Adriano Augusto · Asif Gill ·
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Iris Reinhartz-Berger · Rainer Schmidt (Eds.)

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Enterprise, Business-Process and Information Systems Modeling

23rd International Conference, BPMDS 2022
and 27th International Conference
EMMSAD 2022, Held at CAiSE 2022
Leuven, Belgium, June 6–7, 2022
Proceedings

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Preface

This book contains the proceedings of two long-running events held alongside the CAiSE conference relating to the areas of enterprise, business-process, and information systems modeling: the 23rd International Working Conference on Business Process Modeling, Development and Support (BPMDS 2022) and the 27th International Working Conference on Exploring Modeling Methods for Systems Analysis and Development (EMMSAD 2022).

The two working conferences had a joint keynote given by Raimundas Matulevičius, Professor of Software Engineering at the Institute of Computer Science of the University of Tartu, Estonia.

This year both conferences were held in Leuven, Belgium, during June 6–7, 2022. More information on the individual events and their selection processes can be found on the following pages.

BPMDS 2022

BPMDS has been held as a series of workshops devoted to business process modeling, development, and support since 1998. During this period, business process analysis and design have been recognized as a central issue in the area of information systems (IS) engineering. The continued interest in these topics on behalf of the IS community is reflected by the success of the previous BPMDS events and the recent emergence of new conferences and workshops devoted to the theme. In 2011, BPMDS became a two-day working conference attached to the International Conference on Advanced Information Systems Engineering (CAiSE). The goals, format, and history of BPMDS can be found on the website http://www.bpmds.org/.

The BPMDS working conference deals with and promotes research on business process modeling, development, and support, and has been a platform for a multitude of influential research papers. In keeping with its tradition, the working conference covers a broad range of theoretical and application-based research on BPMDS.

The intention of BPMDS is to solicit papers related to business process modeling, development, and support in general, using quality as the main selection criterion. As a working conference, we aim to attract papers describing mature research, but we still give place to industrial reports and visionary idea papers. To encourage new and emerging challenges and research directions in the area of business process modeling, development, and support, we have a unique focus theme every year. Papers submitted as idea papers must be relevant to the focus theme, thus providing a mass of new ideas around a relatively narrow but emerging research area. Full research papers and

experience reports do not necessarily need to be directly connected to this theme (although they still need to be explicitly relevant to BPMDS).

The focus theme for the BPMDS 2022 idea papers, Reflections on Human-human Interaction and Responsibility in a Virtual Environment, reflects the abundance of virtual environments in all domains of our lives. Technologies are here and abundant. Are we ready to use these technologies in an extremely connected world where false information spreads faster than the truth with detrimental consequences? Are we mature enough to process the information as fast as the computers provide it? What is the meaning of a "like" in a professional environment when the "thing" which has been "liked" was not precisely read or understood? How should we enhance business process engineering, modeling, and management to master this increasingly complex new deal? How could/should human-computer interfaces support the issues related to increasing reflexes (fast clicks) to the detriment of reflection? How shall we consider the *quality* of the collected data by the means of logs, clicks, events? A pilot who is using a flight simulator during her training is aware that this is a virtual and fictitious platform, and she is confident that she will use the competencies she is acquiring in this virtual and fictitious environment later in the physical world; the new competencies will be partly due to the mistakes made using the flight simulator. On the other hand, is the surfer, who likes or comments in an online social network, totally aware that she acts in the "real world" (not a fictitious one) when she clicks? Is she aware of her *responsibility*?

Virtual does not mean fictitious. Using virtual environments expands our capabilities/frontiers of action in the real world ("real" in opposition to "fictitious"). For example, using voice-based assistants such as Amazon Alexa allows integrating people who have been excluded (because of their handicap) by graphical user interfaces from using software systems so far. Digital technologies enable the creation of new business models. An important factor to accomplish this is the provision of information on these resources and evaluation of their *quality*. Both can only be accomplished by collecting this information with digital means. Consequently, we are more and more drastically responsible for what we produce as information.

Organizations and the world are going through huge transformations due, in large part, to information technologies and their direct and indirect impacts. These transformations impact frontally the information systems, which support the business processes of organizations and therefore the actors in carrying out their activities/missions. The speed of organizational and societal transformations requires continuous improvement and innovation processes. *Creativity* and *responsibility* are determining factors and require detailed and multi-faceted knowledge of the problem to handle and of the context. The unpredictability of the related transformations (and more particularly their detrimental effects) requires more than ever a systemic vision in (i) the engineering and governance of information systems and (ii) the engineering and architecture of business processes ecosystems, the latter have to support.

The opportunities for evolution and transformation assume the ability to capture, store, organize, search, and analyze large volumes of information and put us in front of

many new challenges: meeting and mastering the requirements of volume, speed, variety, veracity, the value of data, compliance with data protection laws, and full awareness of (and responsibility for) the components of the new VUCA (volatility, uncertainty, complexity, and ambiguity) world. We are all responsible as engineers, researchers, professors, and citizens. We need human intelligence more than ever.

