KNOWLEDGE OBSERVATORIES: a case study

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Abstract

The promotion of sustainable development in the West of the State of Paraná, Brazil is approached by the Itaipu Technological Park (ITP) through educational programs, promotion of Science & Technology and social actions. In order to implement such actions, the ITP established the Expertise and Innovation Network (EIN) to identify and mobilize expertise in Brazil and abroad to support the development of the actions foreseen in the operational plan of the ITP. This article aims to describe the Knowledge Observatory that is being established to support the mobilization of skills and the coproduction of knowledge and innovation in the themes of water, energy, food and sustainable development. The Observatory aims at combining data from different sources in order to establish a cloud data bus on expertise, research groups and technical-scientific production in the areas of interest for the development of the territory, involving techniques for treatment of large volumes of data, treatment semantic information and information availability through knowledge services in the cloud.

Keywords
Observatory, Knowledge Observatory, Network of Expertise and Innovation, Intelligent Territories, Technology Parks.

1 Introduction

The discussion about intelligent territories is seen as strategical in the context of territorial development (LANDRY, 2000). In the information and knowledge society, territories have redefined their development strategies in creating a new concept of emerging territory in a

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society marked by innovation, knowledge and new information and communication technologies (FERNANDES, 2008).

As the world increasingly adopts advanced communication infrastructures and other information and communication technologies (ICTs), intelligent territories need to use methods in which technology could support data integration, decision support and knowledge coproduction involving various actors (FERNANDES, 2008).

The Expertise and Innovation Network (EIN) aims at supporting the actions of the Itaipú Technological Park in the development of the territory of the West of the State of Paraná, Brazil, mobilizing expertise and promoting actions of knowledge coproduction involving actors from the territory and national and international competencies.

EIN expects to create an inventory of expertise and skills to help map the human, relational and structural capital of the park and the external intellectual capital demanded to support the various ITP initiatives. In order to support this initiative, a knowledge observatory was set up to establish a data lake on actors, scientific-technological production and research groups related to water, energy, food production and sustainable development.

The observatory helps EIN by integrating data sources, providing accessible and reliable data and facilitating access to information and knowledge, as well as providing the means for coproducing knowledge and the development of multiple actions for the development of the territory (ORTEGA; DEL VALLE, 2010).

In this article we describe the elements that constitute the Network of Expertise and Innovation and the knowledge observatory that should support the actions of the Network.

2 The expertise and innovation network – EIN

The project entitled "Network of Expertise and Innovation (EIN)" was signed between the Itaipu Technological Park (ITP) and the Stela Institute and aims to support several initiatives foreseen in the ITP operational plan, as well as strategic challenges for Itaipu Binacional (IB) and the ITP itself involving the mobilization of expertise and the knowledge coproduction for the development of the territory.

The Itaipu Technological Park (ITP), created in 2003 by Itaipu Binacional, is an innovation environment and has the mission of promoting the sustained development of the territory where it is installed. The ITP is managed and operated by the Itaipu-Brasil Technological Park Foundation (FITP), created in 2005. The FITP is a civil non-profit organization, under private law, whose objective is:

"To maintain and operate the Itaipu Technological Park (ITP), contributing to regional development, in a sustained manner, through activities that foster institutional, scientific, technological and innovation development, knowledge diffusion, professional training, and generation of companies, employment and income, interacting with public and private, academic and research entities, for development and production." (FPTI, 2014).

The EIN project encompasses R&D actions that aims at establishing the bases of the technological infrastructure and its model of governance and operation. The project envisaged several activities to enable the start of operation of a network that will involve multiple actors in support of regional sustainable development and support to various initiatives foreseen in the strategic plan of the ITP.

For the EIN project, it was necessary to define a strategy for the knowledge coproduction by articulating competences in Science, Technology and Innovation (STI) in Brazil and abroad, facilitating the formation of clusters to promote innovation, the development of technologies and the development of educational actions in the territory around the themes prioritized in the operational plan of ITP.

In this context, both for ITP and for Itaipu, numerous opportunities and challenges related to Knowledge Management are presented, which, once addressed, can define tools of strategic impact to the management of knowledge and innovation processes and serve as instruments for the management of organizational intelligence referenced in the ITP strategic plan. Therefore, it is necessary to establish a strategy for collecting and organizing information from multiple sources of data and mechanisms to support the knowledge coproduction, which are addressed by the Knowledge Observatory.

