Chapter 4

Information Systems and the Open World Challenges

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Abstract

This paper discusses the challenges which must be faced by the Brazilian Information Systems Research community regarding the new requirements brought by the open world to information systems specification, design, implementation and evaluation as new digital information ecosystems. This challenge is based on the epistemological view of cyberdemocracy, a conceptual view to approach these systems as digital ecosystems; a pragmatic view to describe and understand their dynamics by understanding their processes; and the desired implications or impacts on these systems´ behavior and mindset through mutual accountability.

4.1. Introduction

In 2013, during the Brazilian Information Systems Symposium (SBSI), the Brazilian research community joined a discussion panel about the challenges of the open world and implications for research and practice of Information Systems. Inspired by Dan Tapscott´s talk - *Four principles for the open world*[1] - the panel examined the viewpoint of researchers and professionals about principles on how to live and survive in the open world – transparency, collaboration, sharing and empowerment – both by enterprises and by individuals. In this panel, Information Systems (IS) researchers gave presentations about the Brazilian Access to Information Law (LAI, 2011), open data, the evolution of social network analysis (including sentiment analysis) – and how to plan and measure the maturity of cities to offer intelligent services to their citizens. Privacy was also focused on the paper, or better, our reactions to information exposure on an uncontrolled scale and at speed.

The organization of this paper, which took place three years ago in the context of SBSI,

[1] https://www.ted.com/talks/don_tapscott_four_principles_for_the_open_world_1

indicates that our community has been sensitive to the challenges of dealing with the open world. We are living in an ever more open and connected world, uncovering new opportunities both for business innovation in organizations and for the empowerment of individuals, with more autonomy and satisfaction. Managers talk about the "VUCA" (Volatility, Uncertainty, Complexity, Ambiguity) world or environments which are full of complex, unpredictable, and rapidly changing situations and the lack of approaches available to cope with it (Mack et al. 2016). While threatening at a first sight, these environments are undoubtedly the next challenge for human society to cope with, and a broad space for innovation and global problem-solving.

The effects of the open and "VUCA" world naturally brings challenges to the area of IS as new information systems must be developed and that ICT is unquestionably the layer which enables and supports them. This brings to our research community the challenge of how to understand, describe, model and build the new information systems in the open world. We are facing the complexity of building new systems which are no longer closed artifacts but rather a connected intra, inter and social organizational organism, with emerging and unpredictable behavior.

In this paper, I describe this challenge from the point of view of the cyberdemocracy concept, i.e. how to provide democracy (equal opportunities of participation and benefits), a conceptual view to approach these systems as digital ecosystems, a pragmatic view to describe and understand their dynamics by understanding their processes, and the desired implications or impacts on these systems´ behavior and mindset through mutual accountability.

4.2. Background

This section defines and motivates the reader regarding concepts which will be further interrelated to describe the challenge described in this paper.

4.2.1. Cyberdemocracy

Cybernetics (Wiener, 1948) is the interdisciplinary study of regulatory systems structure. It is closely linked to control theory and general systems theory (Bertalanffy, 2008). Both in its origins and development, cybernetics applies both to physical and social systems. Complex systems affect their external environment and then adapt to it. In technical terms, they focus on control and communication functions: both external and internal phenomena from/to the system. This ability occurs naturally in living organisms and has been imitated in machinery and organizations. Cybernetics is the science of control, the science of governance.

The concept of Democracy ("demo+kratos") is a government model where the power of making important political decisions comes directly from the citizens, or in its most usual form, through elected representatives. The history of democracy refers to a set of historical processes and has a difficult definition, grounded on the notion of a political community where all people have the right to equally participate, debate and decide on political processes and, in the modern sense, in which certain rights are universalized from the principles of freedom of expression and human dignity. The concept of democracy, although closely linked to legislation and constitutionalism, is not limited to legal equality, and also depends on democratic access (i.e. the same for all) to spaces and social benefits.

The principles of Cyberdemocracy are grounded on the assumption that, in the open world provided by ICTs, information transmission, connection and reconfiguration by individuals leads to collaboration, plurality, openness, empowerment and governance. The idea is that the more we produce, deliver, distribute and share information, the more intelligent (in the sense of governance) and aware a society will be. Cyberdemocracy is a term meaning the collective intelligence which arises through public opinion and empowerment through the use of technology, leading to better levels of governance of social and organizational systems. According to Lemos and Levy (2010) the relationship between communication (social power) and technicality (power of action) is on the basis of this new political dimension, bringing every individual connected through technology into a new relationship with space and time, a new dimension of living together.

