COMPLEX NETWORKS AND KNOWLEDGE MANAGEMENT IN A COMPANY OF RESEARCH, DEVELOPMENT AND INNOVATION

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Abstract: This article highlights the agents involved in the research process, development and innovation in order to share knowledge and to record knowledgement regarding cane sugar. It seeks to evaluate alternatives for the knowledge management, considered the greatest asset of the organization. The proposal is based on existing theoretical framework on the main technologies of information and communication as support to managerial knowledge. It is created a discussion about how companies treat knowledge and propose a method to record knowledge.

Keywords: knowledge management, complex networks, technologies of information and communication

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1 Introduction

The current context of the corporate world and the society is characterized by the inherent complexity (SIMON, 1987; MORIN, 1997, CASTELLS, 1999; CAPRA, 2001) and it is affected by social and economic phenomena of global approach. In this sense, contemporary phenomenology becomes decisive restructuring of the business environment, with emphasis on the information technology impacts and communications in daily life of citizens and organizations.

The concepts of the complexity theory in opposition to the Cartesian principles of fragmentation of knowledge and dichotomy of the dualities and propose another way of thinking about contemporary problems (MORIN, 1991). According to Morin (1991, p. 123), the sum of knowledge of parts is not sufficient to know the properties of whole set, because the whole is greater than the sum of its parts. Also, when considering the whole, the wealth of qualities of the parts is not seen, because they become virtualized and inhibited, prevented from expressing itself in its fullness. Hence, the whole is less than the sum of its parts. The relationship of the parts with the whole is dynamic, so, the whole is, at the same time, smaller and bigger than the sum of the parts.

Radical or incremental technologies, embedded or emerging explain and disseminate knowledge of man in the timeline. The control of fire and the domestication of animals, for example, are demonstrations of human knowledge to solve problems on

behalf of its survival. Nowadays, ethanol, besides providing an alternative to a non-renewable natural resource, explains the innovative capacity of the world energy matrix and consistent biofuel knowledge.

Thus, it is presented that technology is related to the artifacts that were produced using the parameters of science and the advancement of human knowledge, leading to develop technological innovations that have revolutionized the world and revolutionize (GATTAZ SOBRINHO, 2001). The technology is, therefore, the fusion of art and science, and can be considered a means to design and create goods and services to meet the essential needs of mankind.

According to De Masi (2000), organizations of the Knowledge Society, especially those dealing with science and technology, are supported more in intangible assets than tangible and their survival is closely related to innovation. Similarly, organizational stocks are more intellectual than physical and privilege the collective or managerial intelligence rather than the individual intelligence. Regarding the last question, it is important that the organization create and deploy processes of generation, storage, management and dissemination of knowledge.

However, companies generally are investing in solutions before knowing exactly what their problems are (DAVENPORT, PRUSAK, 1998). This finding highlights the value of knowledge in decision making and focuses on the difference between data, information and knowledge. Applied knowledge reduces waste, queues and expenditures on technology initiatives, and improves the results of the decision process.

Davenport and Prusak (1998), by incorporating the notion of knowledge as a corporate asset, expand the concept beyond a tool for decision making. In knowledge management, all the knowledge in the enterprise belongs to the organization, and all collaborators who contribute to this system can make use of all the knowledge present in the organization.

Therefore, whether in the ethanol production chain, agribusiness or any other sector, knowledge emerges as a strategic value. As mentioned, for a long time, knowledge plays a fundamental role for people, but nowadays it has become more evident and determined to the survival and to the capacity to differentiation of individuals, companies and nations. The obsolescence of information and avoidance of intelligence routinely challenge companies and nations. It should be created mechanisms for protection of knowledge and control of skills evasion.

An organization of research and development in cane sugar, for example, is challenged daily, both with regard to the processes of genetic improvement as well as knowledge management. The same way as competitive urges optimization and reduction of time for launching a variety of cane sugar from 10 to 12 years to less than 8 years, this same organization must know how to organize and systematize, at all levels of contact, to have the ability to capture, generate, create, analyze, translate, transform, modeling, storing, disseminating, implementing and managing information, both internal and externally. This information must be effectively transformed into knowledge and making it accessible to those interested.

