



WEB SCIENCE BRASIL
Brazilian Institute of Web Science
Research



Report

Brazilian Institute of Web Science Research

June 2010



1. Main Researchers

Institute Organizational Structure

The Institute Organizational Structure is divided into three layers. The Steering Committee is located at the top layer. Five Research Managers (one for each stratum) compose the management team located in the middle layer. Several Researching Groups are located at the bottom one. A finance and procurement manager does provide support to decisions held by the Steering Committee.

The Steering Committee is composed by six members. Its main responsibilities are: to approve the annual research plan; to allocate the budget aligned with this proposal; to manage the institute operations; and to report the institute performance to CNPq. Additionally an Advisory Board, composed by a Brazilian and a foreign researchers, on an annual basis, will audit the institute performance according to the plan previously approved by this committee, reporting written recommendation to guide the institute in achieving the goals enumerated in this proposal. This committee activities are described in the Stakeholders Liaison Function and its structure is the content of 1.

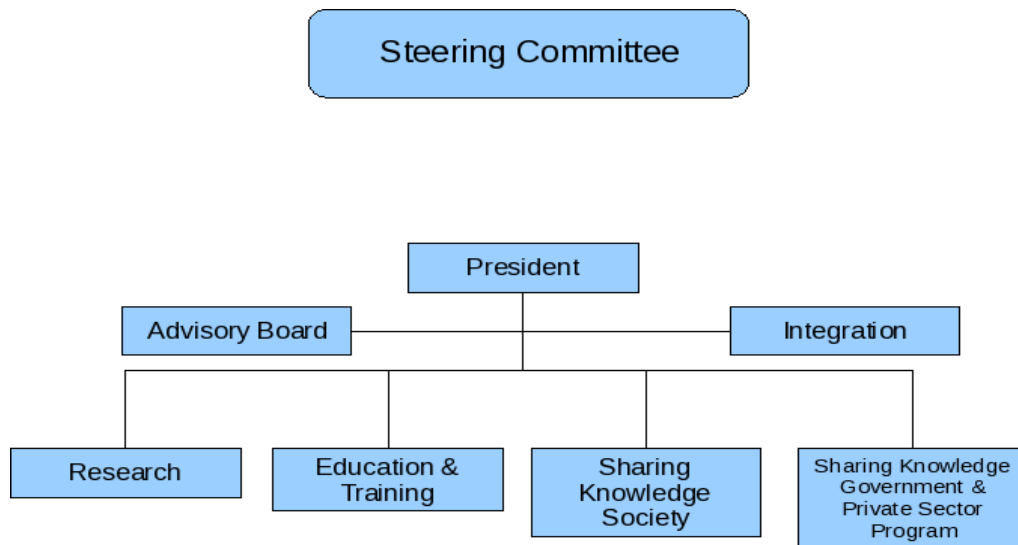


Figure 1: Steering Committee Composition

Steering Committee

In order to fulfill the above mentioned responsibilities, the Steering Committee will be structured as follows:

- Prof. Carlos José Pereira de Lucena (President)

As the institute coordinator prof. Lucena will be the steering committee president. He will focus on the liaison between the institute and the stakeholders.

Prof. Lucena has graduated in Economics and Mathematics from the Pontifical Catholic University of Rio de Janeiro (1965), he got a Master's of Mathematics from the Department of Computer Science & Applied Analysis of the University of Waterloo (1969), a PhD in Computer Science from the Computer Science



