

Founding Editors

Gerhard Goos

Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis

Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino

Purdue University, West Lafayette, IN, USA

Wen Gao

Peking University, Beijing, China

Bernhard Steffen 

TU Dortmund University, Dortmund, Germany

Gerhard Woeginger 

RWTH Aachen, Aachen, Germany

Moti Yung

Columbia University, New York, NY, USA

More information about this series at <http://www.springer.com/series/7409>


Dirk Fahland · Chiara Ghidini ·
Jörg Becker · Marlon Dumas (Eds.)


Business Process Management


18th International Conference, BPM 2020
Seville, Spain, September 13–18, 2020
Proceedings

Editors

Dirk Fahland 
Eindhoven University of Technology
Eindhoven, The Netherlands

Jörg Becker 
University of Münster
Münster, Germany

Chiara Ghidini 
FBK-irst
Trento, Italy

Marlon Dumas 
University of Tartu
Tartu, Estonia

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-030-58665-2 ISBN 978-3-030-58666-9 (eBook)
<https://doi.org/10.1007/978-3-030-58666-9>

LNCS Sublibrary: SL3 – Information Systems and Applications, incl. Internet/Web, and HCI

© Springer Nature Switzerland AG 2020

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The year 2020 will be remembered as the time when many business processes were turned upside down as a result of the COVID-19 pandemic. The process of organizing and hosting conferences was one of them. The 18th International Conference on Business Process Management (BPM 2020) was no exception. Under the leadership of the general chairs, Manuel Resinas and Antonio Ruiz Cortés, from University of Seville, Spain, BPM 2020 became the first edition in the BPM conference series to be held online.

The World Health Organization declared COVID-19 a global pandemic on March 12, 2020, just four days before the deadline for paper submissions. As many countries entered into lock-down, the BPM research community displayed an exemplary level of resilience and flexibility. Despite the disruptions caused by the lock-down, the conference received 138 full paper submissions, which is comparable to the number of submissions on a regular year.

As in previous editions, the BPM 2020 conference was structured into three tracks, corresponding to the three traditional communities of the conference series: the foundations track (computer science), the engineering track (information systems engineering), and the management track (information systems management). Out of the 138 submissions, 32 came into the foundations track, 50 into the engineering track, and 56 into the management track. Following initial verification of each paper leading to some desk-rejections, 125 submissions made it to the review process (respectively 28, 45, and 52 across the three tracks).

The tracks cover not only different phenomena of interest and research methods, but also apply different evaluation criteria. Accordingly, each track had a dedicated track chair and Program Committee. The foundations track was chaired by Dirk Fahland, the engineering track by Chiara Ghidini, and the management track by Jörg Becker. Marlon Dumas acted as consolidation chair. Each paper was reviewed by at least three Program Committee members and a Senior Program Committee member who triggered and moderated scientific discussions that were summarized in a meta-review. In the end, we accepted 27 papers to the main conference (acceptance rate 19.5%). Moreover, 19 submissions appeared in the BPM Forum, published in a separate volume of the Springer LNBIP series.

The accepted papers cover a wide range of topics, from multiple perspectives. Alongside already well-established topics such as business process modeling, process mining, process redesign, BPM maturity, and stakeholder management, we witnessed a notable increase in submissions related to predictive process monitoring and robotic process automation, in line with ongoing industry developments.

The topics of the conference are also reflected by the keynote speakers. Avigdor Gal, from Technion, Israel, spoke about process mining, specifically reflecting on the

ongoing move in this field from small data to big data. Rama Akkiraju from IBM, USA, exposed her vision of how AI techniques will transform the DNA of business processes and the challenges that this transformation raises for researchers and practitioners. Finally, Jan vom Brocke led a reflection into the meaning of process science and how the BPM research community needs to take the next step in embracing its multidisciplinary nature by conceptualizing processes in a way that is independent from a single discipline's perspective.

This year, the conference made a step towards embracing the principles of Open Science, including reproducibility and replicability. The evaluation form for research papers included an item asking reviewers if the artifacts (prototypes, interview protocols, questionnaires) and the datasets used in or produced by the empirical evaluation reported in the paper, are available in a suitable form. Authors were asked to include in their paper a link to one or more repositories where reviewers could find the research artifacts associated with the paper. We are thankful to the authors for embracing these principles as reflected by the large proportion of papers that have permanent links to artifacts.

Organizing a scientific conference is a complex process involving many roles and countless interactions. The pivot from a physical conference to an online conference added to this complexity. We thank all our colleagues involved for their exemplary work. The workshop chairs attracted seven workshops, the tutorial chairs attracted five tutorials, the industry chairs organized an exciting industry forum, the doctoral consortium chairs allowed PhD students to benefit from the advice of experienced researchers, and the demo chairs expanded the scope of the demonstrations track in order to host not only tool demonstrations, but also presentations of resources of interest to the community, such as datasets and benchmarks. Weaving across all these tracks, the publicity chairs energetically mobilized the BPM research community despite the challenging times, while the proceedings chair, Bedilia Estrada, professionally interacted with Springer and with the authors to seamlessly prepare the conference and forum proceedings, as well as the other proceedings associated with the conference.

The members of the tracks' Program Committees and Senior Program Committees deserve particular acknowledgment for their dedication and commitment. We are grateful for the help and expertise of sub-reviewers, who provided valuable feedback during the reviewing process and engaged in deep discussions at times. BPM 2020 had a dedicated process to consolidate paper acceptance across tracks. During the very intensive weeks of this phase, many Senior Program Committee members evaluated additional papers and were engaged in additional discussions. Special thanks go to these colleagues, who were instrumental during this crucial phase of the reviewing process. We also thank our sponsors: Signavio (Platinum), Celonis (Platinum), AuraPortal (Gold), DCR Solutions (Gold), Papyrus (Silver), Springer, and University of Seville.

Finally, we applaud the Organizing Committee, including Adela del Río Ortega, Amador Durán, Alfonso Márquez, Bedilia Estrada, and Beatriz Bernárdez who, together with the general chairs, sacrificed a tremendous amount of time to overcome

the challenges of switching from a physical to an online conference. The BPM research community is forever grateful for their effort.

September 2020

Dirk Fahland
Chiara Ghidini
Jörg Becker
Marlon Dumas

In Memoriam of Florian Daniel

Fabio Casati¹, Stefano Ceri², and Marco Montali³

¹ Servicenow, Inc., USA

² Politecnico di Milano, Italy

³ Free University of Bozen-Bolzano, Italy

Florian Daniel recently passed away, at the age of 42. He was not only a passionate, frank, enthusiastic person, but also a brilliant, sharp, thoughtful colleague. He was a multifaceted, talented researcher who contributed to advance the state of the art in several areas of research, including that of Business Process Management. In this *In Memoriam* we briefly recall the scientific career of Florian, as well as his impact and service to the BPM community. We then include some memories from colleagues who had the chance, and the pleasure, to work with him. Those who loved or knew him will for sure find some of his most distinctive traits. Those who did not will learn about a role model who inspired, and will inspire, many of us.

