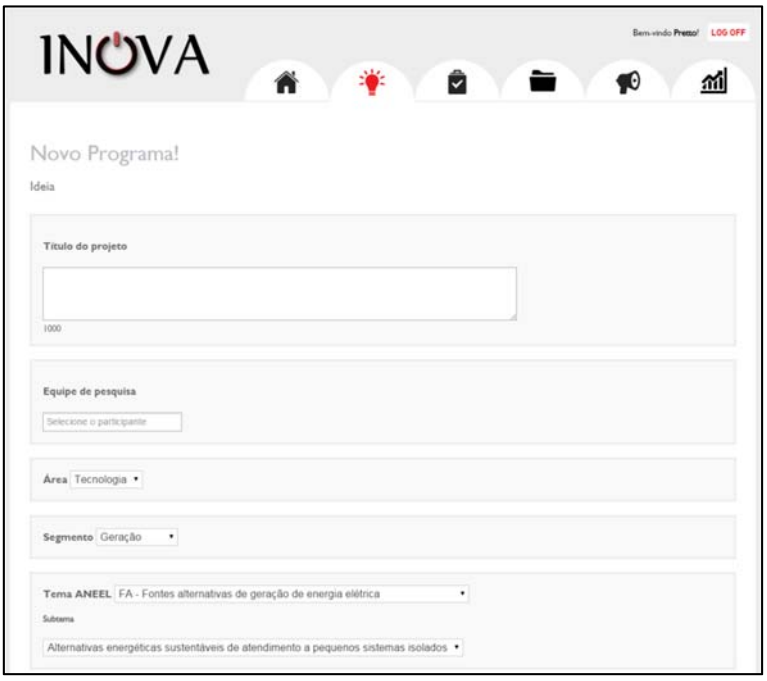

Figure 3: Partial view of the idea submission form

Once submitted, an idea is evaluated by referees appointed by the innovation management team. These referees can approve an idea, so it becomes an innovation proposal, or they can reject the idea in this current state. In the latter case, the idea is then stored in a repository for future consultation. Ideas that are approved at this point are returned to the authors so they can improve and further elaborate. An innovation proposal requires much more detail that the initial idea. The data bellow must be added and thoroughly described in the innovation proposal form:

i. Product/Process Description: a brief description (up to 1,000 words) of the major product or process change expected to be generated by this innovation proposal.

ii. Motivation: a brief description (up to 1,000 words) of the reasons for proposing the project.

iii. Originality: a brief description (up to 1,000 words) of the main results envisioned in relation to the state-of-the-art in the electric power sector.

iv. Applicability: a brief description (up to 1,000 words) of the scope of the main product or process change proposed and its adherence to the firm's existing markets and strategy;

v. Required Investments: a brief description (up to 1,000 words) of the main investments envisioned for transforming the idea into a full-fledged innovation project; the authors are invited to think in all kinds of investments, not only in terms of financial resources.

vi. Required Costs: a brief description (up to 1,000 words) of the main operational costs that will be required by the project and, later, by the innovation after it is implemented.

vii. Benefits: the authors must describe, in short form (up to 1,000 words), the main potential benefits they estimate according to five categories: financial, environmental, social, intangibles, and complementary benefits in other projects.

viii. Attached Files: the authors can complement their proposal with .pdf files.

If an innovation proposal is approved after the evaluation stage, it becomes an innovation project. A project requires further additional information in order to monitor its implementation. The information to be entered by the proponents into the system when an innovation proposal is approved, becoming a project, is the following:

i. Leader and team members;

ii. Initial and Finish date;

iii. Number of landmarks;

iv. Description, detailing, deadline and percentage of project progress associated to each landmark;

v. Approved budget;

vi. Free comments concerning landmarks or budget.

Evaluation Process

Three evaluators independently evaluate each idea or innovation proposal. The evaluators' initial interface shows all the ideas or innovation proposals available to that particular evaluator. The list shows how many evaluators already assessed each idea or proposal. Clicking on the idea or proposal opens up the evaluation interface.

For an idea/proposal to advance through the stages in the system, three evaluators must positively evaluate it at each stage. The first evaluator assesses the idea with no collaboration from colleagues. The system allows the second evaluator to see the scores attributed by the first referee, but not to change it. Similarly, the third evaluator can also view the scores given by the other two, and is responsible for finalizing the evaluation process. Each evaluator can modify and complete his evaluation at any time, creating a collaborative process to enhance the judgment process. The evaluation process follows a partial blind review method, that is, each reviewer can see the others' evaluations, but not their identities. There is also a comment's section at the bottom of the interface for the referees to exchange comments and questions. Thus, the evaluation interface for the evaluators is based on forums layout. The forum design allows a collaborative evaluation process: each reviewer can ask questions such as 'why did you think this idea has such a high technical viability?' or 'do you really believe this idea is so worthwhile?'

