Brazilian Public Software: beyond Sharing

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ABSTRACT

This work presents a case of an innovative Brazilian experience of use of free software in public administration as an emergent ecosystem, and the attempt to establish a quality framework for that. It describes a new concept: the Brazilian Public Software (BPS) developed by policy makers of the Ministry of Planning, Budget and Management. At the beginning of the century, Brazilian policy makers were concerned with the limitations of the Free Software Model of Production (FSMP) to provide software to public administration. Issues such as installation and operational support, quality of software (users interfaces, manuals) and bugs were not effectively solved by the FSPM alone. They then shaped a new concept, the Brazilian Public Software, which is based on code opening (FSPM), but includes some additional duties to the entity that makes the software available. To support and to make the concept operational and institutional, an environment was formed and so a virtual ambience named Brazilian Public Software Portal (BPSP) began to exist. Since their beginning in the end of 2006, the BPSP[1] has increased its number of associates to 74,000 users, and today it has 36 software solutions available, in many technological areas: geo-processing, health, public town management (sanitation, hospitals management, data management, etc). Even software solutions originated from private entities that had public interest as textual database and web application server ambience. The solutions are used not only by governmental agencies but also by small and medium-sized companies and other kinds of organizations. Other related interest groups emerged inside the BPS: 4CMBr, driven to municipalities; Virtual Market focused on services; 5CQualiBr devoted to the quality of the software in a large sense and to the ecosystem sustaintability. Quality and quality assurance are a challenge in this kind of ecosystem. In this work we will describe the solutions and findings in the Quality Framework to the SPB ecosystem.

Categories and Subject Descriptors

K.4.3 [Organizational Impacts]: Computer-supported collaborative work

General Terms

Quality in software ecosystem, cooperative engineering.

Keywords

E-Government, digital emerging ecosystem, network quality model

1 www.softwarepublico.gov.br

1. INTRODUCTION

This article presents a case about the quality in the BPS, the cooperative network focused at producing public software in the Brazilian government.

The quality framework is based on the Brazilian Public Software experience, seen through the lens of the Complex Thinking Theory.

Brazilian Public Software (BPS) is a project of the Planning, Budget and Management Ministry (PBMM) of Brazil that introduces a new concept and operational structure to produce software, aimed at improving efficiency[2] of the governmental system.

The project began officially in 2006 [1]. At that time, the free software production model (FSPM) adopted by the Federal Government was strongly stimulated by national policies. One of the experiences of code opening, the Cacic software [2] (infrastructure inventory software), gave to Brazilian policy makers the perception that the government and several sectors of the Brazilian society were interested in sharing and improving the software knowledge. In few months, thousands of software developers accessed the site where Cacic was and formed a virtual community, similar to FSPM communities.

Then, policy makers of PBMM developed the concept of public software and created the Brazilian Public Software project. The BPS project is based on a code opening model (FSPM), but it also includes additional duties to the entity interested in making its software available as a public good. This is basically because the government has the legal responsibility to make public goods available (including software) in minimal conditions of use, security and trust. These duties are established by a formal term between PBMM and the entity that includes [3]: 1) to license software in GPL (General Public License) form; 2) to provide software guidebooks to users and guarantee that software work after installation; 3) to provide a focal point or a team that constitutes a communication interface with the society, driving and solving their needs concerned with the available software; 4) to provide associated services to do the communication with society, like forum, internet site, software version control tools and 5) to manage the collaboration with the virtual community, inducing participating, registering contributions to software, defining quality patterns, launching and new versions.

To support and to make the concept operational, a virtual ambience portal was created and became operational in 2006; today there are more than 74,000 people using the portal and 36

[2] This efficiency can be expressed by lock-in reduction, cost reduction, improvements in network collaborative work, elimination of software development redundancies, knowledge sharing, etc.

solutions available. Around each software solution a community has been formed that interacts with the leaders. Therefore, many people participate in more than one community. The solutions came mostly from public entities, but private enterprises began to release software.