1 Academic Life and Impact in BPM

Florian's career as a student was at Politecnico di Milano, where he obtained his master degree cum laude in 2003 and his PhD in 2007; then, after a short period as post doc, he moved to Trento. During his PhD, advised by Stefano Ceri, Florian was extremely prolific: by 2008, Florian had produced 11 journal papers and 22 conference papers, setting an outstanding record of productivity. What is most impressive, Florian managed to collaborate with over 50 scholars – besides Stefano Ceri and Fabio Casati who had been mentoring him in Milano and Trento, he started working with scholars who have been work companions throughout his life, including Maristella Matera, Boualem Benatallah, and Sven Casteleyn; in 2008 he produced the first of many works with Cinzia Cappiello, much loved partner in life.

In his early years, Florian's interests covered several aspects, but with a very coherent approach. Topics included web applications, web services, process modeling, and mashups; the research contribution made them well founded and sound, but also simple, clear, and easy to use and compose. Throughout his very productive career, thanks to his acute and brilliant mindset, Florian's work has been able to mix formal elegance and abstraction with pragmatics and engineering. He left Milano for Trento,

We are deeply thankful to Chiara Ghidini and Marlon Dumas for having supported this initiative, and to the many colleagues who contributed to this *In Memoriam* by sharing their experiences, thoughts, and feelings.

but he continuously collaborated within an international network rooted in Milano and Trento but encompassing a huge number of collaborators worldwide. In Trento, he worked with Fabio to advise dozens of PhD students, lead EU and industrial projects, and write grants. In summary, as a post doc, he was already doing the kind of work expected from a professor, and was doing so brilliantly. He was always incredibly helpful and supportive with the students as well as brilliant and prolific in research. Besides Milano and Trento, his affiliations included HP in Palo Alto, the University of Alicante, UNSW in Sydney, PUCRS in Porto Alegre, TPU in Tomsk, UNIST in Korea, and USI in Lugano – a sign of his ability to create collaborations around the world.

Florian was active in the BPM conference and community since the time he joined the University of Trento, both as author and organizer. As for service to the community, he acted as program chair of the BPM 2013 conference, held in Beijing. He was workshop chair twice: at BPM 2011 in Clermont-Ferrand and at BPM 2018 in Sydney. He also served as Program Committee (PC) member and Senior PC member in several editions of the conference. Research wise, he contributed to advancing the state of the art in BPM along several research directions, all oriented towards enriching process models and systems with computational and human intelligence. Particularly interesting is how Florian was able to intertwine processes with mashups and crowdsourcing. In this respect, we like to remember his work on distributed orchestration of user interfaces [1], on crowd-based mining of process patterns [2], and on micro-task crowdsourcing [3].

The approach in [1] brings forward the notion of distributed orchestration for user interfaces. Specifically, the paper presents a novel component-based model, language, and system for orchestrating complex processes that include human tasks, which in turn require dedicated, end user-tailored interfaces. Well-known research challenges related to process and service orchestration, and composition is consequently lifted to the much more challenging case where humans are part of the picture.

In [2] a complementary perspective is adopted: instead of studying how to better support humans during the execution of processes, the paper investigates how humans can be effective when mining specifications, a task that is usually ascribed to machines. The type of specification considered in the paper is that of model patterns, to be extracted from a repository of mashup (or process) models. Notably, an extensive experimental evaluation leads to the conclusion that a complex task such as that of model pattern mining can be effectively crowdsourced, obtaining patterns that are rich in domain knowledge especially in the case where the input repository is small.

Finally, [3] proposes an extension of BPMN to properly account for crowdsourcing processes where different tasks and multiple actors (machines, individual humans, and the crowd) are integrated. The notion of multi-instance task in BPMN is conceptually extended towards that of crowd task. But the paper does not limit itself to modeling: it also shows how to enrich standard BPMN engines with crowdsourcing platforms, resolving the impedance mismatch between the process orchestration flow and the flow of information produced by the crowd.

All in all, the three papers are exemplar witnesses of Florian's passion in research: the intersection between processes, user interfaces, and people.

2 Memories from Colleagues

We have collected some memories, impressions, thoughts, anecdotes about Florian from various colleagues active in the BPM community, and who had the chance to know Florian and to work with him.

Barbara Pernici. I met Florian many years ago during his PhD at Politecnico di Milano where he attended a PhD course. At that time, I came to know about his brilliant mind and, on the side, how passionate he was about brewing beer. Many years later he talked to me about possible student projects, about supporting recipes, and beer production with very sophisticated workflows. He was so passionate about it and several groups of students enjoyed working on those projects enjoying his very rigorous technical approach in research. He was a special and dedicated teacher and he was able to transmit his passion to all his students who loved him a lot. I will always remember how brilliant, gentle, and original he was.

Gigi Plebani. Florian was first of all a friend then a colleague. Literally. We started spending time together when we were PhD students and then postdocs at Politecnico. After his period in Trento, when he came back to Milan, I was really happy for him and for Cinzia to really start living together and also to have more opportunities to talk with him about everything: life, running, beers, and eventually work. Yep, even though I knew Florian for 15 years, it was only last year that we had the chance to work together when we started to investigate on the relationship between business processes and blockchains. Thus, I had the possibility to see how the same kindness, determination, and method he used to face any type of issues in life, he also used to apply to his research works. It was great to work together with the students of Alta Scuola Politecnica, to share ideas with him, and together, make those ideas grow. In many situations, we did not have the same opinion, but he was always open to understand the others' standpoint and we had the opportunity to make our positions more aligned. Thanks Florian, it was a pleasure to know you. I learned a lot from you, as a man and as a researcher. Everyone can appreciate your contribution to research, but only I can appreciate your contribution to my life.

Wil van der Aalst. Florian was an amazing person: smart, funny, and social. He was an active and highly respected member of the BPM community for many years. Next to his seminal contribution to the Business Process Management (BPM) field, he worked on web engineering, service-oriented computing, blockchain, and crowdsourcing. Florian is well-known for his work on mashup development, context-aware web applications, service composition, and crowdsourcing. He was also active in organizing various events within our community. He was able to connect different fields and



Fig. 1. Florian was one of the PC chairs of the successful BMP 2013 conference in Beijing.



Fig. 2. There as always time to socialize with fellow BPM-ers.

communities. He was also one of the program chairs of the International Business Process Management conference in Beijing in 2013 and workshop chair of BPM 2011 and 2018. I vividly remember a trip to Rifugio Maranza (a mountain hut close to Povo).¹ He was always able to create a positive atmosphere where people matter most. In his last email to me he wrote: “Sure... mountains in Milano... not good. But with good weather I can see them in the distance :-) ... There is beer too in Milano :-).” This is the way that I would like to remember him.

¹ A note from Marco: I was also there. We organized a visit to Florian and Fabio in Povo. Florian had the idea to meet in the woods instead of the department. This transformed what could have been a standard research meeting into one of the most striking memories I have, not just about Florian, but about my research life in general.



Fig. 3. During presentations in one of the main tracks and demo session at BPM 2012, Tallinn, Estonia.