Figure 4 shows part of the evaluator interface for innovation ideas. The idea is evaluated according to seven categories: technical viability, direct financial returns, environmental returns, social returns, complementary benefits in other projects, other intangible returns, and alignment with the firm's strategy. The evaluation uses a seven point Likert-like scale, ranging from 1.0 (very low) to 5.0 (very high).

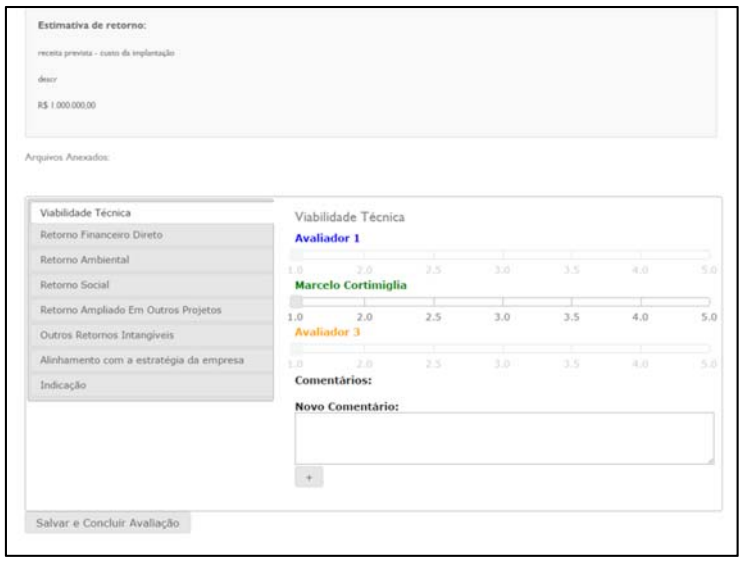

Figure 4: Partial view of the idea evaluation form

The evaluation of innovation proposals follows the same steps and general structure. However, as the innovation proposals contain richer information than the simpler innovation idea form, it is possible to employ a quantitative return of investment appraisal to guide the selection of the proposals to be implemented. This appraisal is performed in monetary units considering the details provided in the innovation proposal. Thus, instead of assessing scores in a 7 point scale, referees evaluate each item on a financial scale; for each item (e.g., total investment, operational costs, direct financial benefits, etc.), the evaluator assesses a most probable minimum value and a most probable maximum value. Using the most probable financial impact as evaluation measure reduces the complexity of the evaluation process, since all referees quantify the investments and benefits and their associated uncertainties, thus providing an economic-probabilistic analysis of the expected returns for each innovation proposal. Thus, it becomes easier to compare and prioritize the proposals. Moreover, as the system calculates the most probable costs and investments required by each proposal, the prioritization mechanism can be set against restrictions such as the estimated budget for innovation projects for the next period. Figure 5 shows a partial view of the innovation proposal evaluation form.

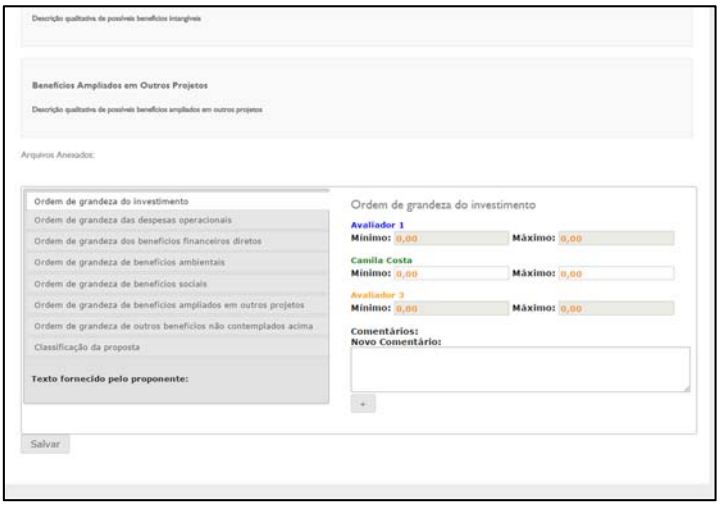

Figure 5: Partial view of the innovation proposal evaluation form

SOFTWARE DEVELOPMENT

The application has been designed based on the set of requirements defined by CEEE-D with the help of business analysts. The requirement elicitation was part of an action research conducted in the company that aimed at, first, developing a conceptual innovation management system based on a generic innovation process and a set of elements that support, facilitate, or drive innovation (Wong & Chin, 2007).

The demand for work at the studied electrical utility company is reportedly very high. Employees were not willing to incorporate new tasks to their already overloaded work routines. Based on that reality, the main goal of the software is to provide an easy and friendly way to obtain and retain employee's ideas with minimal user interaction. Thus, it may be also to foster creativity and idea generation, as one of the barriers for effective collaboration (time spent using the tools to register the ideas) is partially removed.

