

Lecture Notes in Business Information Processing

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Business Modeling and Software Design

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Preface

We light the deepest ocean
Send photographs of Mars
We're so enchanted by
How clever we are
Why should one baby
Feel so hungry she cries
Saltwater wells in my eyes
(*Julian Lennon, 1991*)

What will life be like in 2050? One would say: “Such an easy question – powerful computing, green energy, smart environments, autonomous vehicles.” But I would state in turn: “And what?”

Indeed, mankind has witnessed tremendous progress since the 18th century, marking the beginning of industrialization – the steam engine is to be mentioned as one of the key inventions. Then many decades later, the invention of the telegraph and the invention of the telephone; also, electric power was introduced. Later, the first automobile was created. Still later, telecommunications and electronics were “born.” All these developments have led to an apogee – the first television coming out in the 1920s. Media has become powerful. Mankind required new developments and the digital era began with the advancement of technology from analog electronic and mechanical devices to digital electronics. Then mainframe computers were introduced and used in enterprises, representing large-scale systems designed for processing and storing huge amounts of data. Nevertheless, it was only possible for larger enterprises to purchase and maintain mainframe machines and it was the appearance of smaller ones in the early 1970s that made computers really popular. During the 1980s, something of crucial importance happened: The Advanced Research Projects Administration (ARPANET) adopted TCP (Transmission Control Protocol)/IP (Internet Protocol) as a suite of communication protocols used to interconnect network devices, and this de facto introduced the Internet and client–server communication, giving way to global telecommunications. Combined with digital multimedia, these advances paved the way to tremendous developments. Further on, Web services and cloud infrastructures have appeared and enterprises facing the challenge of making (some) internal business processes external. And we are now in 2019, enjoying smart mobile devices that give us the impression that *anything* is “one click away.” But is it?

In our view, currently we often observe greedy corporations showering customers with services that “they can’t refuse.” Customers pay a lot for these services but they are rarely capable of precisely understanding what exactly they are paying for. These services are often of low quality but customers have rarely the chance of proving this and receiving compensation. Further, it is rarely realistic to enjoy transparency (with regard to what is going on between persons and big corporations servicing them) as

well as accountability (featuring those who “in theory” should be kept accountable if something goes wrong). Finally, we argue that most customers are not at all able to control and protect their privacy (in terms of privacy-sensitive data) and as a result we observe an increasing number of virtual crimes, fake news, and so on. The only thing that is certain is that corporations become more powerful and richer while the average person becomes less happy and poorer. Then what if, for example, this “average person” would be able to let his or her car “park on its own” – what is the “value” of one or more particular technical facilitation if the overall process context is unsatisfactory? Why do administrations become more bureaucratic, more expensive, and less effective, and business processes more and more confusing to customers? Why do we observe more and more errors in service provisioning? Why would everything become more and more complex (instead of becoming less complex)? Why should people suffer from new restrictions with regard to anything they do – technology is supposed to give us more freedom and protect public values but in “doing so” technology imposes severe restrictions on people, making their lives more complex, less happy, more stressful, and more expensive? And if we have this now, how would it be in 2050?

Maybe much of this concerns society and politics. But still, it is worthwhile asking ourselves the question of why science and technology developed so much while the average person is less happy now than in the past (as can be seen from numerous surveys). We argue that this is not only a matter of politics.

A big problem in our view is societal immaturity regarding the utilization of new technology, and this has two essential perspectives:

- How we specify what technology “does for us” (making sure that it really does what we need and not what somebody else claims we should need)
- How we integrate what technology “does” with the “surrounding” enterprise processes.

Unfortunately, 25 years after UML was developed, we are still unable (in our view) to adequately specify software (making absolutely sure that it does what the user needs) and we are still unable to adequately align the software with its corresponding enterprise environment.

Unfortunately, in 2019, we often have to adapt our behavior with regard to the software we are using but it should be the other way around – what the software “does” should be “adapted” to our behavior. We argue that this is what would increase user satisfaction and it is not a matter of yet another technical “fashion” decorated in posh terms. Instead:

- It is a matter of understanding the enterprise construction, the corresponding roles and signs, as well as rules and regulations, in order to reflect them in the specification of software.
- It is a matter of aligning this with coordination and interoperability mechanisms, for the sake of achieving reliable service provisioning.
- It is a matter of harmonizing different enterprise engineering viewpoints (structure, dynamics, data, and so on), achieving overall consistency.

