LIVING LAB: a proposal for a collaborative network for open innovation between University and High School

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Abstract
The Living Lab model and the concepts of BPM and OM were used as reference for designing a collaborative network between college and high school. The focus is to help spread scientific thinking and knowledge building through ICT, innovating the relationship among students and teachers, broadening ideas and shortening distances.

Key words: ICT, BPM, Living Lab and Governance

Introduction
Brazil occupies the 57th among 65 countries in the 2012 Programme for International Student Assessment (PISA), an international survey that evaluates education systems worldwide by testing the skills and knowledge of 15-year-old students (OECD, 2012). This work aims to contribute to changing this scenario. The Living Lab model was used to guide us to conceptualize a collaborative network between a college and a high school. Our initial focus is to spread scientific thinking and knowledge building through innovation in the relationship among students and teachers from both institutions. The importance of this research is justified by the local context, there are several high schools separated by a long distance from large urban centers, where colleges are, these students have few opportunities to share and exchange experiences with higher education. The Information Technology and Communications (ICT) is used as a tool to shorten distances and as a facilitator. The concepts of Business Process Management (BPM) were taken as a basis for structuring the collaborative network and its processes and it was designed in conjunction with members of the high school. We also discuss the challenges ahead for the implementation and also the desire to expand the network to other schools. The research started from the assumption that the exchange of information between students and teachers in solidarity and cooperation can promote the construction of knowledge in an innovative way. In fact, it is a viable option to leverage the Brazilian education fostering students learning from their context and needs and not imposing ready models, currently has proved that are inefficient. We believe that Living Lab may constitute an important mean to open up new possibilities in the development of students’ thinking. This paper is structured as follows: social context, methodology, theoretical reference, the living lab design and final considerations.

Social Context
To understand the relevance of this project we present some of our field’s characteristics such as geographical, social and the high school and college environment.
The state of Tocantins was created in 1988, has 277,620 km² and it represents 3.26 % of the national territory and 7.2 % of Northern Brazil. Tocantins is part of the largest Brazilian socio-geographic division called Amazônia Legal (Legal Amazon) - it was created in 1948 based on studies of the Brazilian government on how to plan the economic and social development of the Amazon region; and the state has approximately 97.9 % of the total area in this region (TO 2012). Palmas is the state capital with 235,000 inhabitants and the entire state has population of 1,383,445 residents, spread over 139 municipalities with a population density of 4.98 pop /Km² (IBGE, 2010).

The college, Centro Universitário Luterano de Palmas (CEULP), began his teaching activities in Palmas more than 20 years, pioneering in the State. Currently offers 18 undergraduate programs in biological and health sciences, engineering, humanities and social sciences and also provides three technology courses, having about 4,500 students. CEULP cares not only with cultural, scientific and technological knowledge but also in forming individuals committed to research aimed at the social development. It is an institution that believes that through research can trace the origins of scientific knowledge, as established truths are tested, expanded the frontiers of knowledge, new applications are discovered knowledge, improves the process of teaching and learning. To this end, teachers and students receive incentives to develop researches, through the Program for Scientific and Technological Initiation (PROICT) and grants for young researchers under continuous guidance of teachers.

The Colégio Estadual Professora Ranulfa (CEPR) is a public high school located in “Aurora do Tocantins”, about 310 miles (500km – 7 hour by car) from Palmas, founded in 1981 and has a staff of 16 teachers and 453 students. The CEPR has excelled in the region for its role in the community and also at the state level. In 2011, it was one of the winning schools Tocantins Sustainable Award, a project created by Redesat (mass midia business), in partnership with the State Department of Education (Seduc), which aims to reward sustainability actions undertaken by school units of Tocantins. CEPR was recognized for his environmental protection and rehabilitation project: Azuis River "Let me run free and clean".

There are several high schools, as CEPR, which are separated by a large geographical distance from large urban centers and have few opportunities to share and exchange experiences with schools of higher education. The collaborative network will be built from the partnership of CEULP and CEPR, it is a pioneering initiative that can contribute to develop the scientific thought in high school; close the Academy to the local needs; innovate the interinstitutional relationship and collaboration among their students and teachers; and also, contribute to the regional development. Furthermore, in the city of Aurora do Tocantins is located in the "Rio Azuis", considered one of the two shortest rivers in the world. The prime localization in a conservation area of cerrado strengthens CEPR as a focal point, as proposed by this project, for debating issues of environmental conservation in the community, adding to the current preservationists trend - to examine the question of protected natural areas under the focus of inclusion of human action - and also through institutional dialogue as social interaction and opportunities for sustainable development of the local economy.