Is there a risk of losing control of a situation due to the unpredictability of detrimental effects? Do we have conceptual and technological means to identify behavioral misuses and the corresponding patterns? Cambridge Analytica, a professor killed after an organized series of fake news in social networks, the United States Capitol attack, a university that is ransacked following a flash organization via social networks requiring two months of repair and maintenance, …

Society 5.0, with its opportunities and threats, has the finality to strengthen the potential of cyber-physical-social relations in promoting the improvement of the quality of life of all people through a super smart society[1].

Driven by these thoughts, we have proposed a challenge to the authors of two promising submissions to (i) present their work as a poster during BPMDS 2022 and then (ii) to co-operate around a hot problem statement, to be identified together during BPMDS, taking into account the feedback of participants. Extended abstracts of these two promising works are included in this volume. The first piece of research work is about the exploitation of "raw" time series data as inputs of (process) mining. The approach could be generic enough to be used in any discipline producing raw sensor data in terms of time series. The second is about a maturity model for industry 4.0.

BPMDS 2022 received 18 submissions from authors in 13 countries (Austria, Australia, Brazil, Canada, the Czech Republic, Germany, India, Italy, the Netherlands, Slovakia, Slovenia, South Africa, and Switzerland). The management of paper submission and reviews was supported by the EasyChair conference system. Each paper was reviewed by at least three members of the international Program Committee. Eventually, seven high-quality full papers, two short papers, and two posters were selected.

The accepted papers cover a wide spectrum of issues related to business process development, modeling, and support, and also fit with this year's focus theme, Reflections on Human-human Interaction and Responsibility in a Virtual Environment, even though none of these papers were submitted as an idea paper. They are organized under the following section headings:

- Actual and Perceived Challenges
- Business Process Modeling
- Understanding Collaboration: One issue, many perspectives
- Event Logs … Why it Deviates?

We wish to thank all the people who submitted papers to BPMDS 2022 for having shared their work with us, as well as the members of the BPMDS 2022 Program Committee who made a remarkable effort in reviewing submissions.

[1] Serpa, S., Ferreira, C.M., Sa, M.J., Santos, A.I. Digital Society and Social Dynamics. Services for Science and Education, UK, August 2020.

We also thank the organizers of CAiSE 2022 for their help with the organization of the event. We also thank IFIP WG 8.1 for its sustainable support and Springer, in particular Ralf Gerstner and Christine Reiss, for their assistance during the production of the proceedings.

April 2022

Selmin Nurcan
Rainer Schmidt
Adriano Augusto

EMMSAD 2022

The objective of the EMMSAD conference series is to provide a forum for researchers and practitioners interested in modeling methods for systems analysis and development (SA&D) to meet and exchange research ideas and results. The conference aims to provide a home for a rich variety of modeling paradigms, including software modeling, business process modeling, enterprise modeling, capability modeling, service modeling, ontology modeling, and domain-specific modeling. These important modeling paradigms, and specific methods following them, continue to be enriched with extensions, refinements, and even new languages, to address new challenges. Even with some attempts at standardization, new modeling paradigms and methods are constantly being introduced, especially in order to deal with emerging trends and challenges. Ongoing changes significantly impact the way systems are analyzed and designed in practice. Moreover, they challenge the empirical and analytical evaluation of the modeling methods, which contributes to the knowledge and understanding of their strengths and weaknesses. This knowledge may guide researchers towards the development of the next generation of modeling methods and help practitioners to select the modeling methods most appropriate to their needs.

This year, EMMSAD 2022 continued its tradition and accepted papers in five tracks that emphasize the variety of EMMSAD topics: (1) Foundations of modeling and method engineering – chaired by Jolita Ralyté and Janis Stirna; (2) Enterprise, business process, and capability modeling – chaired by Jānis Grabis and Paul Grefen; (3) Information systems and requirements modeling – chaired by Roman Lukyanenko and Marcela Ruiz; (4) Domain-specific and knowledge modeling – chaired by Tiago Prince Sales and Arnon Sturm; and (5) Evaluation of modeling approaches – chaired by Renata Guizzardi and Oscar Pastor. More details on the current and previous editions of EMMSAD can be found at http://www.emmsad.org/.

In total, 30 submissions were received from authors in 17 countries (Australia, Austria, Belgium, Brazil, Canada, Denmark, Estonia, France, Germany, Israel, Italy, the Netherlands, Pakistan, Spain, Sweden, Switzerland, and the USA). The division of submissions between the tracks was as follows: three submissions related to foundations of modeling and method engineering, six related to enterprise, business process, and capability modeling, seven related to information systems and requirements modeling, nine related to domain-specific and ontology modeling, and five related to evaluation of modeling approaches. After a rigorous review process, which included three reviews per submission (and a meta-review written by a track chair for submissions with conflicting reviews/scores), 14 high-quality papers, comprising 11 long papers and three short papers, were selected.

Foundations of modeling and method engineering

- Simon Hacks, Sotirios Katsikeas, Engla Rencelj Ling, Wenjun Xiong, Jérôme Pfeiffer and Andreas Wortmann. Towards a Systematic Method for Developing Meta Attack Language Instances.