The growth of software communities in the BPS portal quickly gave rise to demands that in their turn led to new dimensions to be analyzed and incorporated into the BPS model [3,4]. Dimensions quite different in terms of their nature, such as intellectual property, services commercialization derived from the apprenticeship in the communities, demands on the infrastructure usability, flexibility and interoperability, new policy acts to complete the public good concept even the implantation of the model in other countries in Latin America[3].

These results seem to indicate that the ecosystem is evolving. Like a living system, BPS ecosystem responds to environmental (socio-politic-economic context) pressures. And the changes occurred in BPS derive from responses to that pressures and the learning process involving it [5]. This learning process is not only derived from responses to practical situations, but involves a common desire and efforts of the communities of BPS and the policy makers of PBMM to understand the complex nature of BPS [6].

This work presents the trajectory followed by researchers of the Centro de Tecnologia da Informação Renato Archer (CTI) to comprehend the complex dynamic of BPS ecosystem. First, it presents the attempts to approach theoretically the BPS ecosystem and the reasons to choose The Complex Thinking Theory (CTT) as a methodological path. Secondly, the initial approach to understand the system is briefly presented. And finally the 5CQualiBR is focused on, the group of interest on quality that has emerged from the ecosystem and from cycles of learning of a complex system BPS.

2. INITIAL APROACH

Since the beginning, the BPS work team has concentrated efforts to analyze and understand the phenomena of the BPS ecosystem. After the first solutions have been released, the communities have quickly adopted an active profile in the relationship with the government and among them, constituting a behavior similar to a living system.

It was soon perceived that these interactions were different inside each community of BPS, but had some common patterns. Some of those had strong flows of contributions, even correcting significant bugs in the software. Others had marginal contributions, mostly focused on implementing problems. However, all communities have a similar process of learning, a collective learning about common problems (like infrastructure problems, security problems) and the exchange of different kinds of knowledge.

Different dimensions of BPS action have emerged to solve operational problems. Some of these dimensions have been achieved by launching new sub-sites aiming to provide services to support BPS software solutions (virtual market of BPS) [7] or to attend specific demands of municipalities (4CMBr) [8]. So, BPS growth has incorporated different knowledge fields and with their own dynamic, which enables different theoretical views to address.

Choosing one of the theoretical approaches could mean loosing a strategic dimension that modulates the SPB ecosystem. Therefore the work group has decided to adopt a theoretical view that could join all critical dimensions that emerge from BPS. After the first reflections, it seemed natural to choose the theoretical and methodological approaches that had the same operational dynamics as the BPS project: an emerging process to generate results.

The answer to these demands was the Complex Theory Thinking (CTT). CTT and its majors exponents like Peter Senge [9], Edgar Morin [10], Humberto Maturana [11, 12], Francisco Varella [13, 14, 15] and Nicolis and Prigogine [16], were seen by the work group as a conceptual base that, not only views different dimensions together, but could also explain some complex behaviors of BPS.

This kind of view led the group to view the BPS not only as a set of components but as the behavior patterns generated by the interaction of these components.

A preliminary exercise generated a view of the BPS ecosystem as inter-related variables and patterns (Figure 1).

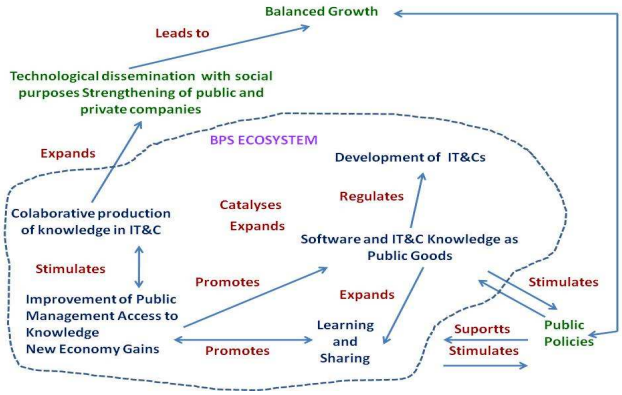

Figure 1 – A preliminary view of BPS Ecosystem

As it can be seen, searching for a systemic view of BPS, it can be described as a set of circular interactions between different nature variables. The figure cannot summarize all kinds and numbers of interactions, but only some that are more critical.