In Brazil, the conservation units began to form in 1937 by federal government initiative. Today, the country has several of these units (3.7% of the territory with restrictive federal conservation units), many others were also created by the State initiative. The Brazilian Constitution opens spaces to the population participation and acting on the conservation and environmental protection, imposing as the collective duty defend the environment and placing a fundamental right of all Brazilian citizens, the environmental protection. However, around the conservation areas in Tocantins is characterized by poverty and low levels of
human and economic development. It also indicated dissociation between general policies and local needs. Not only the subject (including government planners) is actively participating in society, as they intend to know it in order to transform to better. This engagement of the social actor prevents severe distinction between subject and object: the indeterminate and uncertain nature of the social game precludes claims of knowledge objectivity of, since the meaning of social action is inseparable from its context or situation (Matus 2005). Matus argues that it is necessary to transcend the economic level, since social reality is more complex, and, for being indefinite and uncertain, must distillate from linear and mechanistic principles of neoclassical models, explaining in part the failure of generic models. For him, the logic of public policy can not be reduced to microeconomic approach in which consumers and producers set prices, good and services quantities in situations of balance. Even though the social actors have a purposes driven behavior; their internal motivation can not be disregarded.

Hence the need to study the community attempts to understand their movements and leverage from ICT mechanisms, their cultural practices. This project is justified in that it seeks to promote the rescue and sense of belonging, leading the subject to become protagonists of their own history, so that the empowerment by local community actions leading to territorial development, not getting to the mercy of exogenous movements. This project assumes create / promote this empowerment through education, helping to build future generations with greater capacity for critical analysis and who value local culture and potential of their region.

**Methodology**

Following the guidelines of Collis and Hussey (2003), this is an applied research toward practical purposes in order to operationalize a collaborative network, in the Living Lab format, between a high school and a college. This is a qualitative and exploratory study, which has used as a work process the analysis of use examples of Living Labs and bibliographies about the theme. During the field research we visited and interviewed persons ob both schools and kept direct and indirect (electronic) contact, in order to develop our Living Lab process.

The literature review was used to explore the subject and outline the work. We adopted the Yin’s (2010) case study approach to structure a research protocol involving the following steps:

- Step 1: survey and acquaintance of CEPR students and professors interests and needs;
- Step 2: structuring processes for deploying a network where high school students post their ideas, questions and projects collaboratively;
- Step 3: survey teachers and students about how should be the process to keep the group motivated in research and innovation.
- Step 4: promote discussions of approached elements, aiming the group experience in the integration of theory with practice, so that the proposed process can be improved.

The case study was useful to identify relevant processes for the operation and structuring the documentation of the different stages of the implementation process. So it can be applied as a reference for current and future network actors (schools, government, businesses etc.).

**Theoretical references**

The main theories explored in this study were: Innovation, as the project aims to innovate the thinking development and the research doing, and besides we want to create an environment
Innovation and Open Innovation

According to the OECD, innovation is the implementation of a product (good or service) new or significantly improved, or a process, or a new marketing method, or a new organizational method in business practices, in the organization of the workplace or in external relations (OECD, 2005). Currently with the advances in technology and increased competition we use more the concept of Open Innovation, which is the deliberate use of internal and external flows of knowledge to accelerate internal innovation, and expand the knowledge and markets through innovation. The paradigm of open innovation is that firms can and should use internal and external ideas, internal and external routes to grub new market and seek opportunities for use of technological advances (Chesbrough, Vanhaverbeke, West, 2008).

For the collaboration dynamics that results in innovation, Sakamoto (2011) has evidence that it is directly associated with the network's role in the community, when the network's goals are not restricted to individual wills, but when are targeted the community welfare. Thus, this argument supports the choice for Living Lab approach for the community empowerment.

Corporate and Information Technology Governance

Corporate governance concept is associated with a structure that allows the organization establish goals, so that enables monitoring and conducting their performance, to ensure the safety of their stakeholders. The OECD (2004) updated the principles of corporate governance which covers the following areas: I) Ensuring the basis for an effective corporate governance framework and II) The rights of shareholders and key ownership functions; III) The equitable treatment of shareholders; IV) The role of stakeholders; V) Disclosure and transparency, and VI) The Responsibilities of the board.