Therefore, it become evident that the acquisition and application of knowledge are steps in a process, in which only knowing is not enough, knowledge management is needed. After all, how to manage this knowledge? Why do the institutions of research, development and innovation are (more) likely to the knowledge management process?

While there are a number of documents, flowcharts, spreadsheets supporting/recording knowledge in a research way, there is a lack of a formal method to enable them to manage such knowledge with features of traceability, integrity, sharing, and security, among other. It is also noted that knowledge is not or is little widespread among the internal areas, whether for security of information, or lack of a sharing policy.

Knowledge, in a research way, can be interrupted, discontinued, or have a significant impact in relation to turnover of its researchers. In addition to these perceptions, some issues suggest the need for a formal method: Who knows the research and collaborates with its exponentiation? Is there the need for protection of a given search?

In case the search turns into a method, is there a way to commercialize this knowledge? There is the need to find a model where the premises raised by the issue are met: (i) centralized registry of knowledge; (ii) knowledge sharing; (iii) cooperation/collaboration among research agents; (iv) protection of knowledge and (v) dissemination/commercialization knowledge. Although it is very important the discovery of the method used to register a given search, the problem is somewhat more comprehensive. This is the Organizational Knowledge Management, where the process "Varietal Crossing" (CTC Breeding Program initial phase) is one of the knowledge of the Organization.

Given the above, the article seeks evidence about the correlation between knowledge management and agribusiness institutions, specifically in addressing the research in sugar cane culture applied to technological innovation. The objective of this study is to use the concepts of the complexity theory to turn Knowledge Management, by processes and register the knowledge with the use of a technological environment for process modeling.

2 THEORETICAL

Science, among them Computer Science, makes use of a series of models and technologies for guidance and assistance in identifying and solving problems. To support this work, will identify the main concepts of Management Knowledge, for through it is possible to manage the main asset of organizations, knowledge. Some aspects related to models of representation and reality and complex networks are also presented, used for sharing and cooperation in organizational knowledge management.

2.1 Boundaries and intersections between information and knowledge

Nonaka and Takeuchi (1997) consider that the process of building knowledge, unlike information, concerns beliefs and commitments and is primarily related to action, attitude and a specific intent. It is a human dynamic human process justifying personal belief regarding the truth. The organizational knowledge is tacit or explicit embedded and used in business processes, and produces, directly or indirectly competitive advantage to these organizations.

Davenport and Prusak (1998) emphasize that knowledge is a fluid mixture of condensed experience, values, contextual information and experienced insight, which provides a framework for evaluating and incorporating new experiences and information. It is originated from and is applied in the minds of experts. In organizations, it is embedded not only in documents or repositories, but also in routines, processes, practices and organizational policies.

Additionally, it is considered that knowledge exists within people, is part of human complexity and unpredictability. Knowledge derived from information in the same way information derives from data. Thus, knowledge is not a rigid structure that excludes what does not fit; it can deal with complexity in a complex way. This is one of the essential sources of its value. Although it is tempting to seek simple answers to complex problems and deal with uncertainties pretending they do not exist, usually we decide better by knowing more than by knowing less, although less may seem clearer and more defined. It is common to be both right and wrong at the same time (GATTAZ SOBRINHO, 2001).

2.2 Knowledge Management

Before conceptualizing Knowledge Management (KM), it is necessary historical rescue for right understanding of radical changes that occurred in the modes of production. We came from a society based on a craft production to an industrial society, and in the beginning of this century, with significant information and communication technologies (ICT); we are rapidly evolving into a knowledge society. The table below summarizes the evolutionary period of the late nineteenth century to the present day.

The creation and implementation of processes of generation, storage, management and dissemination of knowledge represent the latest challenge to be faced by companies. Knowledge management is not limited to processes business modeling, from generated knowledge. It means the structuring of organizational activities linked internal and externally, based on parameters generated by constant monitoring of the internal and external environment (market value chain, etc.). According to Alvarenga Neto (2008, p. 121), this ability to learn and renovate meanings subject to new ideas and propositions becomes the indelible "learning organization" and "intelligent organization." Senge (1990, p.37) apud Alvarenga Neto (2008), "learning organizations" are defined as:

> Organizations where people continually expand their capacity to create results they truly desire, where they stimulate new thought patterns and comprehensive, collective aspiration generates freedom and where people learn continually to learn together.