Most of these variables express the interactions inside the portal, but are not confined to that. The limits of most of the variable are flexible and comprehends other networks, others virtual environments and there is not a hierarchy of variables. The borders of BPS ecosystem are fluids.

The concept of software as a public good, the inductive action of the PBMM and the values associated to FSPM are the main factors that create the basic conditions for the BPS ecosystem to exist with a single identity. The main goal (balanced growth of Brazilian society) is another element that helps to catalyze the support of volunteers and influences the kind and intensity of the collaboration.

[3] In march 2009 the International Public Software (UNDP project) was created, which intends to map the needs of free software in Latin American countries to E-government, and to form a network (such as the SPB model) to meet this demand. The countries involved in this project are Costa Rica, Honduras, Trinidad and Tobago, Argentina, Paraguay, Uruguay, Equator, Venezuela and Chile.

All of the characteristics mentioned above reinforce the character of the BPS as a complex system [17, 18], given that the dynamics of interactions are characterized as non-linear and non-trivial. Thus, for its development, it has sought guidance on new fields of study such as systemic thinking and complexity theory [19].

After this understanding of the BPS ecosystem a new dimension has been added: the dimension of quality. This dimension emerged from the efforts of the team to write the BPS model of reference. The dimension of quality materializes by means of the quality subsite, which is a specific place to treat the quality of the artifacts available in the ecosystem, be them software solutions, models or quality technologies.

3. THE 5CQualiBr

5CQualiBr is a group of interest which deals with the topic of quality in the realm of the BPS ecosystem [20]. The main values of the 5CQualiBr group are: Trust, Cooperation, Community, Knowledge and Sharing.[4] . The objective of the group is to build knowledge in a collaborative way about Information and Communication Technology (ICT), directed to the Quality of the Brazilian Public Software. In the group, the team Quality of BPS is divided into many subjects. Each specific topic of quality is called a vector. The vectors currently implemented are: Ecosystem, Interoperability, Quality of Software Products, Quality of development process, Quality of services, Software tests. The members of the group of interest may participate in all the vectors or only in those of their interest. The dynamics of the group is aligned by Cooperation to build and Share Knowledge within the Community. A fifth fundamental element for the development and sustainability of the environment is Trust. Trust is important for all in the group and in the ecosystem. For the Sharing of Knowledge to exist, Trust is needed, and so that Cooperation exists, knowledge is needed. The higher the quality of BPS solutions, the more Trust will be placed by the society, given that Trust generates Quality and Quality generates Trust, in a virtuous cycle. The participation in the vectors of interest occurs in the following ways: download of contents (technical documents or publications), posts of opinions in the vector blog; participation in forums; participation in chats and file upload [21]. 5CQualiBr also uses in its environment tools like Twitter [22] and identi.ca! [23]. The environment also counts on a blog ("Hello Community"), which is the virtual space created for the discussion of topics of the BPS community as a whole, that is, a space for posting opinions, criticism, doubts and suggestions about the BPS interactivity. It is a space to treat the environment common to all communities and vectors, the necessary changes and the existing conflicts. It is a site for collecting ideas and improving the collaborative environment and makes it sustainable. The dissemination activities of the 5CQualiBr aim to support two basic steps to build knowledge and make it available in a collaborative way that are: attracting a heterogeneous public of collaborators and publicize the knowledge generated by the collective interaction. The needs identified for the first step are: 1) Obtaining information about the previous understanding of the purpose of the Project by its participants and above all, by the communities of the BPS portal; 2) Creating a proper virtual environment for the formation of communities for discussion of themes and development of knowledge about the public software; 3) Developing publicity about the environment for discussion and creation of knowledge; 4) Publicizing the relevance of the discussions and the importance of the contributions. The needs identified for the second step are: 1) Developing publicity about the results (knowledge); 2) Publicizing the knowledge (results from discussions); 3) Creating mechanisms capable of transferring the discussions and knowledge to the portal in a spontaneous and sustainable way. Figures 2 and 3 illustrate the development expected, in the sense of an induced system of construction of knowledge in a collaborative way between BPS communities and those 5CQualiBR, for a spontaneous and sustainable system with the same purpose.