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Department of the School of Engineering and Applied Sciences of the University of California at Los Angeles (1974) and was a post-doctoral research fellow at the IBM Research Laboratory in Palo Alto (1975). Since 1982 he is a full professor at the Pontifical Catholic University of Rio de Janeiro. He is also an adjunct professor at the University of Waterloo and a Research Associate at the Fraunhofer FIRST Institute in Berlin. He is a member of the editorial board of several international journals: the Communications of the ACM, the Proceedings Journal of the Brazilian Academy of Sciences, The International Journal of Formal Aspects of Computing and the International Journal of Agent-Oriented Software Engineering (IJAOSE). He has experience in the field of Computer Science, with emphasis on formal aspects of computing, software engineering and multi-agent systems. Prof. Lucena receives a level 1A research productivity fellowship from the CNPq (Research Council). In his career he worked at the Pontifical Catholic University of Rio de Janeiro as vice-rector of the University, Dean for the Center for Science and Technology, and several times Director of the Computer Science Department. Prof. Lucena was awarded the insignia for the Grand Cross of the Order of Scientific Merit of the Presidency of the Republic of Brazil, the Medal of Scientific Merit Carlos Chagas Filho from the Council of Directors of FAPERJ (State Research Council), the Alvaro Alberto Award for Science and Technology (Ministry of Science and Technology) and several times the IBM Innovation Award, among many others. Prof. Lucena is a fellow of the Guggenheim Foundation and a member of the Brazilian Academy of Sciences.

- Prof. Nelson Maculan Filho (Integration Mission)

The Integration Mission is responsible for conducting the internal operations and execution of the Institute's operational plan. Four missions fall within his purview: addressing research, training and education, sharing knowledge with society and sharing knowledge with government and private sector.

Prof. Maculan has a B.Sc. degree in Mining and Metallurgy Engineering, School of Mines, Ouro Preto, (1965), a M.Sc. degree (DEA) in Mathematics Statistics, Université de Paris VI (Pierre et Marie Curie) (1967), a Ph.D. degree in Operations Research, Federal University of Rio de Janeiro (1975) and the Diplôme d'Habilitation à Diriger des Recherches (DHR) en Sciences de la Gestion (1988), Université Paris-Dauphine (Paris IX). He is currently Full Professor of the Federal University of Rio de Janeiro. He has a vast experience in the field of computer science, with emphasis on computational mathematics, acting mainly on the following themes: combinatorial optimization, integer programming, linear programming, generation of columns and overall optimization. Prof. Maculan receives a level 1A productivity fellowship for his research from CNPq. His research areas encompass graph theory, optimization of graphs and combinatorial optimization. Former President of the Federal University of Rio de Janeiro, Director of the Alberto Luiz Coimbra Graduate School of Engineering (COPPE/UFRJ), and Head of Department of the Systems Engineering and Computer Science Graduate Program (COPPE/UFRJ), he also served as National Secretary for Higher Education (Ministry of Education) and, recently, as State Secretary for Education in Rio de Janeiro, Brazil. Prof. Maculan was awarded several honorary degrees, such as: Chevalier dans l'Ordre National du Mérite, Paris, France; Docteur Honoris Causa, Université Paris 13, France; Doctor Honoris Causa, Universidad Nacional Mayor de San Marcos,



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Lima, Peru, and with the Medal of the Grand Cross – National Order of Scientific Merit – by the Presidency of the Republic, Brazil. Prof. Maculan is a full member of the Brazilian Academy of Sciences.

- Prof. Valmir Carneiro Barbosa (Research Mission)

The Research Mission is primarily concerned with promoting a high quality international standard research program aligned with the Action Plan for 2007-2010 for Science, Technology and Innovation (PACTI in Portuguese).

Prof. Barbosa holds a PhD in computer science (University of California, Los Angeles, 1986), is professor of the Federal University of Rio de Janeiro. He operates in the area of computer science, with emphasis on parallel and distributed computing and models of complex systems. He receives a level 1A research productivity fellowship from the CNPq. Was a Visiting Scholar at the University of California, Berkeley, UCB, USA. Member of editorial board of IEEE Journal of Transactions on Computers and Journal of the Brazilian Computer Society.