It proposes five vital disciplines of learning organizations, namely: (i) systems thinking, (ii) personal mastery, (iii) mental models, (iv) shared vision and (v) team learning. It is noteworthy that the author proposes in item (iv) the shared vision aligned with the organizational strategy. Another observation is necessary with respect to item (v), it deduces a holistic perspective, in which the whole is greater than the mere sum of its parts or the total (MORIN, 1991; SENGE, 1990 apud ALVARENGA NETO, 2008; CHOO, 2002 apud ALVARENGA NETO, 2008; GATTAZ SOBRINHO, 2011).

Davenport and Prusak (1998) propose a marketing perspective to knowledge, according to which people perform alternately the role of sellers, buyers and brokers of knowledge, and the types of payments are, in descending order of importance, reciprocity, reputation and altruism. There are some market signs that indicate where knowledge can be more present in the organization and how to obtain access to it: the position and formal education of people; informal networks between people; communities of practice of some kind of skill.

2.3 Competitive Intelligence

Aligned with the principles of modern Knowledge Management, subject on the so-called "Learning Organization" (SENGE, 1990 apud ALVARENGA NETO), coined the term Competitive Intelligence (CI). It is a systematic process that transforms scattered pieces of information in strategic organizational knowledge. This does not mean that companies are "competing" to develop knowledge.

The role of Competitive Intelligence facing complex context, dynamic, competitive and everchanging is consistent with WEICK (1985) apud Davenport and Prusak (1998), which recommends not rely on a single and indisputable data source, as this may give the organization a sense of omniscience, but single data source is likely to have unrecognized faults that lead to actions that are inconsistent with reality. In view of Gattaz Sobrinho (2001) the more clearly we can show the complexity of reality, more visible is problem, and hence, its solution.

The advantages in implementing a competitive intelligence process, from the viewpoint of Santos (2008) are: (i) to prepare the company to act rather than react to events in the market; (ii) to help the company capitalize with market opportunities; (iii) to allow the association of central efforts in competitive intelligence with operational aspects of information sources of managerial units; strategic business units and functional areas; (iv) to increase the understanding of executives as the company may acquire and maintain a competitive advantage.

2.4 Knowledge modeling technologies

When it comes to qualifying a problem it is needed to take into account that not every problem is susceptible to scientific treatment. This means that, to perform a search is necessary, first, to check if the problem is included into a science category. One problem is scientific when it involves variables that can be tested, observed, manipulated. A problem can be determined by practical reasons or intellectual order.

The market offers us a number of tools, techniques and technologies in which there will be investigated the necessary adherence of such tools to the needs of the problems.

2.4.1 Flowcharts

The process flowchart, according to Campos (1992) apud Pinho *et al*. (2007), is critical to the standardization and further understanding of the process. It facilitates the visualization and identification of the products produced, customers and internal and external suppliers of the process, roles, responsibilities and critical points. It is important at this stage, according to Ostrenga *et al*. (1993) apud Pinho *et al*. (2007),

verifying the multiplicity of paths in the workflow. If all the work just does not flow through the same path, it is important to document the points at which it can divide. It is also important to document the percentage of work flowing through each path.

A flowchart outlines the flow of information, people, equipment or materials through various parts of the process. Flowcharts are plotted with boxes containing a brief description of the process, and with lines and arrows show the sequence of the activities. The rectangle is the usual choice for a flowchart box, but other geometric shapes can differentiate types of activities. Flowchart can be created for several levels in the organization. For example, at the strategic level, they could show the main processes and their interactions. In this case, the flowchart would not have many details, but they would give an overview of the process. Figure 1 represents an exemplary of flowchart with some symbols most commonly used.

2.4.2 Entity Relationship Model

Among the languages of representation most commonly used by the industry, the Entity Relationship Model or ER is the most used. This model was originally proposed Peter Chen and despite all its problems has had great acceptance. This acceptance is due mainly to its characteristic of being a shallow model. It is used only three concepts (entity, relationship and attribute) (REZENDE, 2005; CYSNEIROS, LEITE, 1998).

The Entity Relationship Model (ERM) allows also a structured way to discern the entities, their attributes and relationships. Through this model, data-driven, it becomes possible the generation of tables in Database Management System (DBMS), responsible for the storage of data and information on a given problem. Figure 2 represents an exemplary of a ERM with some symbols most commonly used.

