University POLITEHNICA of Bucharest
Faculty of Automatic Control and Computers

Habilitation Thesis Summary

Computer Science, Information Technology and Systems Engineering

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This habilitation thesis presents my contributions related to model-driven development and evolution of federative and service-oriented systems, as well as research challenges and trends that I shall investigate as a PhD coordinator with the Faculty of Automatic Control and Computers, University Politehnica of Bucharest.

My PhD thesis concerned automated systems based on algorithms for processing biomedical signals, applying high order spectral analysis in order to separate individual waves of the body electrical activity from the overlapping noise; I investigated both simulated signals and real-life measurements. My research interests progressively evolved towards the use of models in engineering and the development of service-based systems, getting to a combination of the two fields.

My achievements are presented in the first part of this habilitation thesis, in three chapters, correspondent to the academic, research and scientific paths, which are actually strongly related to each other. My teaching history consists of 15 courses, 4 of them being taught in English and 1 in French, including subjects related to: software engineering, model-driven engineering, process management and business service integration. Several details on education for model-based and model-driven engineering are also presented, followed by the contributions for aligning education on services to the European trends.

The summary of the research activity shows the history of my implications in research grants and projects, in programmes like FP4, FP6, FP7, CEEX, CNCSIS A, Partnerships, IDEI etc. The habilitation thesis describes the main contributions of 10 years of research. My interest in models was materialized through the realization of:

- A UML profile, metamodels, methodology and tools for software federations based on compositions of models - within the FP6 FEDARC project, at University of Grenoble;
- A metamodeling paradigm and a model library for measuring instruments, model-driven data integration tools and a Web-based learning environment based on them – within national research projects (CNCSIS, CEEX, IDEI), in collaboration with the Technical and Applied Magnetism Center, University Politehnica of Bucharest;
- Object-oriented models for medical records dedicated to general and chronic diseases, within the FP7 Eurocancercoms project, at Siveco Romania.

Regarding my interest in services, the main results are related to:

- An evolvable trans-national business system based on Service-Oriented Architecture and semantic technologies, within the FP6 LD-CAST project, in collaboration with 7 European partners;
- A cyberphysical system for water management based on early warning services, within the PN II CyberWater project, coordinated by the Computer Science Department, UPB, in collaboration with 2 partners from Romania.

Apart from these systems, my goal was also to apply models for the documentation, design and execution of a large variety of service-oriented systems. A brief enumeration of contributions, where the two research interests presented above are overlapped, contains:

- View models applied for an SOA system integrating services provided by chambers of commerce form different European countries;
- Code generation for service composition based on a metamodel of inter-domain relationships;

- SoaML design for a service-oriented system based on a cyberinfrastructure;
- Metamodel and tools for characterizing the human aspects of migration to SOA.

The results were published in more than 10 books and book chapters, 60 research papers and articles indexed in major databases, 20 indexed by ISI Thompson, with more than 150 citations reported on Google Scholar. This publication work was performed in collaboration with more than 30 co-authors from 10 countries and pertaining to 13 organizations. The thesis gives a comprehensive description of my publication activity, the scientific and professional organizations where I am a member, and the scientific community maintained with the occasion of various collaborations for research projects, co-authoring articles or books and organizing scientific events. I served in more than 20 editorial boards and program committees for international events (15 of them being indexed by ISI Thompson). I thus had collaborators from 19 countries from Europe, North America, South America, Asia and Australia, and I intend to continue to get involved in the scientific community, on the topics previously mentioned.

The second part of the habilitation thesis presents my plans for evolution and career development. The research trends and challenges that I am going to investigate in the subsequent work, including in the future coordination of PhD students, are grouped around 2 main directions:
- Migrating Legacy Applications to Service-Oriented Systems and Cloud Based Environments,
- Ubiquitous Modeling within an Extended System Lifecycle.

These trends were identified through multiple methods, including a systematic study of scientific literature, the analysis of research topics promoted by the major conferences in the domains of interest, as well as multiple discussions with world-class specialists in the field. Last but not least, they were crystallized during my direct participation to or coordination of scientific community activities, like: organizing the IEEE International Symposium on the Maintenance and Evolution of Service-Oriented and Cloud-Based Systems, a co-located event of a rank A conference; editing a featured book on Migrating Legacy Applications: Challenges in Service-Oriented Architecture and Cloud Computing Environments, published by IGI Global in 2013; participating to the Special Interest Group of an FP7 project on model-driven transformation of legacy software to service provisioning.

My research agenda follows the two main directions previously indicated and aims to converge towards my central objective of combining models and services. The topics that I am going to investigate in the ongoing research projects, as well as in future projects, proposals and student advisory are:
- Services for Geographical Information Systems,
- Metamodels for Big Data in Advanced Cyberinfrastructure,
- Scientific Cloud Computing,
- Socio-technical aspects of software and systems evolution.

Summarizing, my plan of career development as a professor and PhD scientific coordinator with the University Politehnica of Bucharest focuses on: creating a solid team for research on model-driven engineering and service-oriented systems; increasing the production of scientific publications in major conferences and journals; strengthening the collaborations with colleagues from the Faculty of Automatic Control and Computer Science and with Romanian personalities in the field from other academic and research centers in Romania and abroad; enhancing the international visibility of the young researchers from UPB and their active involvement into a high-level community of scientists from all over the world.

Solving the challenges related to extreme data, advanced services and social aspects is essential for facing the new requirements of the global scale, induced not only by the industry, but also by the new living paradigm. Given the huge complexity of this task, models can play an important part to increase the level of abstraction and to open the path towards simplicity, seen as "the ultimate sophistication".

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