3 Knowledge engineering

Knowledge Engineering has emerged from Artificial Intelligence as a subarea dedicated to the design, development and implementation of Knowledge Based Systems (SBC). In this period, defined as Classical Knowledge Engineering, experts extracted knowledge and transferred it to a computational knowledge base (STUDER; BENJAMINS; FANSEL, 1998). More recently, the new Knowledge Engineering has had its emphasis on the paradigm of knowledge modeling (SCHREIBER et. al., 2002).

Starting from the same object - knowledge as an intangible asset - Knowledge Engineering and Knowledge Management are differentiated by the way they are positioned in organizations. For Kendal and Creen (KENDAL; CREEN, 2006), the term "management" of Knowledge Management relates to the executive exercise and to the administrative and supervisory direction, while the term "engineering" is related to the act of constructing, inventing or planning. While Knowledge Management establishes a strategic vision for positioning organizational knowledge, the Knowledge Engineering designs and develops intelligent mechanisms (formal models and technologies) for information technology to align with that vision. In terms of products, Knowledge Management proposes Knowledge Management Systems (KMS) and Knowledge Based Systems (KBS).

According to Schreiber (SCHREIBER et. al., 2002), current knowledge engineering offers several benefits: it allows the identification of opportunities and bottlenecks in the way organizations create, distribute and apply their knowledge in order to provide tools for organizational knowledge management; provides methods for obtaining a complete understanding of structures and processes in the creation, distribution and application of knowledge, enabling a better integration of information technology and the use of knowledge; and, finally, enables the construction of knowledge systems that are easier to use, architecturally structured and simpler to maintain.

4 The knowledge observatory of the expertise and innovation network

Observatories originate in the knowledge society and represent the recognition that information and knowledge are the main vectors of political, cultural, social and economic development of the country, taking a central role in decision making (ORTEGA; DEL VALLE, 2010).

The integrative mission distinguishes the central role of observatories, which do not define public policies, but rather offer data and information to support decision-making on the part of those responsible (AMIN FILHO, 2010).

There is no consensus definition in the literature for the concept of Observatories, although in almost all studies it seeks to support strategic decision-making processes for an organization in different areas of value generation. Among these, one of the most relevant is that of organizational competencies, the main protagonist in the generation of value based on knowledge.

Observatory is a structure for the observation, systematization and diffusion of knowledge about the various aspects of the reality that it proposes to examine. They are known by the various types, according to actions they develop, methodology they employ, and the roles they perform (COSTA, 2008).

For Gusmão (2005), the main mission of an observatory is "to enable the aggregation, systematization and 'intelligent' and coordinated treatment of a huge range of data, from diverse sources (national and international), in order to ensure a greater degree of compatibility, complementarity and comparability between them".

Silva (2013) mention that the term “Observatory” has been used to designate three constructs: (i) organizational units (e.g. departments, centers) responsible for decision support; (ii) tools created to support decision-making, based on the demand to monitor actors (e.g. Platforms, Portals); and (iii) processes and mechanisms dedicated to the strategic analysis of information on several segments of economic activity. This distinction of outbreaks is the main reason for the difficulty of obtaining a definition of consensus on the term "Observatory", as Silva concluded in his study.

For Batista et al. (2017), the observatories have three types of mission that complement each other in the functions performed, including: (A): Analysis and studies to support decision making; (B) Sectoral Monitoring; (C) Knowledge Dissemination. It is important to note that there is an increasing relationship of increase of functions between types A to C. Type C is the observatory that has the most complete mission, that is, conducts studies and analyzes to support decision making (Type A), and has indicators and monitoring and monitoring systems (Type B), assuming the commitment of communication with interested stakeholders. Type B observatories carry out studies, analyzes and sectoral monitoring through indicators, while the

Type A conduct studies and analysis of potential use for decision makers. Through the definitions found in the literature that differ in the nature of the observatories and in the mission attributed to them, the definitions were classified as presented below.

Silva (2013) shows that the observatory concept is positioned around the following practices and aspects: information, data and knowledge; analysis, production and diffusion; coordination, integration and intermediation; debate, dialogue and consensus; education, construction and facilitation; technical, political and social; reference, excellence and innovation; idea, reflection and action.

However, observatories need to overcome the "repository syndrome", where it is limited to adopting a profile for recording, reproducing and storing information. It is important that observatories act as data lakes or databases, information and knowledge (SILVA; NETT; SELIG; 2013).