4.2.2. Digital Ecosystems

The ecosystem concept has its roots in the field of biology (Dhungana and Groher, 2010) meaning a community of living organisms (i.e. plants, animals and microorganisms) together with non-living components (i.e. water, air and soil), and the relationships among them and with the environment, interacting as a system (Smith and Smith, 2012).

The concept of ecosystems has been used in technological contexts giving rise to the Digital Ecosystems concept (DigitalEcosystems, 2007). Digital Ecosystems comprise enabling technologies and approaches to promote endogenous local development and knowledge sharing processes which provide services based on ICTs which are adapted and customized for individuals and business networks. Digital Ecosystems is an emerging paradigm for technology and social innovation. They can be defined as a self-organizing digital infrastructure with the aim of creating digital environments for organizations (or other agents) connected through networks, providing support for collaboration, knowledge sharing and the development of adaptive and open technologies.

Digital Ecosystems are open communities, where there is no permanent need for centralized or distributed control. Leadership can be structured or fade away in response to the needs of the environment dynamics (Boley and Chang, 2007). Digital Ecosystems promote changes in traditional communication patterns, where organizations stop acting as isolated islands, to be part of a highly connected ecosystem by means of engagement techniques provided by ICTs (Armano, 2012).

Boley and Chang (2007) summarize the essential characteristics of Digital Ecosystems, inspired by the field of biology, based on the concepts of agents (entities integrated into an environment or community by their own interests) and species (different kinds of agents): (i) *Openness, Interaction and Engagement*: Openness refers to a transparent virtual environment, in which interaction among agents occurs, aiming at the welfare and the engagement with others to obtain opportunities and share resources. Sometimes the community must come together to defend itself against external threats. The agents will not be able to survive unless they recognize that they are interdependent regarding other species in the ecosystem and are willing to cooperate with them. (ii) *Balance*: Balancing means harmony, stability and sustainability within an ecosystem. If any species becomes disproportionately stressed or

divided, the entire ecosystem may collapse. However, a single point of failure does not need to lead to disaster, but can give rise to a new equilibrium of the ecosystem as a whole. (iii) *Grouping and loose coupling*: The species comprise an ecosystem by choice. Its members share culture, social habits, interests and similar goals. Each species preserves the common environment, being proactive and responsive for their own benefit. At the same time, the agents are aware of the benefits of collaboration, there being a common mutual interest between the parties. They are enthusiastic in participating in community work. They are therefore able to live together in community and support each other for the sustainability of the ecosystem. (iv) *Self-organization*: Each species is independent, self-empowered, self-prepared, able to defend itself and survive through self-coordination. The digital ecosystem agents can act independently, make decisions and fulfill responsibilities.

4.2.3. BPM and Social BPM

Organizations have long focused on Business Process Management initiatives (BPM) (Dumas et al, 2013) for customer satisfaction by improving the efficiency of their internal process management. Public and private organizations have addressed the management of their processes in order to improve productivity and quality. Business process management is considered an important approach in organizations, helping with tracking, data generation and operational process performance measurement reviews to improve efficiency.

Business process management comprises a set of methods conceived to help organizations to model and manage their business, in addition to a continuous improvement process lifecycle entailing the following: (i) *Process identification*: comprises the understanding of the internal and external organizational environments, especially concerning organizational business strategy. Key processes are identified, as well as their weaknesses and opportunities. Processes are prioritized, and the tasks needed for their implementation described. (ii) *Process discovery*: processes are modeled and documented as they are executed in the organization (AS-IS). (iii) *Process Analysis*: processes are quantitatively and qualitatively evaluated concerning their performance. (iv) *Process redesign*: the necessary changes to solve the problems identified in the previous phase are designed in a new process model (TO-BE). (v) *Process Implementation*: the redesigned processes are implemented in the organization, which involves training, and in most cases, automation. (vi) *Monitoring and Control*: process execution data is collected to evaluate if process performance addresses the previously identified needs. Managers can make decisions based on process behavior, observing whether outcomes are kept as expected or whether deviations can be observed and addressed.