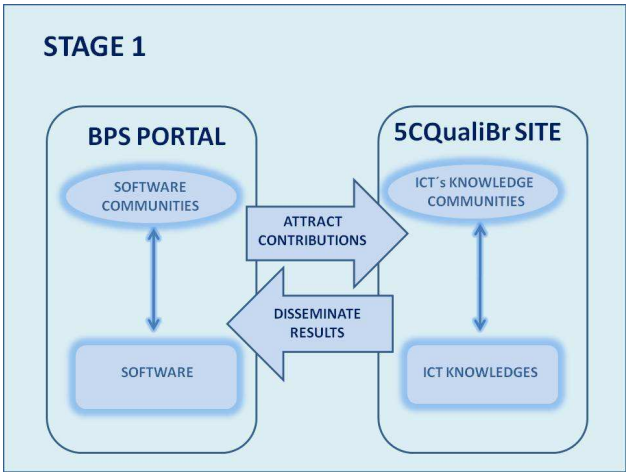

Figure 2: 5CQualiBr development – Step 1

In the first stage efforts of communication are sent, both to stimulate participation of community members in the discussions and to publicize the partial results for these discussions.

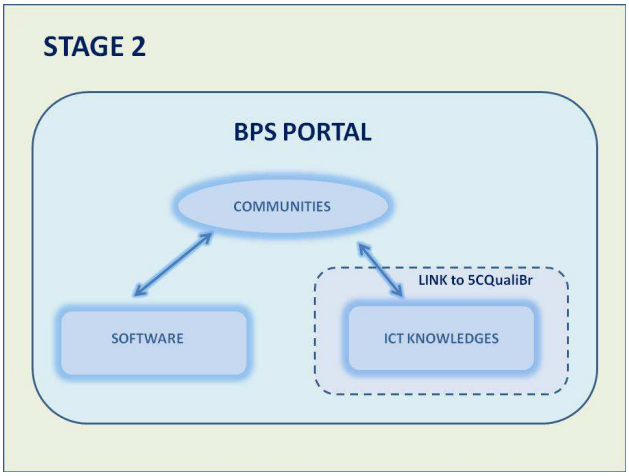

Figure 3: 5CQualiBr development– Step 2

In a second step it is expected that the consultations to the available knowledge, as well as participation in new discussions, are dynamically and spontaneously performed by the members of the BPS community. The group was released in October 10 2009 and amounts today to approximately 2000 members and counts with *seed codes* available in all quality vectors that constitute the first version of the environment [24].

4 Translator's note: the five values held by 5CQualiBr all begin with a 'c' in Portuguese.

4. THE VECTORS

The vectors consist of knowledge represented in the form of quality guides, handbooks, reference models of the ecosystem. They are: 1) Structural base of the BPS ecosystem and improvement in the approach of the BPS as a system of collaborative production; 2) Interoperability of the software products produced; 3) Quality of the software products; 4) Quality of the process of software development; 5) Quality of services offered; 6) Software tests and 7) Dissemination and Sustaining of the Ecosystem.

4.1 Structural Framework

The term ecosystem emerges from the digital ecosystems concept, originated in Europe in the late 90s. It defines a conceptual structure for describing the complex interactions between business, technology and knowledge, which is inspired by biological ecosystems (The Digital Ecosystems Research Vision, 2009). This concept originated significant investments of the European Community to build a technical infrastructure and logistics for the promotion of inter-relationship among small software companies in Europe with the main objective of achieving new business.

In the context of the BPS, ecosystem is a distinct concept; although the achievement of business is also included among its objectives, its main focus is on improving public management and public access to knowledge of IT, towards the development of a sustainable country.

The term ecosystem is used to describe the virtual environment of the BSP (PSPB, 2009) consisting of various actors that inter-relate in a collaborative and dynamic way, without setting limits to the variety of actors, or the intensity, or the forms of those relations. Part of this ecosystem that involves the whole productive chain of the portal consists of the community of developers of software (the production environment), the community's business sector, and the figure of service providers (which may be companies or interested users), the community of users of the solutions, communities of practice and public organizations [19].

The actors in this scenario tend to be at the same time both producers and consumers, which Tapcscott & Williams define as "*prosumers*" [20].