- It is a matter of identifying the domain-imposed requirements and the user-defined requirements, making sure that they will play a role (and not be replaced by what the software developer would “imagine” that the user “should” need).
- It is a matter of possibly providing such solid software solutions in a service-oriented way, rather than showering the user with many different services that would often be in poor synch with each other.
- It is a matter of delivering autonomic and/or context-aware IT services, if needed, but only if this could really be tuned to the behavior of the user – it should not be the case that the user’s life gets more complicated by using technological facilitation.
- It is a matter of effectively re-using modeling constructs, software components, etc. featuring “proven solutions,” but not mixing up general and specific things that may result in a totally inadequate product in the end.
- It is a matter of considering crosscutting concerns, such as security, logging, and recoverability – they have to be precisely identified and reflected in functional solutions.
- It is a matter of data analytics – the current availability of so much data would allow for the application of advanced approaches based on statistics and machine learning, such that the user behavior is effectively predicted; but if the user behavior is badly predicted, then the software system may even become dangerous for the user.
- It is a matter of incorporating smart contracts and trust mechanisms in the software being developed, but this should not give (as a “side effect”) too much power and control to somebody.
- It is a matter of considering IoT, especially currently when there are too many devices and sensors around, but who is responsible if a device “does” something wrong or even harmful to the user?

Is anybody going to claim that currently all the aforementioned issues are effectively taken into account when developing enterprise information systems, in general, and software applications, in particular? We argue that any development covers only some of them but not all of them.

BMSD (<http://www.is-bmsd.org>) is an annual international symposium that brings together researchers and practitioners who are inspired to dream of better ways of developing (enterprise) information systems and software applications. What is more – the BMSD community is active in proposing innovative ideas, encouraging open discussions, and stimulating community building, driven by the goal of contributing to useful improvements in that direction.

We are proud of our history and for this reason we mention again (as in the 2018 proceedings preface) our editions: Since 2011, we have enjoyed eight successful BMSD editions. The first BMSD edition (2011) took place in Sofia, Bulgaria, and the theme of BMSD 2011 was: “Business Models and Advanced Software Systems.” The second BMSD edition (2012) took place in Geneva, Switzerland, with the theme: “From Business Modeling to Service-Oriented Solutions.” The third BMSD edition (2013) took place in Noordwijkerhout, The Netherlands, and the theme was: “Enterprise Engineering and Software Generation.” The fourth BMSD edition (2014) took place in Luxembourg, Grand Duchy of Luxembourg, and the theme was: “Generic

Business Modeling Patterns and Software Re-Use.” The fifth BMSD edition (2015) took place in Milan, Italy, with the theme: “Toward Adaptable Information Systems.” The sixth BMSD edition (2016) took place in Rhodes, Greece, and had as theme: “Integrating Data Analytics in Enterprise Modeling and Software Development.” The seventh BMSD edition (2017) took place in Barcelona, Spain, and the theme was: “Modeling Viewpoints and Overall Consistency.” The eighth BMSD edition (2018) took place in Vienna, Austria, with the theme: “Enterprise Engineering and Software Engineering – Processes and Systems for the Future.” The 2019 edition in Lisbon marks the ninth event, with the theme: “Reflecting Human Authority and Responsibility in Enterprise Models and Software Specifications.”

We are also proud to have attracted distinguished guests as keynote lecturers, who are renowned experts in their fields: Jan Mendling, WU Vienna, Austria (2018), Roy Oberhauser, Aalen University, Germany (2018), Norbert Gronau, University of Potsdam, Germany (2017), Oscar Pastor, Polytechnic University of Valencia, Spain (2017), Alexander Verbraeck, Delft University of Technology, The Netherlands (2017), Paris Avgeriou, University of Groningen, The Netherlands (2016), Jan Juerjens, University of Koblenz-Landau, Germany (2016), Mathias Kirchmer, BPM-D, USA (2016), Marijn Janssen, Delft University of Technology, The Netherlands (2015), Barbara Pernici, Politecnico di Milano, Italy (2015), Henderik Proper, Public Research Centre Henri Tudor, Grand Duchy of Luxembourg (2014), Roel Wieringa, University of Twente, The Netherlands (2014), Kecheng Liu, University of Reading, UK (2013), Marco Aiello, University of Groningen, The Netherlands (2013), Leszek Maciaszek, Wroclaw University of Economics, Poland (2013), Jan L. G. Dietz, Delft University of Technology, The Netherlands (2012), Ivan Ivanov, SUNY Empire State College, USA (2012), Dimitri Konstantas, University of Geneva, Switzerland (2012), Marten van Sinderen, University of Twente, The Netherlands (2012), Mehmet Aksit, University of Twente, The Netherlands (2011), Dimitar Christozov, American University in Bulgaria – Blagoevgrad, Bulgaria (2011), Bart Nieuwenhuis, University of Twente, The Netherlands (2011), and Hermann Maurer, Graz University of Technology, Austria (2011).