- Prof. Edmundo A. de Souza e Silva (Education and Training Mission)

The Education and Training Mission is devoted to developing and implementing a high quality international standard program at undergraduate and graduate levels. The implementation of training programs (short and long duration) for government and private sector personnel is among the objectives of this Mission, enabling the flow of knowledge from the institution into these sectors. One big challenge in this Mission is to guarantee that the education and training programs have a nationwide coverage.

Prof. Souza e Silva has an Electrical Engineering degree from PUC-Rio (1975), an M.Sc. in Electrical Engineering from PUC-Rio (1978), a Ph.D. in Computer Science from the University of California, Los Angeles (1984), and has residencies at the IBM Watson Research Center (1985) and the University of California, Los Angeles (1994). He is currently Full Professor at UFRJ. He has experience in Computer Science in the areas of availability, performance, queueing networks and reliability. He has a productivity scholarship from CNPq at level 1A. He is visiting professor at the Chinese University of Hong Kong, at the University of California, Los Angeles and at the University of Southern California, among others. He has the Medal of Scientific Merit – Comendator, and he is a member of the Brazilian Academy of Science.

- Prof. Marco Antonio Casanova (Transfer to Society Mission)

The Transfer to Society Mission, besides the publication of articles in journals and congresses, is responsible for promoting, through its researchers and graduated students, training programs target to the general public, focusing high school audiences.

Prof. Casanova has graduated in Electronic Engineering at the Military Institute of Engineering (1974), holds a Master degree in Computer Science from the Catholic University of Rio de Janeiro (1976), Master in Applied Mathematics from Harvard University (1978) and Ph.D. in Applied Mathematics also from Harvard University (1979). Today he is Associate Professor and Director of the Department of Information Technology of the Pontifical Catholic University of Rio de Janeiro. His main area of research is Database. Prof. Casanova receives a level 1C productivity fellowship for his research from CNPq.



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- Prof. Claudia Maria Bauzer Medeiros (Transfer to Government and Private Sector Mission)

Building a network of private and governmental initiatives enabling the participation of qualified institute personnel in the development cycle of new products and services where emerging knowledge from the institute will be embedded is part of this mission objectives. A narrow relationship with innovative enterprises embraced within the Brazilian Technology System (SIBRATEC in Portuguese) will also be a point of focus.

Full professor at the Institute of Computing, UNICAMP, since 2001, has graduated in Electrical Engineering - Catholic University of Rio de Janeiro (1976), MSc in Computer Science - Catholic University of Rio de Janeiro (1979), Ph.D. in Computer Science - University of Waterloo (1985). Member of the Advisory Committee of Computer Science and Engineering of FAPESP (2004-present), was coordinator of the Advisory Committee on Computer Science at CNPq (2001-2002), vice coordinator of the Advisory Committee on Computer Science at CAPES (1998-2000). Conducts research in databases, with emphasis in scientific databases, scientific workflows and eScience (biodiversity and agro-environmental planning). Former president of the Brazilian Computer Society (2003-2007). Receives a level 1B research fellowship from CNPq. She was awarded the Newton Faller prize (SBC 2000), the Change Agent Award (ACM and Anita Borg Institute) and twice the Zeferino Vaz Academic Excellence Award (UNICAMP). In 2007, granted a Doctor Honoris Causa by the University Antenor Orrego, Trujillo, Peru and in 2008 admitted at the Brazilian Order of Scientific Merit, as Commander.

Advisory Board

The Advisory Board is constituted by two internationally recognized researchers:

- Prof. Philippe Michelon (B.Sc., D.E.A, Ph.D., H.D.R.) is a full professor in computer science and vice president for research at Université d'Avignon et des Pays de Vaucluse. He is the advisory member working in France (<http://www.univ-avignon.fr/fr/presentation/organisation/conseils.html>); and
- Prof. Lindolpho de Carvalho Dias (B.Sc. and Ph.D.) is a full member of the Brazilian Academy of Science (ABC in Portuguese) and also at the National Academy of Engineering (ANE in Portuguese). He was rewarded due to the merits achieved during his academic career with the Grand Cross Medal – National Order of Scientific Merit – by the Presidency of the Republic, Brazil. Prof. Lindolpho de Carvalho Dias curriculum can be accessed at <http://www.abc.org.br/sjbic/curriculo.asp?consulta=lindolpho>.