The characteristics that permeate the ecosystem are decentralized, self-organized and feedback from the virtual communities and end users participating in the project and the network of stakeholders that has been expanding since its creation. Figure 4 illustrates this network.

Thus, we can say that the ecosystem BPS is composed of elements that relate to the infrastructure that supports it, by the actors that compose it and the relations between themselves and between their infrastructures. The momentum resulting that is expressed by the interaction, sharing and learning is what characterizes this ecosystem.

All of the characteristics mentioned above reinforce the character of the BPS as a complex system, once the dynamics of interactions that are characterized as non-linear and non-trivial. Thus, for its development, it has sought guidance on new fields of study such as the system thinking and the complexity theory.

The system thinking and the complexity theory, are both new fields of study which intend to be "….a new way to think, and a language to describe and understand forces and relationships of systems of behavior. The system thinking helps us to understand how to change the systems in order to make them more effective and act in better harmony with the largest processes of natural and economic world." In these fields the main authors are: Peter Senge, Edgar Morin, Humberto Maturana, Francisco Varela and Ilya Prigogine[9, 10, 11, 12, 13, 14, 15, 16].

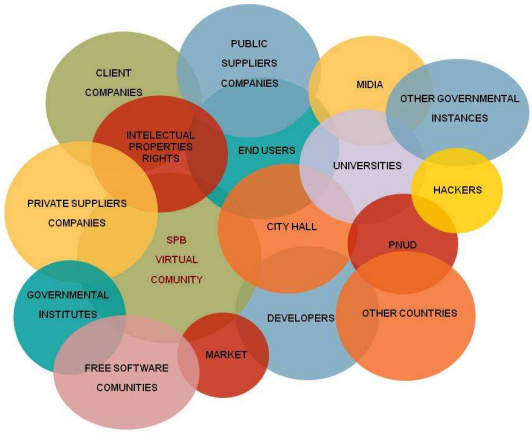

Figure 4: BPS Network

4.2 Interoperability Vector

The collaborative mode of development of the software is essential for the model of software as a public good, due to the reusability of the knowledge produced and the low costs associated to it. Sharing is the optimal utilization of the knowledge resource, where it is not necessary to keep secrecy, because the profit is associated with the common benefit that can be raised. In this context, the abstraction by means of models and the formalization of the knowledge allow the construction of communities by means of modeling languages shared and specified by domains. The platforms and frameworks that can be interoperated promote the creation of digital ecosystems in which groups of people have the opportunity of sharing a language, work collaboratively and share information, services and software components. The objectives of the Interoperability Vector are: creating a community to promote the interoperability for the ICT systems in the public domain, by means of collaboration, capacitation, innovation, and identification of opportunities for acting [26].

4.3 Product Quality

This vector is about the question of the quality of the software products and introduces the mains concepts found in literature and applied to national and international projects related to the quality of the software, which can be adopted by the communities involved with the Brazilian Public Software.

One of the main aspects that contribute for the adoption or rejection of a software product is reliability. This is valid for any software product, and is especially true when it comes to the products of the BPS ecosystem.

The quality if free software is frequently perceived with more difficulty than in products of closed code. It is just now that the government, the industry and the market have begun to investigate the potential of the free software. These organizations are interested in how to evaluate the quality of products to choose those that are most adequate for its objectives and needs.

A model of software quality has the objective to help managers of Communication and Information technology to specify and evaluate which software product would be more adequate to their needs.

The quality model allows to specify and determine the maturity of a software product, analyze the group of characteristics of the product with the requisites of the business of the organization, and to compare the products with commercial alternatives.

A quality model for free software may have as a basis attributes of quality of software products, almost as NBR ISO/IEC 9126-1 [27], NBR ISO/IEC 25000 [28] and other models of quality.

The model developed and consolidated by the quality community of the BPS product has as a basis attributes of quality characterized in well defined groups such as: 1) Description of product; 2) Quality of product; 3) Quality in use; 4) Documentation for users; 5) Training; 6) Support.

The biggest challenge for the BSP is the development of a quality reference model for the product, which can have as basis issues for free software from other approaches. This model should provide a systematic methodology for the specification and evaluation of BPS products.