Social and participative approaches to BPM, so-called Social BPM (Erol et al. 2010) (Fischer, 2011), have been suggested as an organizational strategy to balance the rigidity of defined processes with the flexibility of social interaction, and as a strategy to provide innovative ways of integrating clients into process definition and execution using social software and its underlying principles. Social BPM technology integrates organizational information systems, business process management systems (BPMS), social media and organizational communication and collaboration tools (Intranets, email, organizational social networks) in order to broaden

collaboration among organizational professionals and clients in distinct phases of business process management (Mathiesen et al. 2012)

4.2.4. Accountability

The concept of accountability, in public administration, is associated to the process of being called "to account" by some authority for one´s actions. It has a number of features (Mulgan, 2000): (i) It is *external*: the account is given to some other person or body outside the person or body being held accountable. (ii) It involves *social interaction and change*: the one calling for the account seeks answers and rectifications, while the one being accounted responds to and accepts sanctions. (iii) It implies *rights of authority*: those who call for an account are asserting rights from a superior authority over those who are accountable. Accountability has been seen as individual responsibility and concern for the public interest (*responsibility*). It is the means through which democracies seek to control the actions of governments (*control*), the extent to which governments pursue the needs of their citizens (*responsiveness*), and it is applied to the public discussion between citizens on which democracies depend (*dialogue*).

4.3. The Challenge(s)

In a time when we are living the technological disruption enforced by convergence of collaboration, mobility and large volumes of data, the challenge to the IS research community is how to promote the integration of these technologies to balance both the need for control as well as opportunities for emergent behavior and innovation. In a world where accountability is a cornerstone, where diversity is considered a need, not a desire, and innovation and multidisciplinarity are key to the solution of the complex problems affecting humankind (ONU, 2015), our world must be open, connected, accessible. Its main actors (individuals and organizations) must be able to organize themselves without the specific need for an expected or foreseen structure, control or order (Shirky, 1998), in a democratic manner through the use of available technology (cyberdemocracy). In the context of the social environment, which will undoubtedly become even more complex in the next decades, corporations and social organizations should open themselves further than they had previously imagined to solve new problems they will face in the near future (CriticalFriends, 2007).

4.3.1. Information Ecosystem Development

The scenario described above means that building information systems for the open world requires approaches which should be able to cope with the growing complexity of these cyberdemocracy or electronic social governance environments, concerning their scalability, flexibility and adaptation. The main challenge faced by the IS community is therefore how to understand, specify, implement, evaluate information systems which might support these new digital ecosystems in the open world.

In Magdaleno and Araujo (2015), we suggest an approach from the digital ecosystems perspective, which provides a conceptual framework for the proposal of computer system development methodologies oriented to the governance of information systems in the open world. We suggest the concept of Open and Collaborative Government Information Systems (SiGACs) - systems covering people, machinery, software and processes to collect, transmit, process and disseminate information in order to enable, support and increase participation and

interaction among organizations, public bodies and society to achieve higher levels of self-governance.

Traditional approaches to information systems development tend to focus on organizational contexts, based on environment observation, process modeling, understanding of users´ needs, turning them into system requirements which can be managed, designed and codified into system artifacts by a team of specialized developers. Approaching new information systems in the open world means that traditional development approaches will need to be enhanced to consider not only the organizational contexts but broader ecosystems which include organizations, individuals, and technologies which interact in the open world. We need new approaches, conceptual frameworks, methods and tools to observe, model and develop the relationship among species and agents of these new ecosystems and how to identify their dependencies and objectives considering ecosystem requirements for balance, openness, engagement, grouping, loose coupling and self-organization.

New development frameworks, programming languages and services continuously enable individuals to design and develop simple applications without the direct need of developers. Large volumes of data and information available in the open world together with the possible simplification of development activities should empower individuals to build their own applications or products, changing and impacting the ecosystems they live in. We need research initiatives to foster ordinary people´s ability to build applications, manipulate data and evaluate its impact. Additionally, new participatory design approaches involving large groups of users should be discussed and explored as a way to improve participation, engagement and innovation. Those are the activities leading to opportunities for technological and social innovation (Tidd et al. 2008), an important component for the sustainability of our world[2].

4.3.2. Open and Collaborative Processes in Information Ecosystems

In the open world, business and organizations will only remain competitive if they learn how to manage their processes in this new connected and open scenario. Meanwhile, the organizations´ internal environment should develop interaction and collaboration among its professionals, and connected to the external environment in order to assure the performance of their business/work processes with more complex tasks, with less bureaucracy, more autonomy and quality.