With that concern in mind, a minimalist interface design was developed with a simple and easy way to collect the proposals. The software interaction was inspired by a board game, as proposals must advance through the steps of the game to be implemented into projects. The system allows idea submission by single individuals or groups, and fosters open innovation by allowing external participants to collaborate with innovation proposals or even submit proposals themselves.

Although the default innovation process has three stages to be completed, it must be able to deal with more than one call for innovation at a time and calls having more than three stages. Thus, it can be assured to the utility that they will not be constrained by pre-defined innovation processes. Considering this requirement, we created a system that can deal with different stages sequences on multiple calls. Each call for innovations in the system is called as Contract. A Contract object is made of one or more Stages hierarchically linked. A Stage has a previously Stage (father) forming a tree of stages. A Stage has a collection of Items associated to it. Each item receives values from the end users (employees) and is evaluated by the evaluators. The evaluation rules can also be customized. As currently configured, each end user can submit more than one proposal to any call, but this aspect can be customized in the Contract rules. An idea or proposal follows through stages until it is fully approved and becomes a project, or is rejected and placed in storage for future reference. A simplified database diagram that describes the core of the system is shown in Figure 6.

The Model-View Controller (MVC) pattern is a way of ordering an application into three distinct components; the Model, the View, and the Controller (Dass, 2013; Jacobson, 2000; Rosenberg and Scott, 2000; Mukhtar, 2004). The system was developed using the MVC approach with Microsoft C# programming Language in a .NET environment. The MVC is suitable for separating domain modelling, presentation, and actions based on user input into three separate but complementary classes. The model manages the behaviour and data of the application domain, responds to requests for information about its state, and reacts to instructions to change state. The view manages the information display, including the output of interactive actions. The controller reads the inputs from the user, informing the model and/or the view to change as appropriate. The separation between view and controller is secondary in many rich-client applications. In Web applications, the separation between view and controller is very well defined and absolutely necessary for the development of agile systems.

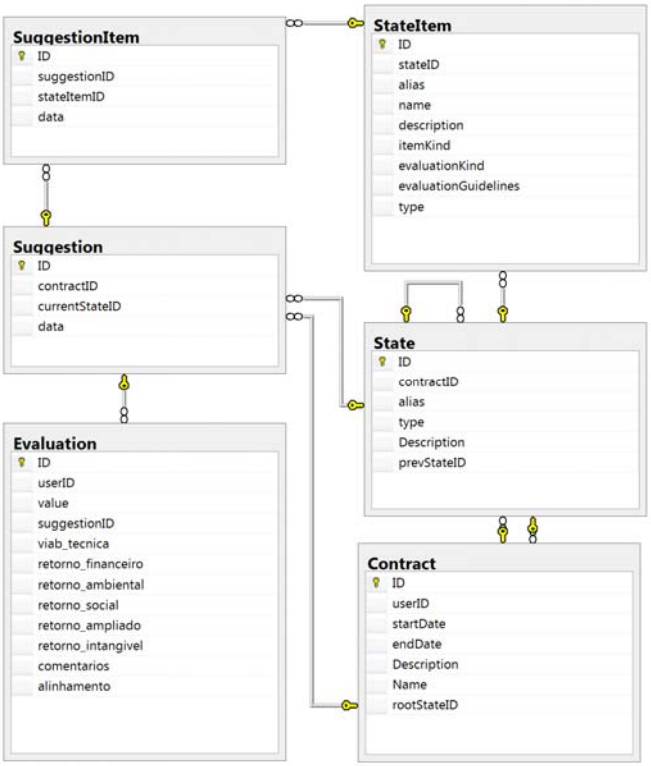

Figure 6: Database diagram

To provide a better user experience, we use AJAX (collection of interrelated Web development techniques used on the client-side to create asynchronous Web applications) to enhance communication between view and the model layers. The user interface uses HTML with Razor engine, CSS and Javascript with elements from JQuery UI.

CONCLUSIONS

The research reported in this paper is still ongoing. The system is ready, tested and validated by the company, but has not been implemented yet. Thus, there are still limited results regarding the actual usage of the system or the rate of adoption and diffusion throughout the company. Currently, the system is in the initial deployment phase on the Companhia Estadual de Distribuição de Energia Elétrica (CEEE-D), an electric utility company. The informal and subjective perception from the test and validation stages shows that the notion of ideas being evaluated together by a team of evaluators was well accepted and provide fair and reliable results. The whole assessment environment using asynchronous communication mechanisms (comprising a forum, with further interactive tools being implemented) was initially well accepted by users. Similarly, the idea submission form was considered simple to use by all who submitted ideas in the pilot call. The next steps in the research project include further development of the process of monitoring the progress of projects in a more detailed way, a further elaboration of a knowledge repository to support ideation and idea/innovation proposal elaboration, including a retrieval system for ideas (approved or not) allowing search by keywords, topics, type of innovation or authors, as well as a mechanism to manage documentation linked to ideas and innovation proposals.

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