

Information Systems Research in Brazil

A systems view for the applied computing science

Renata Araujo

Computing Department
Mackenzie Presbyterian University
São Paulo SP Brazil
renata.araujo@mackenzie.br

Sean Siqueira

Department of Applied Informatics
Federal Univ. of the State of Rio de Janeiro - UNIRIO
Rio de Janeiro RJ Brazil
sean@uniriotec.br

ABSTRACT

Information Systems (IS) have been one of the main agents of economic growth and social transformation in Brazil and in the world, and it will persist as so in the coming years. IS theories, concepts and solutions had been frequently understood as an intersection of distinct domain areas, mainly Computer Science (CS) and Organizational Management. Thus, the area of IS research understands computing as a means or instrument for solving problems in the real world, society and organizations. Its applied and multidisciplinary character makes it a challenge, requiring a deeper reflection not only on the constructed technologies but also on their unfolding when applied in practice. However, the intense use of IS in all social and business areas, fastened by the digitalization phenomena, has driven a disruptive change in the way we study IS in Brazil.

It has been fundamental to turn our research focus from technologies to problems in real multifaceted, complex, unstructured, and uncontrolled contexts. This complexity can only be addressed through the development of a strong systemic view ability [2], which requires a broad and open perspective as well as to combine new research mindsets and contributions coming from other sciences (social, arts, humanities). It also requires a review on research epistemologies, methodologies and practices, understanding and including in our research repertoire theories, approaches and methods which avoid fragmenting the reality into social and technological separated aspects [3][4]. Finally, a deep change on how we educate new IS professionals and researchers is also taking place [5][6].

As a response to this, the IS scientific community within the Brazilian Computer Society (SBC) recently elaborated on the research challenges in IS [1]. The challenges reflect the prevailing ideas of the IS community to cope with the increasing technical complexity and social diversity of contemporary society, which are: C1) Systems of Information Systems, C2) IS and the Open World Challenges, C3) IS Complexity, and C4) Sociotechnical view of IS (see Appendix II).

The movement towards conducting applied research is also identified in the overall CS research community in Brazil. A brief survey (see Appendix I) on recent publications from Brazilian CS/IS researchers shows a multitude of contexts being addressed: Education, Entertainment, Culture, Industry, Government, Health and Healthcare, Natural resources, Military, Media and Services etc. These research initiatives are directed to important Brazilian problems, like tropical diseases, hunger, management of natural resources, government programs and policies, industry and business digitalization (e.g., SMEs, informal work), urban life (e.g., 'favelas'), cultural aspects of dealing with information and digital media (e.g., indigenous people) etc.

This landscape exposes how we are on the threshold of a new way of doing IS research and how, as a research community, we must embrace the challenge of nurturing the education-research-innovation Brazilian ecosystem to produce significant scientific advances and innovation with technological, economical and social impacts in Brazil.

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APPENDIX I - Brief survey on recent CS applied research

We do not intend to be extensive on the CS/IS research and innovation contribution in Brazil, but just to bring a brief overview of some areas and solutions provided that we are aware of.

In Brazil, CS/IS research has provided theories, inputs and artifacts that contributed to several areas, such as Education, Entertainment, Culture, Industry, Government, Health and Healthcare, Natural resources, Military, Media and Services. In pandemic times it is straightforward to remember works on Dengue, Zika and H1N1 epidemics as well as disaster risk monitoring, early-warning and emergency response. IS research and innovation in Brazil has also provided support in Health and Healthcare for diverse cases and situations, for instance prediction of leptospirosis cases, cancer screening, monitoring patients with Alzheimer's and other dementias, automatic diagnosis, remote patient monitoring, alarm fatigue in hospitals, mortality prediction, support of chronic diseases treatment, improved affectability for children at hospitals, weight change, dealing with depression, and hearing aids and frequency modulated systems for deaf and people with hearing disabilities.

In the scope of natural resources, IS research and innovation in Brazil has provided support for analysis of carbon monoxide, anomaly detection of natural gas production, energy consumption forecast and situation-awareness for energy efficiency (here we call attention to several Brazilian blackouts in the years 1985, 1999, 2000-2002, 2009, 2011 and 2018), smart bathroom (for water and electrical energy economy), and determining flooded areas. We can also mention works on satellite control, navy management, planning military operations.

IS Research in Brazil have also provided support for government in several perspectives such as looking for opinions and solutions for the region, improving citizen participation, making public services better and more transparent and understandable, analyzing the scalability of government programs, providing digital elections, predicting results, investigating contracts and driving policies.

In the industry, Brazilian IS research has driven digital innovation and transformation, business process thinking, management and improvement, including knowledge-intensive processes, customers understanding of business services, transparency, accountability, (social) innovation, predictions and decision-making in diverse

areas, value assessment, negotiation mechanisms, and workarounds in retail work systems.

IS research has provided support for pedagogical support of digital technologies (an even more important issue in pandemic times), including indigenous people and active learning; informal learning such as through question and answer communities, and searching; understanding of students motivation and engagement (or lack of); IS curricula and didacts. Understanding online news, digital media and social networks is also supported by IS research: identifying fake news, discrimination, hateful users, experts, and different behaviors.

From the epistemological-methodological point of view, we notice a movement towards pragmatism, and action-design and design science research.

APPENDIX II - IS Research Challenges Description

C1) Systems of Information Systems. In the open, globalized and connected world, information systems not only support a high diversity of application domains, such as business, health, and crisis response but perform several tasks and complex functionalities. Systems-of-Information Systems (SoIS) are a specific type of Systems-of-Systems (SoS) that presents new challenges for the Information Systems (IS) development and research community. SoIS exhibits all SoS characteristics with an additional strong business nature. SoIS are made up of several IS that combine their capabilities.

C2) Information Systems and the Open World Challenges. The world is a network. The challenge is to understand its dynamics and to propose, build and understand the impact of information systems to support it. A long list of aspects should be considered when associating information systems to the open and virtual world. These include mobility, collaboration, empowerment, interoperability, knowledge sharing, scalability, transparency, privacy, security, flexibility, value, reliability, diversity, licensing... the list is endless. New technology trends also must be considered: open and linked data, social networks, multi-agent systems, just to mention a few. The open world is true and necessary for different application domains, from service provision to innovation, including society's access to information, and participation, both in the public as well as private sectors. Different relationships between consumers and providers are emerging. Anyone can be a producer, anyone can be a consumer in the open world. New ecosystems arise from this connected world and new approaches to designing and

providing information systems to support these ecosystems are needed, challenging Brazilian legislation, government, industry and market production processes and people's behavior, education and culture.

C3) Information Systems Complexity. Current and Future Information Systems comprise several components. These components could be other systems, software or sensors hosted on different computational platforms. Due the diversity and quantity of components IS are becoming more and more complex. In the context of information systems, information exchange and interaction between users frequently occurs across heterogeneous environments. Interoperability is a key requirement to support activities in heterogeneous environments efficiently and effectively. Additionally, concerning information technology infrastructure for information systems, virtual support and development platforms are changing the way customers interact with data and applications.

C4) Sociotechnical View of Information Systems. Information systems are not just software or people using software. They are the full integration of people and technology and the multitude of relationships that arise from this integration. Information systems today and in the coming years cannot be designed, developed, researched, used or learned without consistent approaches to address the complexity of the sociotechnical system that our society is and will continue to be. Effectively solving information systems problems means developing competencies in IS research, education and in the professional community to fully understand what a sociotechnical view is, and to consistently apply interdisciplinary methods and practices in order to understand and solve real world problems.