Frank Leymann. I met Florian the first time more than a decade ago in 2008 in context of the EU project COMPAS. This project was about compliance by design, and one of the focus areas was compliance of business processes. My team worked on the modeling side, how to specify corresponding compliance rules as process fragments, while Florian (part of Fabio's group) worked on how to assess compliance during runtime and present it properly on a dashboard. Very soon it became clear to me that Florian was exceptional, both, as a scientist as well as a human. We soon became friends: besides joint cooperations, we had several joint dinners and drank "one or two" beers (well, it's mandatory to mention "beer" when remembering Florian). He was very passionate about his work, and he was able to explain his ideas very clearly and vividly. Because of this, I was always very pleased when he accepted invitations to my institute to discuss and present his ideas to a broader community. But also via mail, we were exchanging ideas and joint publications resulted. For example, in the area of blockchains, a language to describe smart contracts and a mechanism to actually locate them has been designed. In our last work, we were focusing on function as a service – which we are finishing in his spirit. We wanted to meet in Milano in September to begin an exchange on quantum computing to see what we could jointly contribute to this area. Then, we planned to finally realize a long delayed idea: a joint hiking tour in Tuscany, having "one or two" glasses of – well not beer – wine together. It turned out that we delayed this event for too long ...

Boualem Benatallah. I have known Florian since 2006. Florian was both a friend and a colleague. We have collaborated intensively in the area of web services and mashups, quality control in crowdsourcing, and more recently on conversational bots. Multiple times, Florian visited UNSW for one or two months joint research periods. I also visited him in Politecnico di Milano. We planned to meet in Milano this September to continue working on our recent collaborative work. We co-authored several research papers and jointly supervised students. I will always remember his positive, collaborative, and constructive attitude. I also enjoyed our social meetings and friendship. Florian was a highly respected member of the research community and a wonderful colleague and friend. He will be remembered by his outstanding scholarly achievements and research contributions to the research community and also services to the university and community.

Carlos Rodriguez. Florian was a wonderful person, academic and professional. I was very lucky to have him not only as a co-advisor during my PhD studies at the University of Trento, but also as a colleague and friend. As an advisor he taught our cohort the best professionalism and guided us in navigating the research world in a rigorous and systematic manner. In the area of BPM, we explored research problems in the context of business process compliance, crowdsourcing for BPM, and extraction of process progression information from transactional databases. As a colleague and friend, he was always happy to collaborate in projects, discuss ideas, and talk about life, where he would always bring in not only smart ideas and wisdom, but also passion and fun. On the latter, I just cannot emphasize enough how much fun it was to work and share time together with Florian. Even during the toughest deadlines and research challenges, Florian would always crack a joke or tell an anecdote that made us laugh and brought fun to our meetings. And, of course, outside work, we would always find some time to enjoy his amazing craft beers. I will always remember him as a true mentor and wonderful colleague and friend.

Stefano Ceri. Florian was one of my PhD students, he has always been appreciated by colleagues and friends for his frank character, his kindness and humanity, and also his ironic style, he was always able to surprise us with his keen observations. Activity with Florian went beyond the end of his PhD, we communicated perhaps more after graduation. I remember long conversations while attending a conference in Shanghai, we discussed a lot about research and what is important in life. During those days, he questioned some of my beliefs, and these dialogues started meditations that were important to me. He appreciated scientific merit and independent thinking, thanks to these he was always able to live and work outside the box. When he won a researcher (RTB) position in Milan, he had publications warranting a full professorship; what's more important, he was a mature and independent thinker, as is clear from his production and overwhelming number of collaborations. Florian leaves our department with an immense void.

Fabio Casati. Florian has been, and is, a close friend, a colleague, and an inspiration to me for many years. I will never forget the many lessons that he gave by example – never with the intent to teach. Many of them had to do with how you approach any problem with the care and passion it deserves, without hidden goals but only with the objective of doing the best he could in solving a problem and being as helpful as possible for those affected, be it the occasional lecture, the work on a project deliverable, a small research effort with a bachelor student, and on and on. As I said many times for the last 10 years, he would have been my choice for full professorship since three years into his post doc tenure. Everywhere he went, in whatever environment, he would just make that place a better one. He was the friend and colleague anybody would want to have, and when he left Trento, although he moved only two hours away, it felt like losing a part of me. To this day, I still think about how he would behave in a given situation, and this helps me figure out the right course of action. Florian, I am sure you are happy and drinking (and probably a bit drunk) wherever you are. We miss you.

References

1. Daniel, F., Soi, S., Tranquillini, S., Casati, F., Heng, C., Yan, L.: From people to services to UI: distributed orchestration of user interfaces. In: Hull, R., Mendling, J., Tai, S. (eds.) BPM 2010. LNCS, vol. 6336, pp. 310–326. Springer, Heidelberg (2010). https://doi.org/10.1007/978-3-642-15618-2_22
2. Rodríguez, C., Daniel, F., Casati, F.: Crowd-based mining of reusable process model patterns. In: Sadiq, S., Soffer, P., Völzer, H. (eds.) BPM 2014. LNCS, vol. 8659, pp. 51–66. Springer, Cham (2014). https://doi.org/10.1007/978-3-319-10172-9_4
3. Tranquillini, S., Daniel, F., Kucherbaev, P., Casati, F.: BPMN task instance streaming for efficient micro-task crowdsourcing processes. In: Motahari-Nezhad, H., Recker, J., Weidlich, M. (eds.) BPM 2016. LNCS, vol. 9253, pp. 333–349. Springer, Cham (2015). https://doi.org/10.1007/978-3-319-23063-4_23

Organization

The 18th International Conference on Business Process Management (BPM 2020) was organized by the Research Group of Applied Software Engineering (ISA Group) at the University of Seville, Spain, with the collaboration of SCORE Lab and the Instituto de Investigación en Ingeniería Informática (I3US). It took place online due to the restrictions imposed because of the COVID-19 pandemic. Originally, it was going to take place in Seville, Spain.

Steering Committee

Mathias Weske (Chair)	HPI, University of Potsdam, Germany
Boualem Benatallah	University of New South Wales, Australia
Jörg Desel	Fernuniversität in Hagen, Germany
Shazia Sadiq	The University of Queensland, Australia
Marlon Dumas	University of Tartu, Estonia
Wil van der Aalst	RWTH Aachen University, Germany
Jan Mendling	Vienna University of Economics and Business, Austria
Barbara Weber	University of St. Gallen, Switzerland
Stefanie Rinderle-Ma	University of Vienna, Austria
Manfred Reichert	Ulm University, Germany
Michael Rosemann	Queensland University of Technology, Australia

Executive Committee

General Chairs

Manuel Resinas	University of Seville, Spain
Antonio Ruiz-Cortés	University of Seville, Spain

Main Conference Program Chairs

Dirk Fahland (Track Chair, Track I)	Eindhoven University of Technology, The Netherlands
Chiara Ghidini (Track Chair, Track II)	Fondazione Bruno Kessler-IRST, Italy
Jörg Becker (Track Chair, Track III)	University of Münster, ERCIS, Germany
Marlon Dumas (Consolidation)	University of Tartu, Estonia