One of the objectives of the quality reference model of the product is to aid the governmental institutions. These can act in the following roles: 1) as costumers – for example, in licitations for the acquisition of software as ordered works; 2) as users – for example in the use of specific systems for governments: Financial, Human Resources, Purchase/Procurement, Suppliers, Income Distribution; 3) as suppliers – for example, software for Income Tax Report; 4) as services suppliers – for example, software for sending the Income Tax Report via Internet.

Aligned with the purpose of the SPB, this quality reference model for software product has been developed in a collaborative way and shared by the actors involved. .

The challenge that the user organizations may face when considering the BPS products is that they differ from the similar commercial items; therefore, it is the quality reference model for SPB product that will help in the choice of the product that better meet the demands of the organization [29].

4.4 Quality for developers and service suppliers Vector

Among the many actors of the BPS ecosystem are the software developers, the service suppliers, those that demand solutions and the users of these solutions.

The objective of the two vectors above quoted is to identify and consolidate, with the communities of the BPS ecosystem, the best practices for the development of a solution and the best practices for service suppliers of the BPS solutions and represent them with one or more models of capacity of process.

To guide people so as to better perform a certain intensive process in software, the area for Software Process Improvement (SPI) suggests the use of models of best practices as references for the establishment of the process to be used.

The BPS is leading to a meaningful change in the context for software production. Production in a broader sense, including not only the development of software, but also the use, knowledge generation, distribution of wealth and demand for intensive solutions in software.

For the BPS, it can be seen that this sequence in growing levels of cooperation, with the dimensions of Sharing, Knowledge, Community and Trust integrated to the concept of maturity will organize in a more efficient way the best practices of BPS.

Two actions are being currently developed as the first step to identify the appropriate sources of best practices for developers and service suppliers.

One of them is the consolidation of the method. Based on the experience and methodology of the work group, a method has been consolidated to identify a set of best practices and for representing this set as a model process capacity.

Another action is the identification of sources for search of best practices. The main source is composed by the experiences of the BPS community. Since interdisciplinarity is the tonic of the BPS Project, we can identify as a complement the experiences and models of best practices of the free software communities, the agile methodologies, the system thinking, the emergent systems of knowledge workers, of software engineering, de system engineering, service suppliers and others. As examples of more specific sources we can cite the experiences of the Center for Free Software Excellence at USP, the Peter Drucker proposals for the processes of the knowledge worker, the Peter Senge proposals (Learning Organization) [8], the Wikinomics proposals [25], the models of process capacity of CMMI [30] for development and services (CMMI-DEV e CMMI-SVC) [31] the models of ISO/IEC 15504 [32], and the initiative of the Improvement of the Brazilian Software Process (MPS.BR) [33], the models of capacity of process for contractors and service suppliers, the model COMPETISOFT[34] for small companies of the ibero-american community.

It is important to highlight that the models of capacity of process of development and services have been developed with the community and from experiences of the community (from below to above, from practice to systematization), one or more models for the reality of the BPS, also using, when appropriate, other practices of these models and of other communities, with the technology and the experience of the work group and of others in development of models for other domains, backed by the successful use of these models for the improvement and evaluation of processes [35].

4.5 Software Test

The technological structure of the test has the responsibility of building and making available in the SPB Portal a technological structure of software testing. The construction of this structure will take place together with the communities so as to adopt the best testing practices which in fact meet the demands of the communities of the portal. This software testing technological structure will be available for the use of all communities and its use has the objective to improve the quality of the software products available in the BPS Portal.

The technological structure must have as a characteristic the possibility of attending to the different types of users of the BPS Portal that are interested in applying tests in the software products in the following situations: a) along the development of the software; b) in the initial homologation of a software for the BPS Portal; c) in the release of new software versions previously homologated in the SPB Portal.

With the objective to attend to different users of the BPS Portal interested in applying software tests in the above situations, the technological structure for tests should be broad enough to attend to the different types of users previously described.

This vector intends to offer a software testing infrastructure formed by contents recognized as efficient by the practitioners of tests, and which reflects upon the latest advances in standards for the software tests.