Within this context, Weil and Ross (2006) propose a framework linking corporate and IT governance. In this framework the authors reports the importance of a committee that articulates the strategy and desired behaviors to achieve the goals and generate business value. Internal teams are responsible for managing the use of the six proposed assets: human, financial, physical, intellectual, and relationship information. out of excellence in financial and corporate governance, where desirable behaviors are monitored and encouraged, the authors define: "IT Governance: the specification of decision rights and framework of responsibilities to encourage desirable behavior in using IT".

Business Process Management (Business Process Management)

The business process management is based on the observation that each of the products that a company offers to the market is the result of a series of activities. Business processes are the main tools for organizing activities and to improve the understanding of their interrelationships (Krajewski, 2009).

Information technology (IT) has great prominence among the business processes, because the activities that a company performs are supported by information systems. There are business processes that can be executed by employees manually or with the help of an information system, and there are also activities in business processes that do not require human intervention, activities can be done automatically by information systems (Weske, 2007).
Mapped processes can be improved if analysed and implemented effectively, as the improvement is in the culture, the control and monitoring tasks that identifies opportunities for adjustments, collect good practices and correct possible faults affecting the performance they became part of the daily routine (Krajeseswki, 2009). In a systemic approach, the process mapping and managing enables the documentation and detailed understanding of how work is performed and how it can be redesigned and adjusted to the changes imposed by the environment.

For this project we adopted the Benedete Jr (2007) proposal that tailored Krajeseswki’s (2009) model to the context of IT use. Therefore BPM for our Living Lab is composed of: defining objectives, process model, execution, evaluate processes, optimize processes and then start the cycle again with new objectives and so on.

By adopting BPM as a tool for managing the process lifecycle and support the network needs, it enables those involved evaluate and adjust strategies and improve their operations, share knowledge and cooperate to guarantee the results. The expected benefits by adopting BPM for this project are: a) to identify and eliminate redundancies and bottlenecks; b) reduce and mange risks; c) separate integration logic from IT implementation; d) enhance portability and to reduce the maintenance cost; processes automation, reducing manual tasks; e) to compare the outcome with performance indicators; f) identify potential process improvements; g) enable audit, controls and verification mechanisms (compliance); and, h) to simplify the processes exceptions management, which usually are not documented and thus may not have standard solution.

Living Lab

According to Santoro and Conte (2009), the Living Lab is a tool for catalyzing the synergy of collaborative networks, virtual communities of professionals in the public and private sectors, which has proven to be a powerful tool for user engagement at all stages of the innovation process, from research to product development. The concept of "Living Lab" is used to name spaces designed to promote and foster an environment for open innovation, from the context of daily reality, fully integrated in the process of co-creation of new services, products and infrastructure in harmony with the social context.

Ståhlbröst (2008, p. 32) states that "the primary goal of Living Lab environments is to enhance and stimulate cooperation and innovation in research and development activities". Thus, one can have greater product or service development, because Living Labs seeks to "facilitate the users to gain deep understanding of how a new product or service will function and correlate to their context based on their own lived experience... from a technology driven approach can be reduced in favor of the user-centered approach aiming to consider users’ needs and desires in every development phase" (STÅHLBRÖST 2008, p.32). This is achieved because Living Lab promotes a collaborative environment where users can put their ideas and new projects and proposals for study.

To the definitions and uses of Living Lab, we associate the concept of Vygotsky’s (1991) Zone of Proximal Development where the pedagogical strategies are driven by the social relationship, so the learning is directed to the students and not to the content to be learned. The Living Lab shall be a channel that opens up the new ways of knowing and thinking from different actors and with interaction possibilities which arise from inter-reference. The idea is that our Living Lab would be a open space that allows the learning building based on ICT evolution and increments in group and process maturity. And besides, the dream of a democratic space that enable the participation and collaboration of any stakeholders, regardless of geographic location, language or race, where everyone is united in the pro
collective cause of knowledge building (education in remote location) and the improvement of living conditions of underprivileged communities.

To implement a solid infrastructure of our Living Lab in high school is the seed that we are cultivating for achieving a solid ground that enables us to develop and cultivate the dreamed environment, culminating with learning, innovation and co-creation among their students, teachers and other agents.

**Our Living Lab Design**

The project is divided into three iterative phases (see figure 1) that can be executed in parallel. The first is the project infrastructure setting, which involves the preparation of the Living Lab, training and the processes definition and how the network will operate (steering committee).