Workshop Chairs

Henrik Leopold	Kühne Logistics University, Germany
Adela del Río Ortega	University of Seville, Spain
Flavia Maria Santoro	Rio de Janeiro State University, Brazil

Demonstration and Resources Chairs

Marco Comuzzi	Ulsan National Institute of Science and Technology, South Korea
Claudio Di Ciccio	Sapienza University of Rome, Italy
Luise Pufahl	Technische Universität Berlin, Germany

Industry Forum Chairs

Gero Decker	Signavio, Germany
Manuel Lama	Universidade de Santiago de Compostela, Spain
Pedro Robledo	ABPMP Spain, Spain

Blockchain Forum Chairs

José María García	University of Seville, Spain
Agnes Koschmider	Kiel University, Germany
Jan Mendling	Vienna University of Economics and Business, Austria
Giovanni Meroni	Politecnico di Milano, Italy

RPA Forum Chairs

Aleksandre Asatiani	University of Gothenburg, Sweden
Nina Helander	Tampere University, Finland
Andrés Jiménez-Ramírez	University of Seville, Spain
Hajo A. Reijers	Utrecht University, The Netherlands

Doctoral Consortium Chairs

Félix García	University of Castilla-La Mancha, Spain
Manfred Reichert	Ulm University, Germany
Jan vom Brocke	University of Liechtenstein, Liechtenstein

Tutorial Chairs

Josep Carmona	Universitat Politècnica de Catalunya, Spain
Hajo A. Reijers	Utrecht University, The Netherlands
Minseok Song	Pohang University of Science and Technology, South Korea

Panel Chairs

Ernest Teniente	Universitat Politècnica de Catalunya, Spain
Mathias Weidlich	Humboldt-Universität zu Berlin, Germany

BPM Dissertation Award Chair

Jan Mendling Vienna University of Economics and Business, Austria

Organizing Committees Chairs

Adela del Río Ortega University of Seville, Spain

Amador Durán University of Seville, Spain

Publicity Chairs

Cristina Cabanillas University of Seville, Spain

Artem Polyvyanny The University of Melbourne, Australia

Kate Revoredo
Vienna University of Economics and Business, Austria

Armin Stein University of Münster, Germany

Web Chair

Alfonso Márquez University of Seville, Spain

Proceedings Chair

Bedilia Estrada-Torres University of Seville, Spain

Supporting Staff Coordination Chair

Beatriz Bernárdez University of Seville, Spain

Track I – Foundations

Senior Program Committee

Florian Daniel Politecnico di Milano, Italy

Jörg Desel Fernuniversität in Hagen, Germany

Chiara Di Francescomarino Fondazione Bruno Kessler-IRST, Italy

Thomas Hildebrandt University of Copenhagen, Denmark

Fabrizio Maria Maggi Free University of Bozen-Bolzano, Italy

Marco Montali Free University of Bozen-Bolzano, Italy

John Mylopoulos University of Toronto, Canada

Oscar Pastor Lopez Universitat Politècnica de València, Spain

Artem Polyvyanny The University of Melbourne, Australia

Manfred Reichert Ulm University, Germany

Arthur Ter Hofstede Queensland University of Technology, Australia

Hagen Voelzer IBM Research, Switzerland

Mathias Weske HPI, University of Potsdam, Germany

Program Committee

Lars Ackermann University of Bayreuth, Germany

Daniel Amyot University of Ottawa, Canada

Ahmed Awad University of Tartu, Estonia

Irene Barba	University of Seville, Spain
Søren Debois	IT University of Copenhagen, Denmark
Claudio Di Ciccio	Sapienza University of Rome, Italy
Rik Eshuis	Eindhoven University of Technology, The Netherlands
Peter Fettke	German Research Center for Artificial Intelligence (DFKI), Saarland University, Germany
Hans-Georg Fill	University of Fribourg, Switzerland
Luciano García-Bañuelos	Tecnológico de Monterrey, Mexico
María Teresa Gómez López	University of Seville, Spain
Guido Governatori	Data61, CSIRO, Australia
Gianluigi Greco	University of Calabria, Italy
Richard Hull	New York University, USA
Jetty Kleijn	LIACS, Leiden University, The Netherlands
Sander J. J. Leemans	Queensland University of Technology, Australia
Irina Lomazova	National Research University Higher School of Economics, Russia
Xixi Lu	Utrecht University, The Netherlands
Andrea Marrella	Sapienza University of Rome, Italy
Werner Nutt	Free University of Bozen-Bolzano, Italy
Wolfgang Reisig	Humboldt-Universität zu Berlin, Germany
Daniel Ritter	SAP, Germany
Andrey Rivkin	Free University of Bozen-Bolzano, Italy
Stefan Schönig	University of Regensburg, Germany
Arik Senderovich	University of Toronto, Canada
Tijs Slaats	University of Copenhagen, Denmark
Ernest Teniente	Universitat Politècnica de Catalunya, Spain
Sebastian Uchitel	University of Buenos Aires, Argentina, and Imperial College London, UK
Roman Vaculín	IBM Research, USA
Jan Martijn van der Werf	Utrecht University, The Netherlands
Francesca Zerbato	University of Verona, Italy

Track II – Engineering

Senior Program Committee

Andrea Burattin	Technical University of Denmark, Denmark
Josep Carmona	Universitat Politècnica de Catalunya, Spain
Remco Dijkman	Eindhoven University of Technology, The Netherlands
Avigdor Gal	Technion - Israel Institute of Technology, Israel
Marcello La Rosa	The University of Melbourne, Australia
Jorge Munoz-Gama	Pontificia Universidad Católica de Chile, Chile
Luise Pufahl	Technische Universität Berlin, Germany
Hajo A. Reijers	Utrecht University, The Netherlands
Stefanie Rinderle-Ma	University of Vienna, Austria
Pnina Soffer	University of Haifa, Israel

Wil van der Aalst
 Boudewijn van Dongen
 Ingo Weber
 Matthias Weidlich

RWTH Aachen University, Germany
 Eindhoven University of Technology, The Netherlands
 Technische Universität Berlin, Germany
 Humboldt-Universität zu Berlin, Germany

Program Committee

Marco Aiello
 Abel Armas Cervantes
 Boualem Benatallah
 Cristina Cabanillas
 Fabio Casati
 Massimiliano de Leoni
 Jochen De Weerd
 Joerg Evermann
 Walid Gaaloul
 Daniela Grigori

University of Stuttgart, Germany
 The University of Melbourne, Australia
 University of New South Wales, Australia
 University of Seville, Spain
 ServiceNow, USA
 University of Padua, Italy
 Katholieke Universiteit Leuven, Belgium
 Memorial University of Newfoundland, Canada
 Télécom SudParis, France
 Laboratoire LAMSADE, Paris Dauphine University,
 France