We, as IS researchers, must dedicate our time to investigating how to increase and to strengthen the ties between organizations and their external environments, delivering better services and establishing an effective dialogue among them by using technology, especially information systems. We should ask a) how to make individuals, society and institutions cooperate and search for ways to effectively share and build upon common objectives b) how to integrate institutions and individuals as collaborators in managing constantly improving processes c) how to build solutions that can help individuals gain access to the way in which organizations work and behave d) how to help individuals and organizations produce

[2] http://www.pnud.org.br/ods.aspx

collaboratively and remain connected in new virtual and memory spaces by putting aside old relationship spaces –usually opposing.

The possibilities of extending the technology and culture of process management to an organizational external environment through Social BPM is perceived as one step towards improving organizational openness and transparency and improving consumer participation. However, relationships in new ecosystems are not restricted only to organizations and to their clients and cannot be analyzed from the unique viewpoint of an organization. A network of interconnected processes among ecosystem agents should now be identified, discovered, modeled, implemented, analyzed and monitored and new approaches for doing so are expected to come. Furthermore, in order to effectively include ordinary people into process management activities, process technology should be extremely simplified and must naturally assure engagement, grouping and flexibility for loose-coupling.

4.3.3. Accountability in Information Ecosystems

The concept of accountability here is not used as a synonym of transparency, but as an endeavor for the democracy pursued by new IS in the open world. Accountability in the open world does not only mean a public administration obligation to render information transparent to citizens or private organizations to their clients. It also means accountability – responsibility, control, responsiveness and dialogue – which must emerge among all participants in the new information ecosystems in the open world.

To guarantee balance, engagement, self-organization, grouping and engagement, the new ecosystems in the digital open world will naturally require accountability interaction among their agents, as a way to dynamically balance their need for trust. As researchers in IS, we should work on approaches and solutions to understand accountability as an important aspect for the internal regulation of an ecosystem.

How should each agent provide external accountability about itself, seeking for responsiveness and dialogue? What should each agent expect and count on from other agents, depending on their relationships and interactions? How can each agent and the ecosystem itself determine different responsibilities for accountability as well as possibilities and limits for control?

4.4. Progress Evaluation

The progress assessment of this challenge includes: (i) monitoring the research on this theme (number of conferences and publications) (ii) monitoring the dissemination of research artifacts (methods, processes and products) (iii) monitoring of technological diffusion on the subject (software records and patents) (iv) monitoring projects and initiatives concerning real digital ecosystems in the open world conducted together with the research community and (v) establishing IS specification development and evaluation standards in this context.

4.5. Relationship with Brazilian Initiatives

As specific goals for the advance of this challenge, we highlight the definition of effective alternatives for modeling, construction and evaluation of these ecosystems in different

application domains. Clearly, these goals will be greatly improved if there is interaction with other scientific areas within and outside the Computer Science area, such as Software Engineering, Data Bases, HCI, Management, Sociology, to cite a few. The Brazilian Workshop on Distributed Software Development, Software Ecosystems and Systems of Systems (WDES, 2016) is a research community initiative to discuss research results and experiences in these areas, and it is workin on with the challenge presented here. In 2016, iSys – The Brazilian Journal on Information Systems (iSys, 2016) – produced several special issues concerning different themes specifically related to this challenge, such as: business process management, innovation in IS and eGovernment, showing the increasing interest of our community in the open world. The scenario discussed here also evolves from previous challenges identified by the Brazilian Computing Society (SBC, 2006), in particular: Complex Networks for Collaboration and Information Management over Big Data, Challenges in Applied Computing, and Reliable Web Systems Development, from which different progress evaluation procedures can also be used. Additionally, other challenges related to the open world have been discussed in the context of the Brazilian HCI community (GranDIHCBR, 2012) through different challenges, such as: Future, Smart Cities and Sustainability, Accessibility and the Digital Divide, Ubiquity, Multiple devices and Tangibility, and Human Values.

4.6. Final Remarks

Democracy is an endeavor pursued by society, not exactly to find absolute equality, something which nature has already shown to be impossible, but to find balance and guarantee welfare. Democracy is not just a political or a public administration matter, but also a challenge for the management of private organizations and social communities. The open world provided by technology should lead to opportunities of mutual governance and balance by means of cyberdemocracy.

Information systems can no longer be seen as just organizational internal artifacts, web systems or mobile applications. A broader systemic view must be embraced by the IS research community to understand the new dimensions of information systems as digital ecosystems and how to use this view to provide completely novel approaches to the design, development, use and evaluation of information systems in the open world, facilitating processes, empowering people, generating trust and establishing new self-organization and governance eras.