Meanwhile, it is essential that this content is presented in a way to facilitate the adoption of the practices of tests by the many interested people, represented by the different types of users described above.

The sharing of artifacts and of software knowledge inherent to the BPS model, offers a great opportunity of stimulating collaborative efforts for the test of software products.

In these cases, developers and users of the products may act together to perform the plan; the Project; the execution of tests, finding and solving the negative point of the software, and what is more, collecting and publicizing information that prove the performance of the test.

The testing infrastructure foreseen has the potential of bringing benefits of different kinds, for example: 1) software developers will be able to do a test more effectively, diminishing the incidence of errors of the software in use and the injures that develop as a consequence; 2) developers and testers will be able to offer testing services, allowing for the improvement of products, even when the professionals responsible for them have not done the testing; 3) organizations that use the SPB software will be able to enhance their trust in the quality of the solutions available in the portal, by means of analysis of evidence about the test of the products provided in the Portal [36].

4.6 Publicity and Sustaintability Vector

The propagation of knowledge generated in the environment 5CQualiBR, as well as the call for new contributions will be done through a mechanism of communication called *"Alô Comunidade"* (Hello Community). This mechanism has been designed to allow the learning process and therefore the sustainability of the net.

It is understood that sustainability, in the context of the collaborative net, occurs in face of the ability of the net to learn dynamically with the environment and implement the knowledge acquired in the benefit of the collectivity, combined with the capacity to promote a fair and democratic atmosphere.

The environment created by the existence of the BPS portal is complex, for it is composed by a numerous and heterogeneous population of members organized in communities with different interests in different moments. The members may be public and private entities as well as individuals. As for the interests, they may vary along the time. In general terms, there are those whose interest lie upon developing or improving solutions, and those who wish to offer software customization services or trainings.

In face of the evident complexity of the SPB environment and the 5CQualiBR Project, we can conclude that this web, in order to be sustainable, must be able to collect opinions, news, doubts and complaints from its members. It must still connect the interested people in the information collected, allow that ideas and information circulate among them, store the knowledge produced by this collective interaction and, eventually, with new knowledge, continuously implement changes in the environment aiming at the collective benefit.

5CQualiBr seeks to improve the quality of the BPS ecosystem as a whole, be it in the realm of the artifacts produced or in the quality of the dissemination of knowledge generated and still in the sustaining of this system as a virtual organization (net of competences

This participation adds another concept to the other, the concept of trust in the system and in the norms that guide the process and the product [37]

5. FINAL CONSIDERATIONS

The ecosystem has been modeled using appropriate methodologies for the treatment of complex ecosystems. Other methodologies have been used whose structures stem from the Complex Thinking. With the methodology used important variables have been raised for the system as well as the relations between them. The material obtained has been used to define the BPS Reference Model as well as to allow the research group the identification of artifacts and emergent relations in the system. Among the systems which have been identified is 5CQualiBr, which has been introduced in this work.

The group of interest 5CQualiBr has shown a continuous growth in the numbers of quality artifacts available in it. In the moment the environment is being redesigned to accommodate frameworks generated by other communities from outside the BPS and the 5CQualiBr environments, and that understand that the environment 5CQualiBr is becoming a reference in software quality. The frameworks will be made available in communities in 5CQualibr. They are: Open Maturity Model (Center of Competence in Free Software /University of São Paulo), Slim Production and BDD: Solution for the Development and Software with Quality (Fluminense Federal Institute - Center of Research in Information Systems) and Quality Assurance Framework (Information and Communication Technology /India).

The Coordination of the interest group 5CQualiBr has been undertaken by the Center of Information Technology Renato Archer (CTI) and, in the second phase to be soon initiated, product quality evaluation tools will be implemented which will be used by the developer/user of the solutions available in the BPS portal.

Two new projects have been written and are currently being evaluated by sponsor agencies. One of them is about the evaluation of the impact of the BPS and the 5CQualiBr and the second one is about the evolution of the reference model o to treat dimensions that have not been treated in the former.

The ecosystem is considered successful by its growing number of members, communities and solutions available. The group of interest is also considered successful for the same reasons and for the interest that it arises in the Brazilian software community

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