Georg Grossmann
 Anna Kalenkova
 Dimka Karastoyanova
 Agnes Koschmider
 Henrik Leopold
 Felix Mannhardt
 Elisa Marengo
 Jan Mendling
 Rabeb Mizouni
 Hye-Young Paik
 Cesare Pautasso
 Pierluigi Plebani
 Pascal Poizat
 Barbara Re
 Manuel Resinas
 Shazia Sadiq
 Marcos Sepúlveda
 Natalia Sidorova
 Nick van Beest
 Han van der Aa
 Sebastiaan J. van Zelst
 Barbara Weber
 Moe Thandar Wynn
 Nicola Zannone

University of South Australia, Australia
 The University of Melbourne, Australia
 University of Groningen, The Netherlands
 Karlsruhe Institute of Technology, Germany
 Kühne Logistics University, Germany
 SINTEF Digital, Norway
 Free University of Bozen-Bolzano, Italy
 Vienna University of Economics and Business, Austria
 Khalifa University, UAE
 University of New South Wales, Australia
 University of Lugano, Switzerland
 Politecnico di Milano, Italy
 Université Paris Nanterre, LIP6, France
 University of Camerino, Italy
 University of Seville, Spain
 The University of Queensland, Australia
 Pontificia Universidad Católica de Chile, Chile
 Eindhoven University of Technology, The Netherlands
 Data61, CSIRO, Australia
 Humboldt-Universität zu Berlin, Germany
 Fraunhofer FIT, Germany
 University of St. Gallen, Switzerland
 Queensland University of Technology, Australia
 Eindhoven University of Technology, The Netherlands

Track III – Management

Senior Program Committee

Daniel Beverungen	Universität Paderborn, Germany
Adela del Río Ortega	University of Seville, Spain
Patrick Delfmann	Universität Koblenz-Landau, Germany
Paul Grefen	Eindhoven University of Technology, The Netherlands
Susanne Leist	University of Regensburg, Germany
Peter Loos	IWi at DFKI, Saarland University, Germany
Martin Matzner	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany
Jan Recker	University of Cologne, Germany
Maximilian Roeglinger	FIM Research Center Finance & Information Management, Germany
Michael Rosemann	Queensland University of Technology, Australia
Flavia Maria Santoro	Rio de Janeiro State University, Brazil
Peter Trkman	University of Ljubljana, Slovenia
Amy van Looy	Ghent University, Belgium
Jan Vom Brocke	University of Liechtenstein, Liechtenstein

Program Committee

Wasana Bandara	Queensland University of Technology, Australia
Alessio Maria Braccini	University of Tuscia, Italy
Friedrich Chasin	Universität Münster, Germany
Ann-Kristin Cordes	Universität Münster, Germany
Rod Dillnutt	The University of Melbourne, Australia
Michael Fellmann	University of Rostock, Germany
Elgar Fleisch	ETH Zurich, Switzerland
Frederik Gailly	Ghent University, Belgium
Bernd Heinrich	Universität Regensburg, Germany
Mojca Indihar Štemberger	University of Ljubljana, Slovenia
Christian Janiesch	Julius-Maximilians-Universität Würzburg, Germany
Peter Kawalek	Loughborough University, UK
Ralf Knackstedt	University of Hildesheim, Germany
John Krogstie	Norwegian University of Science and Technology, Norway
Michael Leyer	University of Rostock, Germany
Alexander Mädche	Karlsruhe Institute of Technology, Germany
Monika Malinova	Wirtschaftsuniversität Wien, Austria
Fredrik Milani	University of Tartu, Estonia
Juergen Moormann	Frankfurt School of Finance & Management, Germany
Markus Nüttgens	University of Hamburg, Germany
Sven Overhage	University of Bamberg, Germany
Ralf Plattfauf	Fachhochschule Südwestfalen, Germany
Geert Poels	Ghent University, Belgium

Jens Pöppelbuß	University of Bochum, Germany
Hans-Peter Rauer	Universität Münster, Germany
Dennis M. Riehle	Universität Münster, Germany
Stefan Sackmann	University of Halle-Wittenberg, Germany
Werner Schmidt	Technische Hochschule Ingolstadt Business School, Germany
Theresa Schmiedel	University of Applied Sciences and Arts Northwestern Switzerland, Switzerland
Minseok Song	Pohang University of Science and Technology, South Korea
Oktay Türetken	Eindhoven University of Technology, The Netherlands
Jan Vanthienen	Katholieke Universiteit Leuven, Belgium
Axel Winkelmann	Julius-Maximilians-Universität Würzburg, Germany

Additional Reviewers

Mehdi Acheli	Jonas Lutz
Ivo Benke	Hugo-Andrés López
Yevgen Bogodistov	Steven Mertens
Silvano Colombo Tosatto	Miguel Meza
Jasper Feine	Roman Nesterov
Rick Gilsing	Xavier Oriol
Sebastian Halsbenning	Nadine Ostern
Markus Heuchert	Guido Perscheid
Benedikt Hoffmeister	Michael Poppe
Felix Härer	Tim Rietz
Florian Johannsen	Lorenzo Rossi
Julian Koch	Alexander Schiller
Safak Korkut	Fatemeh Shafiee
Ingo Kregel	Peyman Toreini
Martin Käppel	Michael Trampler
Fabienne Lambusch	Jonas Wanner
Susanne Leist	Anna Wilbik

Abstracts of Keynotes

Process Minding: Closing the Big Data Gap

Avigdor Gal¹(✉) and Arik Senderovich²

¹ Technion – Israel Institute of Technology, Technion City, 82000 Haifa, Israel
avigal@technion.ac.il

² University of Toronto, Toronto, Canada

arik.senderovich@utoronto.ca

<http://ie.technion.ac.il/~avigal>

<https://ischool.utoronto.ca/profile/arik-senderovich/>

Abstract. The discipline of process mining was inaugurated in the BPM community. It flourished in a world of small(er) data, with roots in the communities of software engineering and databases and applications mainly in organizational and management settings. The introduction of big data, with its volume, velocity, variety, and veracity, and the big strides in data science research and practice pose new challenges to this research field. The paper positions process mining along modern data life cycle, highlighting the challenges and suggesting directions in which data science disciplines (*e.g.*, machine learning) may interact with a renewed process mining agenda.

Characterizing Machine Learning Processes: A Maturity Framework

Rama Akkiraju^(✉), Vibha Sinha, Anbang Xu, Jalal Mahmud,
Pritam Gundecha, Zhe Liu, Xiaotong Liu, and John Schumacher

IBM Watson, IBM Almaden Research Center, San Jose, CA, USA
{akkiraju,vibha.sinha,anbangxu,jmahmud,psgundec,
liuzh,Xiaotong.Liu,jfs}@us.ibm.com

Abstract. Academic literature on machine learning modeling fails to address how to make machine learning models work for enterprises. For example, existing machine learning processes cannot address how to define business use cases for an AI application, how to convert business requirements from product managers into data requirements for data scientists, and how to continuously improve AI applications in term of accuracy and fairness, how to customize general purpose machine learning models with industry, domain, and use case specific data to make them more accurate for specific situations etc. Making AI work for enterprises requires special considerations, tools, methods and processes. In this paper we present a maturity framework for machine learning model lifecycle management for enterprises. Our framework is a re-interpretation of the software Capability Maturity Model (CMM) for machine learning model development process. We present a set of best practices from authors' personal experience of building large scale real-world machine learning models to help organizations achieve higher levels of maturity independent of their starting point.