The community must also be open to the emergence of unknown or already known aspects affecting the development of these ecosystems, such as privacy, empowerment etc. though not directly mentioned in this paper.

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References

Armano, D. (2012) "From Islands to Ecosystem: Connecting Social, Digital + Mobile". Available at: http://darmano.typepad.com/logic_emotion/2012/06/dig_ecosystem.html. Last access: 10-10-2016.

Bertalanffy, L., "Teoria Geral de Sistemas". Editora Vozes, 2008. (In Portuguese)

Boley, H. and Chang, E. (2007). "Digital Ecosystems: Principles and Semantics." Inaugural IEEE International Digital Ecosystems and Technologies Conference. http://www.ieee-dest.curtin.edu.au/2007/index.php. 398–403.

CriticalFriends. (2007) "The reference resource center on corporate stakeholder engagement". http://www.criticalfriendsinternational.com/index.php (last access on 25.03.2016)

DigitalEcosystems. (2007) "The Information Resource about the European approach on Digital Business Ecosystems". http://www.digitalecosystems.org/ (last access on 25.03.2016).

Dhungana, D., Groher, I. (2010). "Software Ecosystems vs. Natural Ecosystems: Learning from the Ingenious Mind of Nature". European Conference on Software Architecture: Companion Volume (New York, NY, USA, 2010), 96–102.

Dumas, M., La Rosa, M., Mendling, J., Reijers, H. "Fundamentals of Business Process Management". Springer, 2013.

Erol, S, Granitizer, M. Happ, S., Jantunen, S., Jennings, B., Johannesson, P., Schmidt, R. (2010) "Combining BPM and Social Software: Contradiction or Chance?" Journal of Software Maintenance and Evolution: Research and Practice 22(6-7). pp. 449-476.

Fischer, L., "Social BPM: work, planning and collaboration under the impact of social technology". Future Strategies Inc, 2011.

GranDIHCBr (2012). "Grandes Desafios de Pesquisa em Interação Humano-Computador no Brasil.". Baranauskas, M. C., Souza, C. S., Pereira, R. (orgs). Sociedade Brasileira de Computação. (In Portuguese) http://comissoes.sbc.org.br/ce-ihc/documentos/RT_GranDIHC_BR_2012.pdf (last access on: 06.01.2017)

iSys (2016) iSys - Revista Brasileira de Sistemas de Informação. http://www.seer.unirio.br/index.php/isys/index (last access on: 06.01.2017)

LAI (2001) Lei Nº 12.527, de 18 de novembro 2011. Lei do Acesso à Informação. Presidência da República. (In Portuguese)

Lemos, A., Lévy, P., "O Futuro da Internet. Em direção a uma ciberdemocracia planetária." Editora Paulus, 2010. (In Portuguese)

Mack, O., Khare, A., Krämer, A., Burgartz, T., "Managing in a VUCA World". Springer, 2016.

Mathiesen, P., Watson, J. Bandara, W., Roseman, M. (2012). "Applying Social Technology to Business Process Lifecycle Management". Business Process Management Workshops. Springer Berlin Heidelberg. 231–241.

Mulgan, R. (2000). "Accountability: An Ever-Expanding Concept?" Public Administration, v. 78, No. 3, pp. 555-573.

Olphert, W. and Damodaran, L. (2007). "Citizen Participation and engagement in the Design of e-Government Services: The Missing Link in Effective ICT Design and Delivery". Journal of the Association for Information Systems. 8, 9 (Sep. 2007), 491–507.

Organização das Nações Unidas. (2015) "Objetivos de Desenvolvimento Sustentável (até 2030)". Available at: https://nacoesunidas.org/conheca-os-novos-17-objetivos-de-desenvolvimento-sustentavel-da-onu/ (In Portuguese) (last access on: 25.03.2016).

Shirky, C., "Here comes everybody. the power of organizing without organization", New York: The Penguim Press, 1998.

Smith, T.M. and Smith, R.L., "Elements of Ecology". Benjamin Cummings, 2012.

Sociedade Brasileira de Computação. (2006) "Grandes Desafios da Computação no Brasil". (In Portuguese) http://www.sbc.org.br/documentos-da-sbc/send/141-grandes-desafios/802-grandesdesafiosdacomputaonobrasil (last access on 25.03.2016)

Tidd, J, Bessant, J., Pavitt, K., Gestão da Inovação. Bookman. 3a edição, 2008. (In Portuguese)

Wiener, N., "Cybernetics: Or control and communication in the Animal and the Machine". MIT Press, 1948.

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