The high quality of the BMSD 2019 program is enhanced by a keynote lecture delivered by an outstanding guest: Jose Tribolet, IST – University of Lisbon, Portugal; the title of his lecture is: “Framing Enterprise Engineering Within General System Theory – Perspectives of a Human-Centered Future.” Also, the presence of former BMSD keynote lecturers is much appreciated: Roy Oberhauser (2018), Norbert Gronau (2017), Mathias Kirchmer (2016), Marijn Janssen (2015), and Ivan Ivanov (2012). Most of those outstanding scientists will take part in a panel discussion and also in other discussions stimulating community building and facilitating possible R&D project acquisition initiatives. These special activities will contribute to maintaining the event’s high quality and inspiring our steady and motivated community.

We demonstrated for a ninth consecutive year a high quality of papers and we are happy to have succeeded in establishing and maintaining (for many years already) a high scientific quality and a stimulating collaborative atmosphere. Also, our community is inspired to share ideas and experiences.

Essentially considering the modeling of enterprises and business processes as a basis for specifying software, in the broader context of enterprise information systems, BMSD 2019 addresses a large number of research topics:

Business processes and enterprise engineering:

- Enterprise systems
- Enterprise system environments and context
- Construction and function
- Actor roles
- Signs and affordances
- Transactions
- Business processes
- Business process coordination
- Business process optimization
- Business process management and strategy execution
- Production acts and coordination acts
- Regulations and business rules
- Enterprise (re-) engineering
- Enterprise interoperability
- Inter-enterprise coordination
- Enterprise engineering and architectural governance
- Enterprise engineering and software generation
- Enterprise innovation

Business models and requirements:

- Essential business models
- Re-usable business models
- Business value models
- Business process models
- Business goal models
- Integrating data analytics in business modeling
- Semantics and business data modeling
- Pragmatics and business behavior modeling
- Business modeling viewpoints and overall consistency
- Business modeling landscapes
- Requirements elicitation
- Domain-imposed and user-defined requirements
- Requirements specification and modeling
- Requirements analysis and verification
- Requirements evolution
- Requirements traceability
- Usability and requirements elicitation

Business models and services:

- Enterprise engineering and service science
- Service-oriented enterprises
- From business modeling to service-oriented solutions
- Business modeling for software-based services
- Service engineering
- Business-goals-driven service discovery and modeling
- Technology-independent and platform-specific service modeling
- Re-usable service models
- Business-rules-driven service composition
- Web services
- Autonomic service behavior
- Context-aware service behavior
- Service interoperability
- Change impact analysis and service management
- Service monitoring and quality of service
- Services for IoT applications
- Service innovation

Business models and software:

- Enterprise engineering and software development
- Model-driven engineering
- Co-design of business and IT systems
- Business–IT alignment and traceability
- Alignment between IT architecture and business strategy
- Business strategy and technical debt
- Business-modeling-driven software generation
- Normalized systems and combinatorial effects
- Software generation and dependency analysis
- Component-based business-software alignment
- Objects, components, and modeling patterns
- Generic business modeling patterns and software re-use
- Business rules and software specification
- Business goals and software integration
- Business innovation and software evolution
- Software technology maturity models
- Domain-specific models
- Cross-cutting concerns – security, privacy, distribution, recoverability, logging, performance monitoring

Information systems architectures and paradigms:

- Enterprise architectures
- Service-oriented computing
- Software architectures
- Cloud computing

- Autonomic computing (and intelligent software behavior)
- Context-aware computing (and adaptable software systems)
- Affective computing (and user-aware software systems)
- Aspect-oriented computing (and non-functional requirements)
- Architectural styles
- Architectural viewpoints

Data aspects in business modeling and software development:

- Data modeling in business processes
- Data flows and business modeling
- Databases, OLTP, and business processes
- Data warehouses, OLAP, and business analytics
- Data analysis, data semantics, redundancy, and quality of data
- Data mining, knowledge discovery, and knowledge management
- Information security and business process modeling
- Categorization, classification, regression, and clustering
- Cluster analysis and predictive analysis
- Ontologies and decision trees
- Decision tree induction and information gain
- Business processes and entropy
- Machine learning and deep learning – an enterprise perspective
- Uncertainty and context states
- Statistical data analysis and probabilistic business models

