

Advances in Service Systems Engineering: a Modelling and Simulation Approach

Monica Drăgoicea

- Habilitation thesis summary -

Main keywords: service systems, service innovation, service systems engineering, modelling, simulation, multi-agent systems, socio-technical description in service systems

This work presents a synopsis of the main research results published after October 2000, when I finalised the PhD thesis, *Contributions to the Design of Adaptive Control Systems Using Neural Techniques*, PhD supervisor: Prof.dr.ing. Ioan Dumitrache.

The new research domain that I approached in the last five years is strongly related to the application of Service Science body of knowledge as high level design guidelines in the development of improved smart services with IT support. Specific results obtained in the Service Systems Engineering context are identified and described in Chapter 2.

Actually, this work describes an exploration towards the usability evaluation of Service Science principles and their transposition into design guidelines of complex service systems of the future. It reinforces the interest to evolve the exploration perspective towards a methodology more specifically targeted to Service Systems Engineering, taking into considerations socio-technical aspects. Exploration in Service Science is considered today as a good opportunity for researchers and practitioners to advance their research.

Chapter 1 presents an overview of the main landmarks on the personal roadmap, both in research and teaching activities, spread over the last 22 years. This chapter presents also specific orientation of activities after finalizing the PhD programme. It introduces the main research topics and time frames, it summarizes topics in conducting research, and highlights personal involvement in PhD supervision, in evaluation juries, and supervising committees.

Chapter 2 describes the main contributions towards engineering service systems, from a modelling and simulation perspective. The need for such research is thoroughly motivated, considering two important aspects: the evolution of the service sector in the current economical situation, and the complexity in evolving service systems and deploying innovated services. As the thesis highlights, a systems approach is crucial for addressing service systems development that integrates people, processes and technologies. Process design, management, and ICT competences are required today in order to address the pervasive technology enabled services. Based on personal past experience, this endeavour is oriented here towards the integration of high-level design and analysis aspects of systems engineering into further research directions. The application of the model-driven development and socio-technical perspectives in service systems engineering is evaluated and supported through recent published results.

In this respect, the thesis formulates a research roadmap integrating three important perspectives: a) *Service Science* research, b) *socio-technical systems* research, and c) *modelling and simulation based systems engineering* concerns. This option of integration of these three perspectives was not approached yet in any of the referred literature.

This presentation of personal contributions in the newly approached scientific domain, referring specifically to the application of the Modelling and Simulation Based Systems Engineering (M&SBSE) and Agent-Based Modelling (ABM) visions in service systems design and development, opens several perspectives on future research activities. They are thoroughly formulated in several recent published articles and formalized as sound future research directions in Chapter 3.

Chapter 3 positions the research developed in the new domain proposed in this thesis in the perspective of the Smarter Cities concept. A research horizon of five years (2016 - 2020) is envisioned. This is exactly the framework of the Horizon 2020, the biggest EU Research and Innovation programme, the main financial instrument implementing the Innovation Union aiming at fostering Europe's global competitiveness.

Three main research directions are defined for future research, following the personal contributions depicted in Chapter 3: a) service systems modelling; b) resource allocation in service delivery, and c) smart transport systems.