Keywords: Machine learning models · Maturity model · Maturity framework · AI model life cycle management

Towards Process Science: Embracing Interdisciplinary Research Opportunities in the Digital Age

Jan vom Brocke

Hilti Chair of Business Process Management, University of Liechtenstein,
Vaduz, Liechtenstein
`jan.vom.brocke@uni.li`

As process researchers, we live in exciting times. Processes are deeply interwoven with digital technologies, such as the Internet of Things, machine learning, distributed ledger technology combined with data analytics, among many others. Processes move beyond organizational boundaries and become independent entities of their own. Processes deliver and connect various services, such as health care, mobility, investments, education, and other important economic and societal services, while organizations such as hospitals, public transport, banks, and universities, only contribute specific shares in form of services to such processes. In essence, we see that processes (not organizations or applications) are becoming the prime phenomena of interest in the digital age. While the growing importance of process is fascinating, we need to ask: Are we prepared to fully embrace the new role of process within our research field? We see a central challenge ahead. We need to conceptualize processes independent of a single discipline's perspective but integrate contributions from various disciplinary fields. This is because processes are socio-technical by nature and, thus, they entail numerous aspects of different kinds. This is evident through contributions by well-established research disciplines, such as computer science, management science, and information systems research, which have developed distinct views on processes. With processes growing outside organizations and application systems, a plethora of additional disciplines will gain increasing importance, too, such as psychology, engineering, architecture, law, ethics, and others. This is exciting because such contributions – when brought together – will greatly advance our understanding of processes. However, we need a platform to integrate and synthesize those various contributions, and given the joint focus is process, we shall call this effort “process science”. We envision process science as a new scientific field, which is based on three key pillars.

1. Interdisciplinary at its core. Process science is an inter disciplinary field that uses various scientific methods to generate knowledge about the development, implementation, and management of processes. Thereby, it draws on insights from various fields and aims to advance our understanding of how processes create value in diverse contexts and settings. These fields include organization science, information systems research, organizational design, computer science, psychology and neuroscience, ethics, among many others.

2. Continuous engagement in and between research and practice. The field of process science aims to develop a shared language among these disciplines in order to direct their attention towards shared phenomena. In order to think about processes in truly novel ways, we need to acknowledge and synthesize assumptions of individual fields. In our view, the term “process science” marks a new beginning for process research, where we develop common assumptions, a core terminology, joint research questions, as well as innovative ways to engage with practice to continuously update and further develop an emerging research agenda.
3. Creating impact by design. By integrating and synthesizing insights from various disciplines, process science aims to develop a prescriptive understanding of how processes can be designed and managed in context. Certainly, the competences we have developed in the field of BPM will play a key role to translate interdisciplinary perspectives into a prescriptive science about processes. The challenge is now how these different assumptions can be brought together under a unified vision of process science, design, and management.

To give an example, one big contribution process science can make is to advance our understanding of change and the adaptability of processes. In times, when change is the “new normal”, the adaptability of processes becomes a crucial skill of the future. How can we organize for a spectrum of emerging changes where desired future states can hardly be anticipated? What are appropriate approaches when pre-defined to-be processes cannot be an option? How can we conceptualize, measure, and predict change? How can we allow for sufficient adaptability in the design and management of processes? Clearly, such solutions need contributions from various different perspectives, including technological infrastructures but also governance structures, skill sets, and cultural values to increase the adaptation capabilities of processes. The BPM community has the theories, methods, and tools to make such contributions. However, to get at the core of these phenomena, we need to equally embrace views and theories from other fields. This is what a joint effort in process science can deliver. This talk will sketch out the field of process science. The aim is to conceptualize essential elements of process science, provide examples for research projects, and stimulate a discourse on the establishment of process science as an interdisciplinary field both for research and practice. I invite all people with an interest in processes to be part of establishing process science to advance both theory and practice. It will be great to – on occasion of the BPM Conference 2020 – jointly bring process science to life and to decide on a few important operational next steps.

Abstracts of Tutorials

Queue Mining: Process Mining Meets Queueing Theory

Avigdor Gal¹, Arik Senderovich², and Matthias Weidlich³

¹ Technion – Israel Institute of Technology
avigal@ie.technion.ac.il

² University of Toronto
arik.senderovich@utoronto.ca

³ Humboldt-Universität zu Berlin
matthias.weidlich@hu-berlin.de

Abstract. The tutorial will expose the audience to queue mining, which is a set of novel data-driven techniques used for modeling and analyzing complex resource-driven environments. Queue mining was born from the synergy between process mining [1] and queueing theory [2]. From automated discovery [3], through conformance checking [4], to predictive monitoring [5], process mining plays a key role in modern process-oriented data analysis. Historically, process mining has mainly focused on the single-case perspective, while in reality, performance of processes is highly influenced from correlations between running cases. Queueing theory, in turn, is a well-established paradigm in operations research that addresses this gap. It revolves around processes that exhibit scarce resources and highly correlated cases that compete for these resources.

In the first part of the tutorial, we shall present a high-level overview of queue mining methodologies. Specifically, we will discuss a range of queue mining methods that involve predictive monitoring in various queueing settings, conformance checking in queue-driven systems, and a generalized congestion-driven approach for predicting remaining times and analyzing bottlenecks. Subsequently, we shall demonstrate the usefulness of queue mining in real-life applications coming from three service domains: call centers, public transportation, and healthcare. We will conclude the tutorial with a discussion of novel research directions that involve queue mining and its extensions into other evolving fields.

We believe that the tutorial will attract both researchers and practitioners in the area of process management and mining, who are interested in performance analysis, predictive monitoring, and operations management.

References

1. van der Aalst, W.M.P.: Process Mining - Data Science in Action, Second Edition. Springer (2016)
2. Bolch, G., Greiner, S., de Meer, H., Trivedi, K.S.: Queueing Networks and Markov Chains - Modeling and Performance Evaluation with Computer Science Applications, Second Edition. Wiley (2006)

3. Augusto, A. et al.: Automated discovery of process models from event logs: Review and benchmark. *IEEE Trans. Knowl. Data Eng.* **31**(4), 686–705 (2019)
4. Carmona, J., van Dongen, B.F., Solti, A., Weidlich, M.: *Conformance Checking - Relating Processes and Models*. Springer (2018)
5. Teinemaa, I., Dumas, M., Rosa, M.L., Maggi, F.M.: Outcome-oriented predictive process monitoring: Review and benchmark. *TKDD* **13**(2), 17:1–17:57 (2019)

Driving Digitalization on the Shopfloor Through Flexible Process Technology

Stefanie Rinderle-Ma 

Faculty of Computer Science, University of Vienna, Austria
stefanie.rinderle-ma@univie.ac.at

Abstract. The current crisis shows that digitalization has become more crucial than ever. We believe that process technology constitutes the vehicle to drive digital transformation throughout all application domains. In this tutorial, we reflect on the opportunities of process technology in more “physical” environments such as industrial manufacturing with machines, sensors, and manual work.