In this sense, the EIN knowledge observatory seeks to support the location and analysis of STI and innovation competencies within the scope of strategic themes to the strategic objectives of the ITP and of Itaipu Binacional.

In addition to articulating different sources of information, the observatory seeks to establish knowledge systems and services to support the knowledge coproduction involving multiple actors. The main elements that make up the technological platform are illustrated in Figure 1.

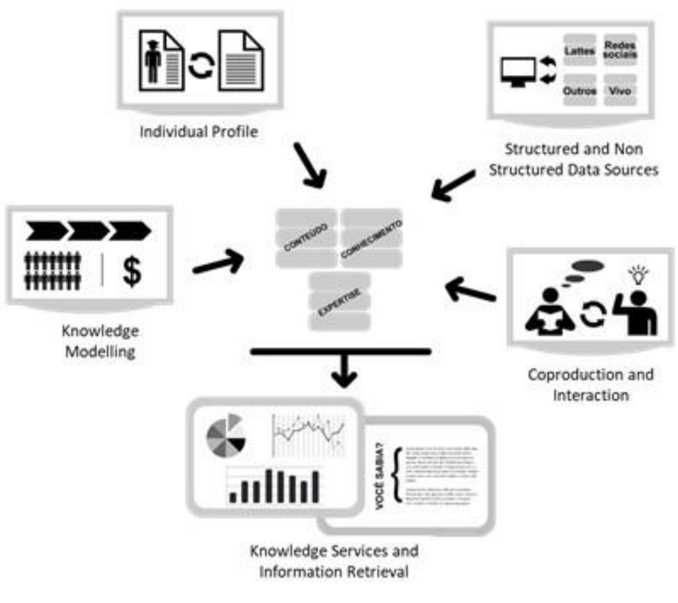

Fig. 1. Elements that integrate the technological platform of the observatory

The observatory data bus, the central element of the platform depicted in Figure 1, consisted of data from national science, technology and innovation bases, such as the curriculum base and research groups of the Lattes Platform, which gather information about more than 5 million academics and professionals related to STI Institutions and more than 46 thousand research groups registered in Brazil. In addition to these data, several data derived from ITP's project management systems and competences from international sources should be collected and structured around water, energy, food production and sustainable development.

One of the most important challenges for the generation of knowledge within the observatory is the understanding of the structure and behavior of complex networks of interactions between processes, humans and systems. However, the size and complexity of the data, from a variety of sources and in heterogeneous formats, requires a differentiated approach.

In order to fulfill these objectives, knowledge observatory projects must include knowledge engineering methodologies (SCHREIBER et al., 2002) and ontology engineering (GÓMEZ-PÉREZ; FERNANDEZ-LOPEZ; CORCHO, 2004); domain representation in the form of ontologies (i.e, shared representations of knowledge). While knowledge engineering offers observatory design ways to model knowledge systems, ontology engineering offers methods and tools to represent this knowledge, both at the domain and application level.

The Knowledge Engineering encompasses technical methods and technologies aimed at producing Knowledge Based Systems (KBS). KBS was developed for a specific solution and therefore did not have the necessary structure to enable scalability and maintenance and, consequently, the construction of large and / or complex systems. The KBSs were built focused on a specific problem and not on a generic solution method, which made it difficult to reuse the system and made it impossible to increase functionalities as organizations evolved and changed. Thus, although KBSs are efficient for what is proposed the commercial use of this type of system became unfeasible at the time of the first KBSs, precisely because of the lack of these characteristics mentioned above (SCHNEIDER, 2013).

In order to guide both the knowledge observatory project and the knowledge modeling and structuring of the knowledge systems that compose the observatory, the knowledge engineering process of the Stela Institute was also adopted, as described in (SCHNEIDER, 2013). Thus, the objective is to identify a problem of the complex environment to propose a viable solution for understanding the knowledge involved. Prior to this, it is important to present guiding principles for designing the strategic context for systems (SCHNEIDER, 2013). The method applied consists of four main steps:

- Step 1. Systemic representation of the problem: A process with the objective of representing, in a CESM model of Bunge (2003; 2004; 1997; 2000), the ecosystem to be supported by the knowledge observatory and the context of the problems and opportunities that involves creation of SBCs.

- Step 2. Representation of the organizational context: A process formed by sixteen tasks that aim to identify and represent the key elements of the organizational context that surrounds the SBC. This process generates the reference document for the SBC that is based on the CommonKADS methodology of (SCHREIBER et al., 2002).