Blockchain-based business models and information systems:

- Smart contracts
- Blockchains for business process management
- Blockchain schemes for decentralization
- The blockchain architecture – implications for systems and business processes
- Blockchains and the future of enterprise information systems
- Blockchains and security/privacy/trust issues

IoT and implications for enterprise information systems:

- The IoT paradigm
- IoT data collection and aggregation
- Business models and IoT
- IoT-based software solutions
- IoT and context-awareness
- IoT and public values
- IoT applications: smart cities, e-health, smart manufacturing

BMSD 2019 received 55 paper submissions from which 23 papers were selected for publication in the symposium proceedings. Of these papers, 12 were selected for a 30-minute oral presentation (full papers), leading to a full-paper acceptance ratio of 22% (compared with 19% in 2018) – an indication of our intention to preserve a high-quality forum for the next editions of the symposium. The BMSD 2019 keynote

lecturers and authors come from: Bulgaria, Germany, Japan, The Netherlands, Palestine, Portugal, Sweden, Turkey, UK, and USA (listed alphabetically); that makes a total of 10 countries (compared with 15 in 2018, 20 in 2017, 16 in 2016, 21 in 2015, 21 in 2014, 14 in 2013, 11 in 2012, and 10 in 2011) to justify a strong international presence. Four countries have been represented at all nine BMSD editions so far – Bulgaria, Germany, The Netherlands, and the UK – indicating a strong European influence.

BMSD 2019 was organized and sponsored by the Interdisciplinary Institute for Collaboration and Research on Enterprise Systems and Technology (IICREST) and co-organized by Instituto de Engenharia de Sistemas e Computadores (INESC), being technically co-sponsored by BPM-D. Cooperating organizations were Aristotle University of Thessaloniki (AUTH), Delft University of Technology (TU Delft), the UTwente Center for Telematics and Information Technology (CTIT), the Dutch Research School for Information and Knowledge Systems (SIKS), and AMAKOTA Ltd.

Organizing this interesting and successful symposium required the dedicated efforts of many people. First, we thank the authors, whose research and development achievements are recorded here. Next, the Program Committee members each deserve credit for the diligent and rigorous peer reviewing. Further, we would like to mention the excellent organization provided by the IICREST team (supported by its logistics partner, AMAKOTA Ltd.) – the team (words of gratitude to Aglika Bogomilova!) did all the necessary work for delivering a stimulating and productive event, supported by our Portuguese Colleagues - Jose Cordeiro and Colleagues from INESC. We are grateful to Springer for their willingness to publish the current proceedings and we would like to especially mention Ralf Gerstner and Christine Reiss – we tremendously value Ralf's inspiring support and Christine's professionalism and patience (regarding the preparation of the symposium proceedings). Last but not least, we thank our keynote lecturer, Prof. Tribolet, for his invaluable contribution and for his taking the time to synthesize and deliver his talk.

We wish you all enjoyable reading! We look forward to meeting you next year in Berlin, Germany, for the tenth International Symposium on Business Modeling and Software Design (BMSD 2020), details of which will be made available on: <http://www.is-bmsd.org>.

June 2019

Boris Shishkov

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Invited Speaker

Jose Tribolet

IST – University of Lisbon, Portugal

Abstract of Keynote Lecture

Framing Enterprise Engineering Within General System's Theory - Perspectives of a Human Centered Future

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Abstract. The emerging field of Enterprise Engineering is growing in maturity, built on solid scientific grounds. Its principles, methodologies and tools are proving to be valuable in several real life contexts, where complexity and dynamics of change are high and intellectual manageability is essential to make sense the emergent realities and to support consistent visions of the future. An Enterprise is a complex dynamic system and as such, it is subject to the laws of nature, like many other systems. The rich BoK of General Systems Theory and in particular the science of Dynamic Systems Theory and Control are fully applicable to any system, and in particular, to any Enterprise. In this Keynote Lecture, Dr. Tribolet will frame the fundamentals of Enterprise Engineering within the wider framework of General Systems Theory, with emphasis of the use of concepts of Observability and Controllability in Enterprise Design and on the novel concept of ESA - Enterprise Self Awareness, to support viable Enterprise Operations, Control and Governance.

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