For this, the tutorial discusses and combines questions in the areas of flexible process technology, Internet of Things (IoT), and industrial manufacturing processes. Specifically, the goals of the tutorial are to

- Show how process technology can be used to foster the digital transformation in industrial manufacturing.
- Discuss challenges and possible solutions at the interface of BPM and IoT.
- Explain challenges and requirements on process flexibility.
- Outline how process flexibility can be provided from the system side.
- Outline prospects of the contextualized collection of manufacturing data.





The tutorial is outlined as follows: a) introduction into flexible process technology, b) introduction to a real-world industrial manufacturing case, c) solution based on the secure manufacturing orchestration platform *centurio.work* [1, 2] which is already applied in several real-world industrial settings, and d) benefits of a process-oriented solution such as vertical and horizontal integration as well as contextualized data collection and integration of the activities of the employees. The tutorial features a mix of presentation and interactive parts, including a demonstration of *centurio.work* and exercises with the Cloud Process Execution Engine CPEE (<http://www.cpee.org/>).

Keywords: Digital transformation · Process technology · Shopfloor · Process flexibility · Internet of Things

References

1. Mangler, J., Pauker, F., Rinderle-Ma, S., Ehrendorfer, M.: *Centurio.work – Industry 4.0 integration assessment and evolution*, Industry Forum at BPM, pp. 106–117, CEUR 2428 (2019)
2. Pauker, F., Mangler, J., Rinderle-Ma, S., Pollak, C.: *Centurio.work – Modular Secure Manufacturing Orchestration*, Industrial Track at BPM, pp. 164–171, CEUR 2196 (2018)

Predictive Process Monitoring: From Theory to Practice

Chiara Di Francescomarino¹ , Chiara Ghidini¹ ,
Fabrizio Maria Maggi¹ , and Williams Rizzi² 

¹ FBK-IRST, Trento, Italy

{dfmchiara,ghidini,wrizzi}@fbk.eu

² Free University of Bozen-Bolzano, Bolzano, Italy
maggi@inf.unibz.it

Abstract. Predictive process monitoring is a branch of process mining that aims at predicting, at runtime, the future development of ongoing cases of a process [1]. Predictions related to the future of an ongoing process execution can pertain to numeric measures of interest (e.g., the completion time), to categorical outcomes (e.g., whether a given predicate will be fulfilled or violated), or to the sequence of future activities (and related payloads). Recently, different approaches have been proposed in the literature in order to provide predictions on the outcome, the remaining time, the required resources as well as the remaining activities of an ongoing execution, by leveraging information related to control flow and data contained in event logs recording information about process executions. The approaches can be of a different nature and some of them also provide users with support in tasks such as parameter tuning. The interested reader can refer to recent surveys such as [2–4]. This tutorial aims at (i) providing an introduction on predictive process monitoring, including an overview on how to move within the large number of approaches and techniques available; (ii) introducing the current research challenges and advanced topics; and (iii) providing an overview on how to use the existing instruments and tools, with particular emphasis on the Nirdizati tool [5].

References

1. Maggi, F.M., Di Francescomarino, C., Dumas, M., Ghidini, C.: Predictive monitoring of business processes. In: Jarke, M. et al. (eds.) *Advanced Information Systems Engineering*. CAiSE 2014. LNCS, vol. 8484, pp. 457–472. Springer, Cham (2014). https://doi.org/10.1007/978-3-319-07881-6_31
2. Di Francescomarino, C., Ghidini, C., Maggi, F.M., Milani, F.: Predictive Process Monitoring Methods: Which One Suits Me Best?. In: Weske, M., Montali, M., Weber, I., vom Brocke, J. (eds.) *BPM 2018*. LNCS, vol. 11080, pp. 462–479. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-98648-7_27
3. Verenich, I., Dumas, M., La Rosa, M., Maggi, F.M., Teinemaa, I.: Survey and cross-benchmark comparison of remaining time prediction methods in business process monitoring. *ACM Trans. Intell. Syst. Technol.* **10**(4), 34:1–34:34 (2019)

4. Teinemaa, I., Dumas, M., La Rosa, M., Maggi, F.M.: Outcome-oriented predictive process monitoring: Review and benchmark. *ACM Trans. Knowl. Discov. Data* **13**(2), 17:1–17:57 (2019)
5. Rizzi, W., Simonetto, L., Di Francescomarino, C., Ghidini, C., Kasekamp, T., Maggi, F.M.: Nirdizati 2.0: Newfeatures and redesigned backend. In: *Proceedings of the Dissertation Award, Doctoral Consortium, and Demonstration Track at BPM 2019. CEUR Workshop Proceedings*, vol. 2420, pp. 154–158 (2019)

Business Process Analysis Using Scripting Languages

Gert Janssenswillen¹ and Sebastiaan J. van Zelst^{2,3}

¹ Hasselt University, Belgium

`gert.janssenswillen@uhasselt.be`

² Fraunhofer Institute for Applied Information Technology, Germany

`sebastiaan.van.zelst@fit.fraunhofer.de`

³ RWTH Aachen University, Germany

Abstract. During the recent decade, various (commercial) software solutions have been developed that support the semi-automated analysis of business processes, i.e., known as process mining solutions. Examples include, and are not limited to, Celonis, Disco, ProcessGold, and myInvenio on the commercial side, and ProM, Apromore, and RapidProM on the open-source/academic side. More recently, several process mining techniques have been developed in the context of scripting languages, e.g., Python, R, etc. The advantage of using scripting languages, which are often interpreted, with regards to compiled programming languages, include flexibility, rapid prototyping, portability, etc. In this tutorial, we focus on two, recently developed software libraries, i.e., `PM4Py` and `bupaR`, developed for `python` and `R` respectively. We sketch the main functions of the two libraries and compare their strengths and weaknesses. For both libraries, importing event data will be discussed. In the context of `PM4Py`, we furthermore focus on applying process discovery and conformance checking. In the context of `bupaR`, we focus more on visualization of event data for descriptive and exploratory analysis, as well as declarative conformance checking. This tutorial is intended for academics, data scientists, software scientists and process (intelligence) consultants, and might additionally be interesting for process owners and department heads/managers. We also aim to discuss the applicability and limitations of scripting languages for the development of novel enterprise-grade process mining technologies.

Keywords: Process mining · Python · R · `PM4Py` · `bupaR`

Information Systems Modeling

Playing with the Interplay Between Data and Processes

Artem Polyvyanyy¹ and Jan Martijn E. M. van der Werf²

¹ School of Computing and Information Systems, The University of Melbourne,
Parkville, VIC, 3010, Australia
artem.polyvyanyy@unimelb.edu.au

² Department of Information and Computing Science, Utrecht University,
The Netherlands
j.m.e.m.vanderwerf@uu.nl

Abstract. Data and processes go hand-in-hand in information systems but are often modeled, validated, and verified separately in the systems' design phases. Designers of information systems often proceed by ensuring that database tables satisfy normal forms, and process models capturing the dynamics of the intended information manipulations are deadlock and livelock free. However, such an approach is not sufficient, as perfect data and process designs assessed in isolation can, indeed, induce faults when combined in the end system.