![Figure 1. Project iterative cycle (Source: Authors)](image)

The second phase involves the development of a research program enabling the project continuity. The last step will be focused on continuous data analysis and processes validation for the preparation of improvements acts to each iterative cycle.

We take as a starting point for the structuring our Living Lab the Ståhlbröst’s work (2008), as we present their elements we will instantiating to our reality. The Living Lab has four elements: participation and context; services, methodology, and infrastructure.

**Participation and Context** - Participation and Context - Involves all stakeholders in a multi-contextual sphere Promoting interaction among actors in their own context. In our case the focus is the interaction between CEULP and CEPR. The high school CEPR has shown as an active agent in this collaborative process, all ideas are used in a participatory manner through three professors motived to awaken the scientific interest in nine students. The school made available the structure of laboratories and a teachers to meet the communication needs with the university. Its structure also allows work out experiments and share them among students and researchers from the College (CEULP).

**Services** – For the proposed Living Lab environment, the following services are planned:

* Synchronous communication: similar to a chat allows both sides to exchange information with each other, directly and instantaneously, ie, there is no waiting for response from any of the parties.

* Asynchronous Communication: existing two models for such communication, the first is similar to a discussion forum, which is left a question, doubt or an idea to share, so that others within the context may leave their contributions. However, there is no time set for the response. The other model may be based on email tool, where the communicator is contacted with a particular group or individual to exchange information without the need for an instantaneous response.
* Files Repository: creating a network location (Cloud Computing) where the files can be used in a shared manner, stored and accessed by Living Lab’s authorized participants.

**Methodology** - To begin our operations we devised an iterative project, a priori bimonthly, based on the students groups formation coordinated by two professors (one from CEULP and other from CEPR) to promote teacher-student interaction in pursuit of common interests and sow the first seeds build the Vygotsky’s zones of proximal development. According to previous survey, the group has a special interest in regional development and environmental issues (see Figure 2).

![Iterative Cycle](image)

**Figure 2 – Iterative Cycle (Source: Authors)**

Step 1: all members will study the research subject, with face-to-face workshops for group integration;

Step 2: Each group works the chosen theoretical framework and specific interest topics, which may involve the field visit - initially the idea is to do exploratory visits to progressively direct to a guided field research;

Step 3: will be reserved for building process, driven by interaction and learning, and involves field practices defined by each group;

Step 4: the group meeting to reflect about best practices, areas for improvement, how to share knowledge, formalize their developments and also discuss planning for the next cycle. Involves detail the process of interaction evolution and learning, the tools used, lessons learned, analyze data, generate research reports, prepare divulgation materials, peer review and nest cycle planning.

This approach also includes the project phases (see figure 1) in an interactive way, indeed the BPM and our Governance policies will close the iterative cycle, indeed is expected to establish an innovative process of knowledge management. Thus builds up a space to promote discussion of the elements addressed collaboratively in the pursuit of integrating theory with practice.

**Infrastructure** – The basic hardware for the proposed Living Lab is a laboratory with a minimum of five computers with access to the upper 512kbps internet, web cam and microphone for video calls, a notebook when needed to field work, a multifunctional printer and a digital camera that will be used as support resources. Our governance policies are based on Weil and Ross (2006) IT Governance framework associated with Kåreborn Bergvall et al (2009) research and established the need for:

- A routine for the acquisition and maintenance of IT equipment and services;
• Organize and conduct training courses for all participants in the Living Lab to take best advantage of available IT resources.
• Design information security policy, since it will work with possible creation of technologies that can be patented.
• Establish a policy for the management of intellectual property - the knowledge produced in common can be worked in scientific publications and presented at scientific meetings and in specialized publications with their credits to everyone who co-created this knowledge. Any products that emerge from this process will have its registered and shared among its co-creators and patent participating institutions. Thus, all network participants feel safe to present their ideas and develop them in partnership because they will know that their potential will be fully recognized and valued.
• Human capital - the relationships will develop in the Living Lab environment, a community comes together in pursuit of a common purpose, tend to close and collaborate to achieve their goal. There will be cases of partners and network users, even with common features but with differing ideas, these are seen and respected as elements that can help co-construct knowledge. Living Lab is a hybrid space where new ideas come from a variety of different actors who are directly involved in the issue. Partnerships with other research centers will be encouraged to expand networking with research funding institutions, so they can put their projects into practice and get a real result of innovation processes; otherwise they would be hidden only in good will of their teachers.