2.4.3 Essential Systems Analysis (ESA)

The expression Essential Analysis was proposed in 1984 by McMenamim and Palmer to reflect the introduction of new concepts that were being incorporated into the classical Structured Analysis. Essential Analysis is a technique that guides the systems analysis to the essence of the business to which it is addressed, regardless of informatics solutions that will be used in its construction, assuming that systems exist independently of computers, and are made aimed at a business opportunity. There are two models in Essential Analysis, called Essential Model and Implementation Model. The Essential Model presents the system in an abstraction level completely independent of technological restrictions. Before a system is implemented, it is necessary to know its true essence, no matter whether its implementation will be manual or automated, not even what kind of hardware or software will be used (REZENDE, 2005 p. 183).

2.4.4 Object-Oriented

According to Rezende (2005), Object-Oriented (OO) has changed the paradigm of structured Analysis. As a modeling method, it is considered the best strategy to eliminate the "semantic gap", recurring difficulty in the process of modeling the real world problem domain in a set of software components that is the most accurate in its representation of this domain. It would facilitate the professional modeler and the user of the target area communication, to the extent that the correlation of symbolism

and abstract concepts of the real world and modeling tool (concepts, terminology, symbols, graphics and strategies) were the most obvious, natural and accurately as possible. Figure 3 shows an example of object-oriented modeling.

2.4.5 Integrated Management Systems ERP

According to Souza Neto and Medeiros Junior (2008) in the 1990s, the reengineering processes were diffused, emphasizing the radical change of processes, focusing on comprehensive processes that roamed several functions in the company. To provide technological support and to justify reengineering projects, Integrated Management Systems were created, also called ERP (Enterprise Resource Planning). Integration can be seen from a functional perspective (systems of: finance, accounting, human resources, manufacturing, marketing, sales, purchasing, etc.), and from a systemic perspective (system transaction processing, management information systems, decision support systems, etc.). (REZENDE, 2005).

For Carrara (2011), ERPs are generally a software platform developed to integrate the various departments of a company, enabling the automation and storage of all business information. The Paradigm of functional structure of an organization, where each department is limited to solving business problems and challenges, lacks a systemic vision of the company. The departmental point of view limits the performance of the departments in an organization and prevents various departments to work together to achieve global objectives of the organization as a whole.

2.4.6 BPMN Process

Business Process Management Norms (BPMN) is a concept that combines business management and information technology focusing on optimizing the results of organizations by improving processes business. Methods, techniques and tools are used to analyze, model, publish, optimize and control processes involving human resources, applications, documents and other information sources.

The term 'operational processes' refers to the routine processes (repetitive) carried out by organizations in their daily life, as opposed to 'strategic decision processes', which are played by high-level management. BPM differs from business process redesign, a 90s popular approach to manage, whose approach was not revolutionary changes in business processes, but their continuous improvement.

Additionally, the tools called business process management (BPM systems) monitor the progress of cases in a quick and cheap way. Thus, managers can analyze and change processes based on actual data and not just by intuition. The company's high-level management can notice, for example, who is delaying (and how much is delaying) particular task, how often this occurs, the percentage of completed and ongoing processes, among others. As a result, crucial factors to the performance of the organization can be analyzed with extreme facility and speed, which usually does not occur with other tools rather than BPM.

According to Gonçalves (2000) apud Souza Neto and Medeiros Junior, (2008) a functional orientation emphasizes much more the division of tasks and optimizing the

functioning of each area, leading rigid and true organizational structures "black boxes" in each area hyper-specialized.

The emphasis in processes, moreover, enables a greater autonomy to the people participating in the process, they have their work facilitated once they receive tasks and must simply perform them without worrying with aspect, e.g., to where they should send them, once the process has been already designed and all possible situations are already registered. Additionally, individuals can realize how it was done and how is it status. The software responsible for the automation of these activities is called Business Process Management Suites (BPMS) (CARRARA, 2011; SOUZA NETO and MEDEIROS JUNIOR, 2008).