All researchers involved with the project are supposed to dedicate 20% of their time to the project.

- UFRJ
 - 29 researchers
 - 7 exclusive laboratories
 - 2 public laboratories
 - Access to COPPE super-computers
 - Approximately 120 graduate students



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- PUC-RJ
 - 22 researchers
 - 7 exclusive laboratories
 - Approximately 120 graduate students
- UNICAMP
 - 12 researchers
 - Information Systems Laboratory
 - 8 Ph.D. students, 10 M.Sc. students, 22 undergraduate students
 - Other common facilities.
- UFF
 - 10 researchers
 - 1 graduate laboratory
- UNI-Rio
 - 7 researchers
 - 2 laboratories, each one with 10 workstations and 1 laser printer
 - 1 server
 - 12 M.Sc. student, 6 undergraduate students.
- UERJ
 - 6 researchers
 - 1 graduate laboratory
- UENF
 - 1 researchers
 - 3 graduate laboratory
- UFRN
 - 6 researchers
 - 3 laboratories, with a total of 35 workstations, 2 laser printers and 2 servers.
 - 3 Ph.D. students
 - 10 M.Sc. students
 - 8 undergraduate students
- UFC
 - 6 researchers
 - 1 graduate laboratory
- RNP
 - 2 researchers



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Main Research Topics

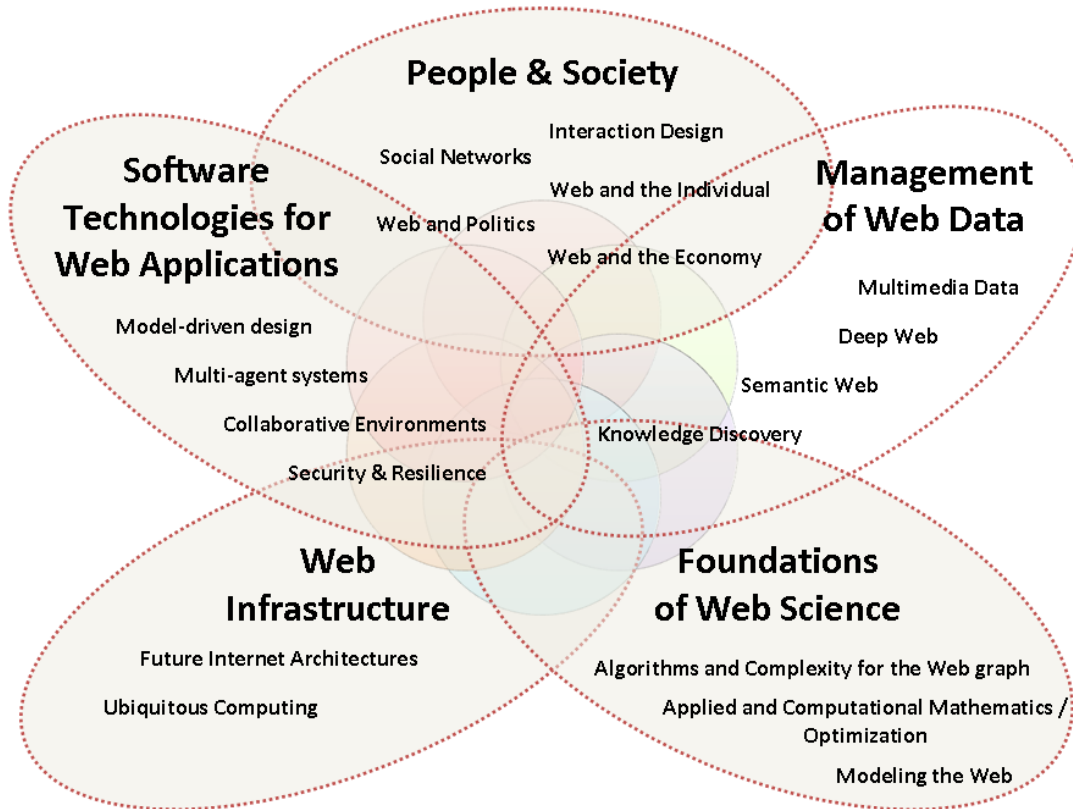


Figure 2: Web Science research program.

The Institute establishes a research program for the Web as a primary object of study. This program is organized along five layers, depicted in Figure 2. Though the figure shows these layers in seemingly independent blocks, they are interconnected: results in each layer contribute to the solution of problems in the others.

The topmost layer, “People & Society”, will investigate the social, political and economic aspects of the Web, concerning for instance its influence in economic shifts and employment, and its role in securing the basic social values of trustworthiness, privacy, and respect for social boundaries. Studies will also deal with the need for new human interfaces – e.g., to allow the digital inclusion of elderly and semi-literate populations. This layer is intimately related with the fourth Grand Research Challenge proposed by the Brazilian Computer Society (“Participative and universal access to knowledge for the Brazilian citizen”) [Medeiros 2008].