The key principles and critical success factors
The use of BPM to align our strategy in accordance with stakeholder needs, presenting as an optimization process that allows us to obtain analytical tools to information and communication process. In fact the Living Lab environment offers a proper support to facilitate new forms of collaboration and innovation co-creation among stakeholders. The Living Lab, as proposed, provides forms to the scientific and technological development in the interaction between University and high school, according to the following principles:

• Continuity: to strengthen creativity and innovation based on trust, it is something that can take time to develop. The structuring an environment that is proposed to be permanent offers subsidies for the project participants understand how to cheer themselves to ongoing expand their presence on the network with their ideas, proposals and challenges.
• Openness: The process of open innovation should be working together with the various perspectives and bringing enough energy to reach the goal. The open process also does its best to support the innovation directed by users, regardless of whom they are and where they are physically located.
• Realism: this principle is observed when is perceived how real can the Living Lab became, because it is focused on real communities situations and their behavior, which is precisely what differentiates the Living Lab for other forms of co-creation.
• Training: the Living Lab, as proposed, provides way to give a direction to the projects developed based on the needs and desires of the members, creating a motivating environment to enable users to participate in this process.
• Spontaneity: to succeed with innovations, it is important to inspire the use of Living Lab environment and meeting the personal needs so that together these two factors contribute to and fit the needs of society, demonstrating the importance of having the ability to detect and analyze the users’ ideas over time.
Some critical success factors are necessary to verify the actual Living Lab capability, if it is appropriately and continually assessed. So, to evaluate the proposed Living Lab is required to be based on some points that should be periodically checked:

- **Generating results** - success will be measured by three indicators known as 3Ps (Ståhlbröst, 2008):
  - Publications: number of publications accepted;
  - Patents: number of patents registered;
  - Products: number of products and services that reach the market.

- **Collaboration** - monitor how cooperation occurs and how the ideas are combined among stakeholders are an important measure for success analysis.

- **“Multicontextuality”** - Another key success factor is the context. The introduction of an environment with multiple and different dimensions, users can contribute, evaluate and be evaluated in real situations. This perspective takes user participation to a new level that implies their performance in various contexts which eventually mixed. The actors acting with comments, suggestions and other productions that demonstrate their integration in different domains indicates the existence of an environment favors “multicontextuality”.

- **Sustainability** - To determine the long-term success, sustainability becomes an important indicator. In Living Lab sustainability can be measured considering the potential for creating permanent jobs, the possibility of inclusion and respect for diversity, and competitiveness.

- **Financial Resources** - availability of financial resources to ensure the project can be maintained.

**Final Considerations**

Through this study we observed the great potential of conducting a collaborative work among researchers (faculty and students) at CEULP and CEPR, when the institutions, professors and students are committed. The Living Lab implementation as proposed provides the elements (context, services, methodology and infrastructure) that will facilitate interaction between students, teachers and interested. The Living Lab serves as a means to facilitate information exchange and knowledge building, enabling one of its main objectives would be achieved that is to strengthen and stimulate cooperation and innovation in research and development activities. Thus, we can conclude that the proposal of a collaborative network through the Living Lab as presented here is an initiative that can contribute to the construction of scientific thought in high school and promote innovation in inter-institutional relations between students and teachers, promoting innovative ways of teaching and learning.

This research project focus was to understand Living Lab model and define the processes and a feasible way to make it operational. Some difficulties may be faced to implement the Living Lab as we proposed here, at first is the responsible profile for conducting this proposal. Since it involves human capital - researchers, teachers and students of both institutions - it is required a real interest and expertise to initially interact with the technologies involved, as well as should have creative and innovative potential to act in a co-creation. Second, the sponsors often can not afford or are not open to provide resources until the first results occur.

Other challenge is local difficulties with physical infrastructure and logistics, which involves hardware acquisition and maintenance; contracts for access, transmission and storage of data; control procedures for information security; maintaining a personnel structure to organize access to offered resources, among others. However, this difficulty can be overcome if
executives involved dispose of political will to see the potential described here and decide to bet on our Living Lab and seek external financial support.

The greatest challenge for students in the future would be the preparation for life outside of school, since the local job offers are limited in most of Tocantins. As the central idea of Living Lab environment is to facilitate the user participation in innovation processes, we have an innovation system that is human-centered, in contrast to the technology. What it is expected after the implementation of such proposal is that, besides contributing to fight the current Brazilian education pitfalls, students can expand their horizons through the act of researching and networking, envisioning new options and references for his future choices.

References