The process management emphasizes the sequence of activities that are performed, crossing departments and hierarchical levels, until the output of services and/or goods to meet the end users (applicant) or internal users (BIAZZI, 2007) apud (GATTAZ , 2010). It is, therefore, a fall in the functional management paradigm. The deployment of solutions and workflow tools were the first to be developed for this purpose and, subsequently, tools called BPMS (Business Process Management System) emerged with new features such as simulation and process monitoring managed, beyond simply monitoring of 'the trajectory of a process (CARRARA, 2011).

The idea is that the company may design, build, improve, analyze, simulate and control processes without technical details that make these activities slow and dependent on IT. The IT staff starts to respond more quickly to the business needs (SOUZA NETO and MEDEIROS JUNIOR, 2008). To meet the challenges for the IT department it was created a service-oriented architecture (SOA). SOA is an approach to develop IT systems that allows companies to easily leverage existing assets and allow the changes required to support the business (HURWITZ *et al.*, 2007 apud SOUZA NETO e MEDEIROS JUNIOR, 2008)

2.4.7 Complex Networks VBPMN

Current literature describes, formal or informally, graphics, activity, entity, event based on process and languages models, because is in the most recent process of "Business Process Management Notation" (BPMN), BPM language and systems, while no such literature conceptualizes process based on the value or the fundamentals and principles of complex theory (GATTAZ SOBRINHO *et al*., 2011).

Value Based Business Process Management Network Model (VBPMN) is a research methodology that adopts a qualitative approach with orientation to problem solving and generating knowledge for action, and develops a kind of research in which the theory is based practice (GATTAZ SOBRINHO *et al*., 2011). The VBPMN methodology provides methods, techniques and tools for the identification, characterization and simulation of the problems/real solutions, generating contextual processes useful in the practice of the companies. Gattaz Sobrinho (2001) defines process contextual as an intelligence expression of the reality to which compete three dimensions – management, structure and function – in the generation of added value required by reality. It is understood by added value what is incorporated into the product or service, giving it

the required quality, without necessarily increasing its price and contributes to improving the quality of human life.

With respect to the three dimensions, it is defined that the size of the management presents a set of rules that expresses the ethical, legal, technological, among others values that govern reality; the size of the structure encloses the behavior of resources that can be people, facilities, equipment, machines, software, financial capital and other items, required for the generation of value to add; and finally, the size of the function is what conducts the assignment of values required by reality over time (GATTAZ SOBRINHO, 2001).

These definitions extend the concept of process adopted by Davenport (1994); Harrington (1991) and (Hammer and Champy, 1994), which defines process as any activity or set of activities, arranged in a logical sequence, taking a input, adds value to it and provides an output to a specific customer. Although there are several conceptual differences observed in the theoretical aspects of the process, dimension is the main one.

The appearance of three dimensions - the management, structure and function - was an evolution of the use of the dimension function, since the latter is contained in the foregoing. It means that one of the three dimensions, specifically the function, is identical to the single dimension currently used by almost all areas of knowledge. This development has given to the VBPMN methodology the ability to meet new changing needs of companies toward the orientation of the process, such as those identified by Grover and Lee (2003) apud Gattaz Sobrinho *et al*., (2011) focused on knowledge management.

VBPMN methodology consists of three elements - PriMethod, PArchitect tool and a set of process principles that guide the use/application of this methodology. PriMethod, an English acronym of *Process Reality Intelligence Methodology*, presents the conceptual framework that leads the stages of design, development and simulation of contextual processes, with the objective of generating intelligence map of reality, see Figure 4. The environment, or tool, PArchitect, an English acronym of *Process Architect*, is the computational resource that enables the production of intelligence map of reality.

The principles of the process are used to help establish and recognize, from the reality, the characteristics of the problem to be shown in form of contextual process. Currently, there are twenty-two principles that must be followed and used to represent reality more faithfully. They contribute intensively to generate a culture that values creativity, sharing and use of individual and collective knowledge (GATTAZ SOBRINHO *et al*., 2011).

2.5 Intellectual property, patents and software registration

Gracio and Fadel (2010) apud Gandelman (2001, p.28) consider copyright a branch of legal science dealing with the immateriality, a characteristic of intellectual property. With the development of ICT (Information and Communication Technology), there is

also the need for the development of legal protection of intellectual works produced in digital format.