The “Software Technologies for Web Applications” layer will consider specific issues in the design, development and deployment of large distributed applications on the Web, involving millions of users. This includes investigating interaction aspects (and thus the People layer), but also new execution paradigms, and models, tools and techniques to support novel application domains (such as those in e-Science, e-Learning and e-Engineering). As such, this layer is related with the second Grand Research Challenge of the Brazilian Computer Society (“Computational modeling of complex systems: artificial, natural, socio-cultural and human-nature interactions”).



The “Management of Web Data” layer will address access and management of heterogeneous, distributed data sources, from the Terabyte (10^{12}), through the Petabyte (10^{15}), to the Exabyte(10^{18}) levels. This involves combining these sources, to extract and generate new knowledge that is served to the Applications layer, to the benefit of People. While present Web knowledge management tools mainly deal with text, new kinds of results are needed to enhance semantics, and to access all kinds of multimedia data available. This layer contributes to efforts towards the first Grand Research Challenge (“Management of information over massive volumes of distributed multimedia data”).

The “Web Infrastructure” layer will deal with the Web as a technological means to ensure scientific, technological and societal progress, dealing primarily on the question of how to scale to meet performance or reliability expectations. It will thus advance results on areas such as computer networks, integrity and dependable computing, ensuring security in data transfer and communications, and distributed and parallel execution of the hundreds of thousands of processes needed by novel applications – therefore contributing to all other layers. It will borrow from, and contribute to research in the fifth Grand Research Challenge (“Technological development with quality: dependable, scalable and ubiquitous systems”).

Last but not least, research on the “Foundations of Web Science” is needed to support research in all of the previous strata. Work conducted here will contribute, among others, to optimize the performance of systems that execute on the Web, to create mathematical models of the Web and the billions of links and interactions among its many systems (a new object of study in graph theory, called Web graph), and models that address the complex interactions between Web applications and their users.

Table 1 summarizes the topics and goals per layer.

Table 1. Summary of Topics and Goals per Layer.