- Step 3. Conceptualization of the elements: A process formed by three tasks. It aims to conceptualize the key elements identified in the context involving a knowledge-based system. This process generates the knowledge glossary of the SBC project.

- Step 4. Semantic representation of the strategic context: A process formed by eleven tasks. It aims to generate semantic representations of the strategic context of a SBC. It may generate artifacts such as an application domain ontology, context model supported by the knowledge glossary and conceptual context maps, and domain ontology.

The EIN observatory relies on an ontology covering water, energy, food and sustainable development. These themes were prioritized in actions to mobilize actors and the co-production of knowledge and were represented through the incorporation of taxonomies in engineering, sustainable development and green nexus. The ontology supplies the business terminology used to enable data sources annotation. Therefore, users will be able to explore information repositories by using business concepts instead of technical descriptions. Also, concepts described in the domain ontology supports semantic drill, slice and extraction of further details from data presented by search and analytical tools provided by the observatory.

The integration strategy, with the use of an ontology, allows the leveling of data associated with the same conceptual term, allowing the integration of several heterogeneous databases from different sources of information. Ontology enables the organization of structured and unstructured information to support knowledge extraction and decision support within EIN.

In addition to the integration of data with the support of an ontology, the observatory sought to create services for the registration of specialists, for co-production and for the location and analysis of expertise, research groups and scientific and technological production. All services are supported by the ontology of the platform, which in addition to supporting the marking of the contents inserted in the modules of the platform, enables the indexing and retrieval of information and the recommendation of contents according to the context in which the users of the observatory meet.

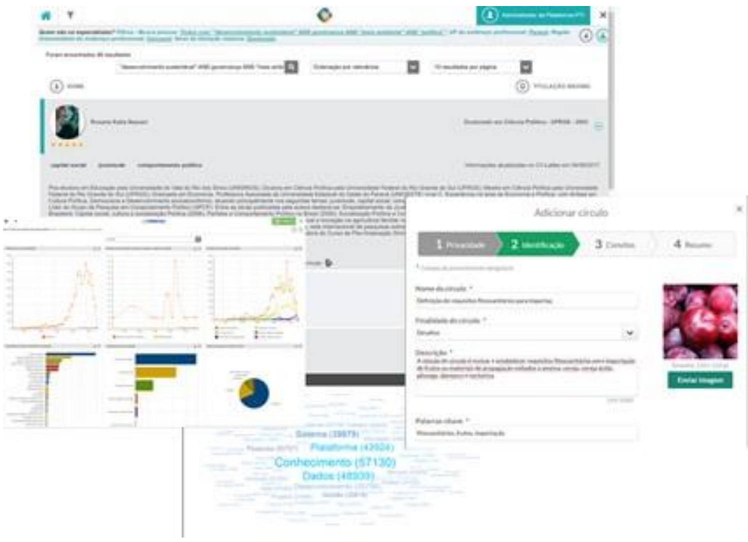

Fig. 2. Illustration of modules that integrate the EIN Observatory

Among the modules of the observatory, the coproduction module stands out. In this module, observatory users can describe missions involving the mobilization of competencies and receive recommendations from people, research groups, production and related content in order to mobilize the resources needed to accomplish the missions.

5 Final considerations

In this article, the initiative was presented for articulating an initiative to create the Network of Expertise and Innovation promoted by the Itaipú Technological Park. The EIN seeks to guide the development of knowledge coproduction action with a view to developing the territory of the West of the State of Paraná, Brazil.

Among the initiatives to promote the actions of co-production of knowledge, the network knowledge observatory was described in this article. The observatory came to support EIN in mapping and engaging expertises in education, technology development and other activities involving water, energy, food production and sustainable development.

Through the knowledge observatory EIN accesses the available knowledge, connects and locates people, contents and processes with intelligent assistance.

As a central element of the services provision strategy at the EIN observatory, an ontology is found. The observatory's ontology enables the semantic integration of the different data sources, the indexing and organization of the information and the support to the inferences of the information retrieval services, the production of indicators and recommendations in the different modules of the observatory.

The improvements on knowledge engineering and related technologies offer new approaches to tackle traditional issues in the context of decision making. Just as the Semantic Web provides agile ways and navigation interfaces based on high semantic expressiveness to locate relevant content on the Internet, analytical architectures should also make use of semantic to support the analytical processing. The knowledge observatory applies an ontology to support the exploration of a large set of content regarding the themes of interest of EIN.

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