In a context in which persists and intensifies the tension between the increasing ability of knowledge coding and deepening the level of tacit knowledge and not codifiable, accumulated by individuals, companies and research institutions, the management of intangible assets takes over a strategic function. As a strategic function, intellectual property can be a bargain factor for access or opening specific markets, working as a ticket to "play the game" (TEECE, 1986; MELLO, 1995 apud CARVALHO, 2003).

Although there, is for decades in most countries, a variety of mechanisms for intellectual property protection, only in the '90s the topic began to be discussed more deeply in Brazil. This movement was caused by the latest revision of the General Agreement on Tariffs and Trade (GATT), known as the Uruguay round of GATT. This agreement includes, for the first time, the item intellectual property, part in the TRIPS (Trade Related Aspects of Intellectual Property Rights). As a result, there was the establishment of two laws - Nº 9279 of 14, May, 1996, known as the Patent Act, which regulates the rights and obligations relating to industrial property, and Nº 9456, of April 25, 1997, which regulates the Plant Variety Protection (Castro *et al*., 2002).

The National Institute of Industrial Property (INPI) is the Brazilian federal agency, created in 1970, under the Ministry of Development, Industry and Foreign Trade (MDIC). INPI is responsible to the traditional tasks of granting brands and patents, the responsibility for registration of contracts of technology transfer, later, by logging computer programs, contracts of business franchise, registration of industrial design and geographical indications.

Intellectual property is a topic of growing importance for the economy of the country and a channel of insertion in the international community. INPI is committed to making it an increasingly powerful tool in the industrial and technological policy. In this sense, it has deepened the process of modernization and decentralization of its activities. One of its main goals is to achieve a more active and dynamic performance with its customers, by focusing on innovation and meeting new demands.

3 Material and methods

The organization used as a research facility has knowledge as its highest value or capital. The tacit and explicit knowledge are the greatest assets of the Institution and may be recognized as inputs for research activities applied to a technological innovation or an improvement product, such as a the new variety of cane sugar with one or some of its features improved or reduced time to launch a new commercial range of cane sugar.

3.1 Methodology

The proposal is to use action research as a method capable of capturing reality and shape the managerial competence. The time horizon of the study is four years, from 2012 to 2016.

The design proposal includes the following steps:

- Interinstitutional technical cooperation protocol for transfer technology license PArchitect;
- Recognition of the problem by employing the Approach of Complex Problem Solving Oriented to Principles Process;
- Implementation of Mobilization Methodology for Civil Projects and Complex Networks, to promote the inclusion of stakeholders in the modeling process desired;
- Using PriMethod and adoption of the principles of the process, listed by Gattaz Sobrinho (2009) for enable the PArchitect technology in order to map the process employed in the initial phase of the CTC Breeding Program, called Varietal Crossing.
- Constitution of complex network for collaboration and sharing with the biofuel production chain, from cane sugar.

PArchitect is a technology that provides the record knowledge and enables the sharing of the research project through a network of cooperation between the departments of interest to the CTC (private coverage), and it can still share with other Institutions (public coverage), provided that the research project is registered with the INPI (National Institute of Intellectual Property) and authorized for sharing.

3.2 Characterization of the research subject

The Center of Sugarcane Technology (CTC) is a corporation dedicated to research, development and innovation that has taking part in technologies that allowed the evolution of the production and processing of sugar cane in Brazil for 40 years.

CTC is one of the protagonists of the process of expansion of sugar cane plantation and the rapid occupation of Brazilian new borders. The CTC Breeding Program of cane sugar is the most complete and comprehensive in the world.

4 Conclusions, expected results and future research

The core of the research lies in the register of a research project called "CTC Breeding Program - Phase 0 - Varietal Crossing" using PArchitect to obtain a model. The employed knowledge in obtaining a variety is not registrable, such as product patent or an intellectual property. The record knowledge is limited to publications in books, articles, papers and other internal applications. The current rules in Brazil do not protect the process of knowledge.

The expected result is not the register of variety, since this is already incorporated into the assets of the Organization through the law No. 9456, of April 25, 1997, which regulates the Plant Variety Protection, as seen in section 2.5 of this document. It is expected to map and register CTC knowledge to develop new varieties, through the use of VBPMN technology, which holds international recognition, presented in section 2.4.7 of this document. The tool responsible for the storage of business intelligence is the software PArchitect. After, the record of knowledge is looked for, registered in the PArchitect software, along the National Institute of Intellectual Property (INPI, 2012),

in order to provide legal certainty for business and protect the ownership of copyright and computer programs.