Enterprise, business process, and capability modeling

- Mario Nolte and Monika Kaczmarek-Heß. Enterprise Modeling in Support Of Transparency in the Design and Use of Software Systems.
- Marco Pegoraro, Merih Seran Uysal, Tom-Hendrik Hülsmann and Wil van der Aalst. Uncertain Case Identifiers in Process Mining: a User Study of the Event-Case Correlation Problem on Click Data.
- Ben Roelens and Louise Tierens. The Integration of Process Simulation within the Business Architecture.

Information systems and requirements modeling

- Simon Curty, Felix Härer and Hans-Georg Fill. Blockchain Application Development Using Model-Driven Engineering and Low-Code Platforms: A Survey.
- Renata Guizzardi, Glenda Amaral, Giancarlo Guizzardi and John Mylopoulos. Eliciting Ethicality Requirements Using the Ontology-based Requirements Engineering Method.
- Steven Alter. Agent Responsibility Framework for Digital Agents: Roles and Responsibilities Related to Facets of Work.
- Thomas Derave, Tiago Princes Sales, Frederik Gailly and Geert Poels. A Method for Ontology-Driven Minimum Viable Platform Development.
- Juan Antonio Gómez-Gutiérrez, Robert Clarisó and Jordi Cabot. A Tool for Debugging Unsatisfiable Integrity Constraints in UML/OCL Class Diagrams [short paper].

Domain-specific and knowledge modeling

- Azzam Maraee and Arnon Sturm. Towards Simplification of ME-Maps.
- Omar ElAssy, Rik de Vendt, Fabiano Dalpiaz and Sjaak Brinkkemper. A Semi-automated Method for Domain-Specific Ontology Creation from Medical Guidelines.
- Elena Planas, Salvador Martínez, Marco Brambilla and Jordi Cabot. Towards Access Control Models for Conversational User Interfaces [short paper].

Evaluation of modeling approaches

- Charlotte Verbruggen and Monique Snoeck. Exploratory study on students' understanding of multi-perspective modelling.
- David Mosquera, Anastassios Martakos and Marcela Ruiz. Experiences from Developing a Web Crawler Using a Model-driven Development Tool: Emerging Opportunities [short paper].

We wish to thank all the authors who shared their work with us, as well as the members of EMMSAD 2022 Program Committee for their valuable reviews in the difficult times of the COVID-19 pandemic. Special thanks go to the track chairs for their help in EMMSAD advertising and the review process. Finally, we thank the

organizers of CAiSE 2022 for their help with the organization of the event, IFIP WG 8.1 for its support, and Springer staff (especially Ralf Gerstner and Christine Reiss).

April 2022

Iris Reinhartz-Berger
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Asif Gill

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Trustworthy Information Systems: Modelling Security, Privacy and Forensics in Business Processes (Keynote Abstract)

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The broad application of information systems requires that the communicated information be reliable, secured, private and used according to the intended purpose. Thus, the need for trustworthy information systems where information creation, communication and storage are done reliably and securely is more than an option. Security-by-design and privacy-by-design methods support the development of secure, private and reliable information systems. However, one can't achieve system security and reliability to the full extent. The trustworthy information systems should be designed so that it would be possible to eventual dispute occurrences of incidents.

Business process model and notation (BPMN) has become a de-facto standard for presenting and analysing business processes. Recent extensions suggest various means to create security- and privacy-aware business process models. It also helps develop the forensics controls to explore the security and reliability incidents within business processes. This talk will focus on three business process modelling aspects: (1) security risk management, (2) private information leakage management, and (3) forensic-ready business process modelling.

Security risk management allows us to explain protected organisations' assets, their potential security risks, and countermeasures to mitigate these risks. The talk will illustrate how one can apply BPMN to capture and explain security risk management concepts in business processes.

Although BPMN is well suited for explaining stakeholder collaboration and its support by the information system, managing the sensitive information and decreasing its leakages remain important system design activities. The talk will present how one can use BPMN and introduce privacy-enhancing technology to mitigate information leakages to third parties.

However, it is not possible to entirely mitigate incidents happening through the business processes. This nature necessitates designing forensic-ready information systems and providing a rationale for security and privacy countermeasure design. The talk will present the forensic-oriented constructs and how one can use them to create forensic-aware business processes. The forensic-based extensions introduced to BPMN are done based on the analysis of the security risks and estimates of information leakages. Forensics controls can produce pieces of evidence while investigating information breaches.

Short Bio of Speaker

Raimundas Matulevičius received his Ph.D. diploma from the Norwegian University of Science and Technology. Currently, he is a Professor of Information Security position at the University of Tartu (Estonia). His research interests include security and privacy of information, security risk management, and model-driven security. His publication record includes more than 100 articles published in peer-reviewed journals, conferences, and workshops. Matulevičius is a principal researcher in the SPARTA H2020 project (task: Privacy- by-Design) and several the Erasmus+ projects, including Safeguarding against Phishing in the age of 4 Industrial Revolution (CyberPhish) and A Blueprint for Sectoral Cooperation on Blockchain Skill Development (CHAISE).

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