People & Society	
Interaction Design	G1. Study the fundamental properties of Web applications as social machines and the theories that could represent a foundation for the interaction design G2. Develop tools to support Web interaction and navigation for users with special needs such as visual impairment and low levels of functional literacy skills. G3. Develop methods and tools to support the development of interaction mechanisms that make the information sharing explicit and in accordance to the social policy expectation of a community of users. G4. Study the pragmatics of human interaction and communication throughout the Web to understand and explain Web languages, based mostly on semiotics and semiotic engineering, but also linguistics, psychology and philosophy G5. Investigate current tools and interaction paradigms for empowering users to adapt and extend content and services on the Web G6. Study non-speech sound interfaces to improve interactions in the Person-to-Person Computer-Mediated Communications G7. Investigate new interaction techniques and paradigms on the Web G8. Investigate the socio-pragmatics of human interaction with information through Web application, the social and legal rules governing information uses.
Social Networks	G1. Ethnographic Analyses to Understand the social Web G2. Definition of models for social networks analysis and mining in order to



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	<p>discover patterns, needs and requirements for collaboration support</p> <p>G3. Definition of mechanisms for knowledge discovery and organization from narrative social content</p> <p>G4. Configuration and conceptualization of digital heritage in social networks</p> <p>G5: Analyze and balance social networks</p> <p>G6. Develop tools to support intentional social networks</p> <p>G7: Incorporate autonomic characteristics into the control of social networks</p> <p>G8: Investigate scientific social networks</p> <p>G9: Investigate temporal and mobile social networks</p>
Web and the Individual	<p>G1. Mapping the field</p> <p>G2. Data collection</p>
Web and Politics	<p>G1. Analysis of the use of the Web in Brazilian elections</p> <p>G2. Analysis of the Web use by social movements</p>
Web and the Economy	<p>G1. Development of Internet auction data collecting software.</p> <p>G2. Development and application of econometric techniques to investigate Internet auction data.</p> <p>G3. Development of a decision support framework based on data from the Semantic Web</p> <p>G4. Framework instantiation for the capital markets domain</p>
Software Technologies for Web Applications	
A Multi-Agent Systems Approach for Developing Autonomic Web Applications	<p>G1. Design techniques to improve the development of autonomic Web applications</p> <p>G2. Define a framework to support the development of autonomic Web applications</p>
Model-driven Design and Implementation of Web Applications	<p>G1. Define a model-driven framework to support specification, design and implementation of Web applications, seen as part of men-machine teams.</p> <p>G2. Develop case studies (software product lines) for the Web context</p> <p>G3. Develop methodologies, empirical studies and tools to support the development of software product lines for the Web context</p>
Design and Implementation of Autonomic Workflows	<p>G1: Investigate and prepare the scenario</p> <p>G2: Develop the autonomic element</p> <p>G3: Integrate sub-workflows</p> <p>G4: Develop autonomic data approach</p> <p>G5: Specialize solution for Web services</p> <p>G6: Analyze the applicability of the solution in other scenarios</p>
Security and Resilience of Web Applications	<p>G1. Define static analysis techniques supporting development approaches for detecting possible threats to application security</p> <p>G2. Propose a development approach to improve Web-application resilience to faults, enabling them to coexist with faults</p>
Web-based Collaborative Virtual Environments	<p>G1. Investigate the Web as a means for eScience and eLearning through CVEs</p> <p>G2. Interactive storytelling for Web-based collaborative virtual worlds</p> <p>G3. Interactive storytelling for cultural content production and e-learning in the Web</p>
Management of Web Data	
Managing Web Multimedia Data	<p>G1. Definition of new multimedia data descriptors and of storage structures to support their indexing, reuse and composition on the Web</p> <p>G2. Design and development of mechanisms to annotate multimedia data, and to index and retrieve such annotations, having in mind educational uses on</p>