The protected and recorded knowledge is the expected result of this research. A range of knowledge forms the organizational intelligence. The value of modeling generates a license to use that intellectual property, which can be shared and traded. It is worth noting that the misuse of a registered knowledge fits into the law of piracy, due to its INPI registration. Therefore, the legal use of the knowledge of CTC by another organization results in a source of revenue and the possibility of integration and cooperation with other players of the sugarcane production chain.

The dialogue with authors from different areas of knowledge allows the analysis of available technologies for processes modeling and employed in knowledge management and on the development of complex networks of collaboration.

According to Oliveira and Neto (2009) apud Carrara (2011) implementation models or processes modeling are open to criticism, given the bias of each method or technique. The Flowchart describes a sequence of activities and not properties of traceability and simulation capability, among others. It sets up, therefore, a tool that aims at simplify reality, giving it a static view of a given moment. The Object-Oriented model reduces reality through models. Nor emphasizes value and only describes the attributes and methods frozen in time and space, making its role before a pre-defined scope, being impossible to characterize more than one role for the same class.

Although widely used, the Entity Relationship model promotes the reduction of reality in its modeling, based on the possibility of abstraction of the richness of reality. The way of communication between the entities is through relationship, one by one, without possibility of traceability. Difficulties are presented when there are variations in attributes, domain restriction of the set of objects and the difficulty of representing the various semantic aspects involving objects in the real world.

The Essential Analysis System is driven to data rather than values. Its premised is the reduction of reality in the design of its models. Now, Integrated Management Systems (ERP) alone do not turn a company truly integrated. The high costs do not prove the cost/benefit relation and reveal a dependency of the vendor of the package. The adoption of best practices increases the degree of imitation and standardization between companies in a segment and makes the modules dependent on each other, because each department relies on information from the previous module. Therefore, the information must be continuously updated, since the information are in real time, leading to more work. It is also worth noting that the ERP are oriented to features;

The BPMN integration, in turn, with other tools is partially met by being only a graphical notation, depending on its textual representation. The focus on processes hampers handling different views and acts in only one dimension: activity or function.

The knowledge modeling process uses VBPMN because it is a modeling oriented to Value that is sought, focused on three dimensions (management, structure and function). In richness reality is reflected in complex systems, unlike industrial processes that are based on theories of simplicity, because they are conceived as closed systems.

Gattaz and others (2001) say that the systems are dependent of the context, which does not occur with systems based on activity but in systems based on value, while activity is a function defined as previously abstracted as reality, value is not a function, is a result of expected transition based on a given knowledge, which depending on context can have different meanings. Taking as example a surgical instrument, in a given context it can be used to save lives, and in another, as a weapon to kill someone, at the same time.

The authors are opposed to the other methodologies and technologies outlined in Chapter 2, namely: (i) Flowchart; (ii) Entity Relationship Model; (iii) Essential Systems Analysis; (iv)Object-Oriented; (v) Integrated Management Systems and (vi) BPMN Process, aimed at reduction or simplification of reality not regarding the existing contexts. The classical systems perceive their components as fixed, in complex processes their components are contextually intertwined and exchanged into a huge structure. Hence, different treatments and knowledge may be needed to face problems and solutions. As a way to illustrate, different diseases in the same individual can be seen using nanotechnology instead of microtechnology, thus, different treatments may be recommended.

Given the limitations of other technologies and due to the advantages found in VBPMN, the software PArchitect was chosen as a way of knowledge modeling. Table 1 summarizes the comparative reported so far.

Table 1 Attributes and comparison of process modeling technologies

	flowcharts	ERM	ESA	OO	ERP	BPMN	VBPMN
Oriented to activity/function	x					x	x
Complex systems							x
Simple systems	x	x	x	x	x	x	x
Susceptible to simulation						x	x
Susceptible to emulation							x
Traceability							x
Oriented to Value							x

Source: Elaborated by the author

Therefore, it is expected to attribute innovation, entrepreneurship, and self-sustainability to the Organization, through the commercialization of its product, knowledge, embedded as software.