	the Web
Accessing the Deep Web	G1. Definition of heuristics for database identification, mediated schema definition and schema matching G2. Development of query mediators
Developing the Semantic Web	G1. Definition of a method to develop reference domain ontologies based on the composition and alignment of existing (upper level) ontology fragments G2. Definition of a method for the description, discovery and automated composition of semantic Web services G3. Design techniques to improve the resilience of service-oriented architectures based on Web services G4. Define a framework to support the development of dynamic and resilient Web applications G5. Design and development of a specification and a model to evaluate, and personalize search results according to users' quality level perspectives
Knowledge Discovery on the Web	G1. Develop learning algorithms for classification and regression problems G2. Develop machine learning frameworks with EPM implementation for large volumes of data
Web Infrastructure	
Future Internet Architectures	G1. Design and deploy a testbed for R&D in network architectures G2. Explore new design approaches aiming at Web Applications G3. Design and implementation of a measurement infrastructure for the testbed G4. Design, deployment and use of a wireless testbed for research on the impact of mobility on web applications
Ubiquitous and Location-aware Web	G1. Develop prototype location-aware Web services G2. Develop frameworks and middleware services that ease the development of such ULW applications
Foundations of Web Science	
Algorithms and Complexity for the Web graph	G1. Define algorithms in graphs, and / or negative results for combinatorial problems
Applied and Computational Mathematics / Optimization	G1. Implementation of a continuous optimization library with and without constraints. G2. Development of new methods for implicit enumeration in combinatorial optimization, column generation and cutting planes. G3. Implementation of metaheuristics aiming to search for lower bounds (in maximization) and upper bounds (in minimization).
Modeling the Web	G1. Study robustness/scalability issues of P2P systems and develop robustness models for those. G2. Development of methods, tools and techniques for e-learning G3. Development of algorithms for P2P systems G4. Model the future Web graph



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Summary of Results

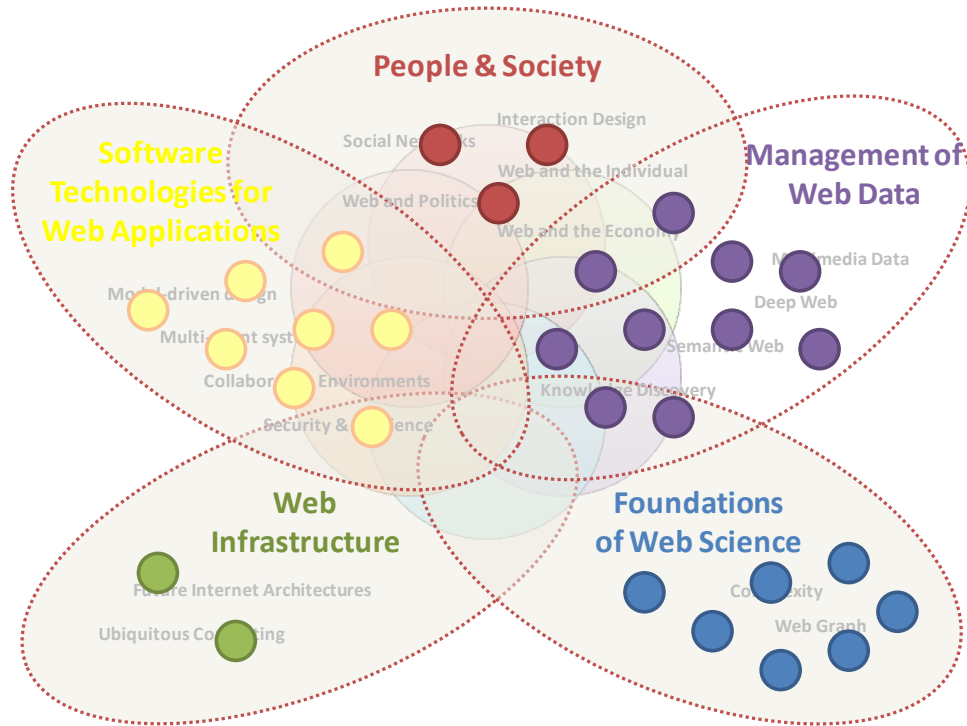


Table 2 summarizes the results per layer.

Table 2: Summary of results per layer.

People and Society
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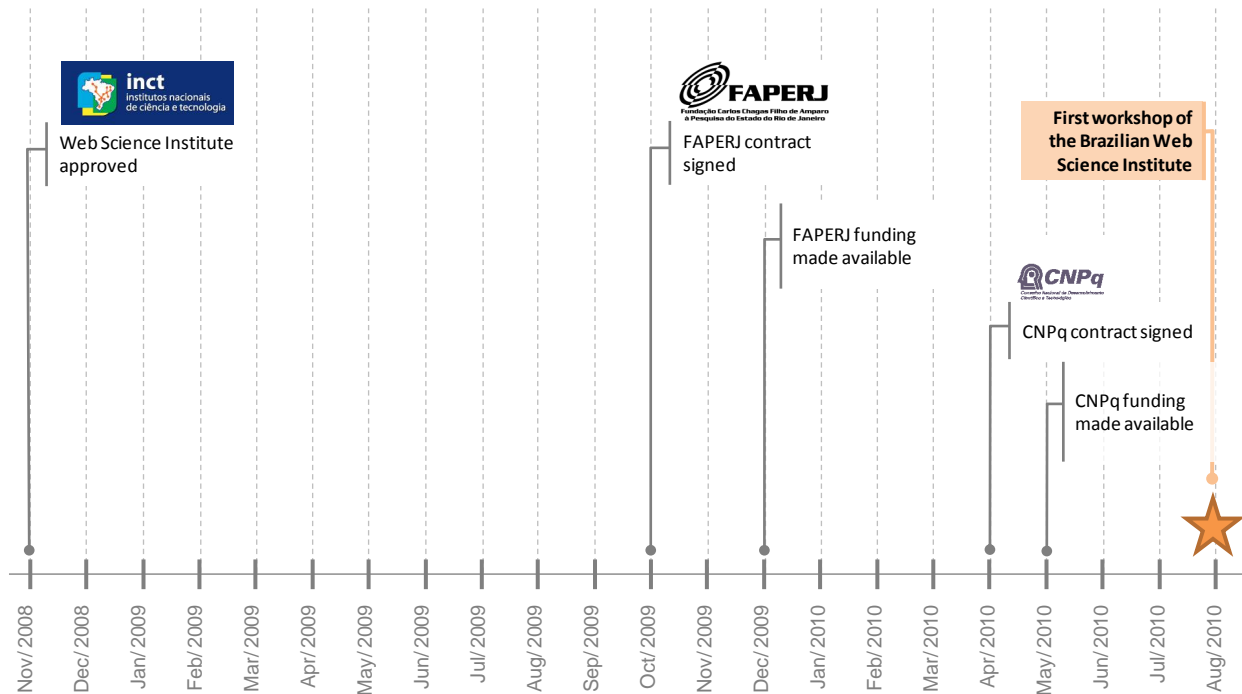
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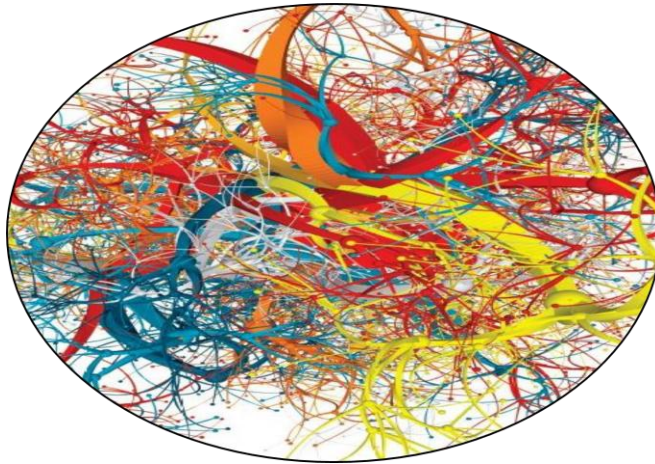
Timeline





Final remarks

- The Web...
 - has had a tremendous impact on scientific research, technological development, and human experience and society



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