In this tutorial, we demonstrate our recent approach to modeling and verification of models of information systems in three parts. Firstly, we present our Information Systems Modeling Language (ISML) for describing information and process constraints and the interplay between these two types of constraints [1, 2]. Secondly, we demonstrate Information Systems Modeling Suite (ISM Suite) [3], an integrated environment for developing, simulating, and analyzing models of information systems described in ISML, released under an open-source license.¹ In this part, using our tools, we show several example pitfalls at the level of information and process interplay. Finally, we discuss current and future research directions that aim at strengthening the theoretical foundations and practical aspects of our approach to the design of information systems.

References

1. van der Werf, J.M.E.M., Polyvyanyy, A.: An assignment on information system modeling. In: Daniel, F., Sheng, Q., Motahari, H. (eds.) BPM 2018. LNBIP, vol. 342, pp. 553–566. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-11641-5_44

¹ see: <http://www.informationssystem.org/ismsuite/>.

2. Polyvyanyy, A., van der Werf, J.M.E.M., Overbeek, S., Brouwers, R.: Information systems modeling: language, verification, and tool support. In: Giorgini, P., Weber, B. (eds.) CAiSE 2019. LNCS, vol. 11483, pp. 194–212. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-21290-2_13
3. van der Werf, J.M.E.M., Polyvyanyy, A.: The information systems modeling suite. In: Janicki, R., Sidorova, N., Chatain, T. (eds.) PETRI NETS 2020. LNCS, vol. 12152, pp. 414–425. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-51831-8_22

Contents

Keynotes

Process Minding: Closing the Big Data Gap.	3
<i>Avigdor Gal and Arik Senderovich</i>	
Characterizing Machine Learning Processes: A Maturity Framework	17
<i>Rama Akkiraju, Vibha Sinha, Anbang Xu, Jalal Mahmud, Pritam Gundecha, Zhe Liu, Xiaotong Liu, and John Schumacher</i>	

Foundations

Extending Temporal Business Constraints with Uncertainty	35
<i>Fabrizio Maria Maggi, Marco Montali, Rafael Peñaloza, and Anti Alman</i>	
Petri Nets with Parameterised Data	55
<i>Silvio Ghilardi, Alessandro Gianola, Marco Montali, and Andrey Rivkin</i>	
Socially-Aware Business Process Redesign.	75
<i>Arik Senderovich, Joop J. Schippers, and Hajo A. Reijers</i>	
Incentive Alignment of Business Processes.	93
<i>Tobias Heindel and Ingo Weber</i>	
PRIPeL: Privacy-Preserving Event Log Publishing Including Contextual Information	111
<i>Stephan A. Fahrenkrog-Petersen, Han van der Aa, and Matthias Weidlich</i>	
A Framework for Estimating Simplicity of Automatically Discovered Process Models Based on Structural and Behavioral Characteristics.	129
<i>Anna Kalenkova, Artem Polyvyanyy, and Marcello La Rosa</i>	
Online Process Monitoring Using Incremental State-Space Expansion: An Exact Algorithm	147
<i>Daniel Schuster and Sebastiaan J. van Zelst</i>	

Engineering

Looking for Meaning: Discovering Action-Response-Effect Patterns in Business Processes	167
<i>Jelmer J. Koorn, Xixi Lu, Henrik Leopold, and Hajo A. Reijers</i>	

Extracting Annotations from Textual Descriptions of Processes.	184
<i>Luis Quishpi, Josep Carmona, and Lluís Padró</i>	
Analyzing Process Concept Drifts Based on Sensor Event Streams During Runtime	202
<i>Florian Stertz, Stefanie Rinderle-Ma, and Juergen Mangler</i>	
TADE: Stochastic Conformance Checking Using Temporal Activity Density Estimation	220
<i>Florian Richter, Janina Sontheim, Ludwig Zellner, and Thomas Seidl</i>	
Predictive Business Process Monitoring via Generative Adversarial Nets: The Case of Next Event Prediction	237
<i>Farbod Taymouri, Marcello La Rosa, Sarah Erfani, Zahra Dasht Bozorgi, and Ilya Verenich</i>	
Exploring Interpretable Predictive Models for Business Processes	257
<i>Renuka Sindhgatta, Catarina Moreira, Chun Ouyang, and Alistair Barros</i>	
Triggering Proactive Business Process Adaptations via Online Reinforcement Learning.	273
<i>Andreas Metzger, Tristan Kley, and Alexander Palm</i>	
Video-to-Model: Unsupervised Trace Extraction from Videos for Process Discovery and Conformance Checking in Manual Assembly	291
<i>Sönke Knoch, Shreeraman Ponpathirkootam, and Tim Schwartz</i>	
Enhancing Event Log Quality: Detecting and Quantifying Timestamp Imperfections	309
<i>Dominik Andreas Fischer, Kanika Goel, Robert Andrews, Christopher Gerhard Johannes van Dun, Moe Thandar Wynn, and Maximilian Röglinger</i>	
Automatic Repair of Same-Timestamp Errors in Business Process Event Logs.	327
<i>Raffaele Conforti, Marcello La Rosa, Arthur H. M. ter Hofstede, and Adriano Augusto</i>	
Management	
Explorative Process Design Patterns	349
<i>Michael Rosemann</i>	
Quo Vadis, Business Process Maturity Model? Learning from the Past to Envision the Future	368
<i>Vanessa Felch and Björn Asdecker</i>	

A Typological Framework of Process Improvement Project Stakeholders	384
<i>Charon Abbott, Wasana Bandara, Paul Mathiesen, Erica French, and Mary Tate</i>	
BP-IT Alignment in SMEs: A Game-Based Learning Approach to Increase Stakeholders' Maturity.	400
<i>Mahi Samir Ismail and Ralf Klischewski</i>	
Understanding Quality in Declarative Process Modeling Through the Mental Models of Experts.	417
<i>Amine Abbad Andaloussi, Christopher J. Davis, Andrea Burattin, Hugo A. López, Tijs Slaats, and Barbara Weber</i>	
Adding Intelligent Robots to Business Processes: A Dilemma Analysis of Employees' Attitudes.	435
<i>Amy Van Looy</i>	
How to Keep RPA Maintainable?	453
<i>Philip Noppen, Iris Beerepoot, Inge van de Weerd, Mathieu Jonker, and Hajo A. Reijers</i>	
A Consolidated Framework for Implementing Robotic Process Automation Projects	471
<i>Lukas-Valentin Herm, Christian Janiesch, Alexander Helm, Florian Imgrund, Kevin Fuchs, Adrian Hofmann, and Axel Winkelmann</i>	
A Multi Perspective Framework for Enhanced Supply Chain Analytics	489
<i>Owen Keates, Moe Thandar Wynn, and Wasana Bandara</i>	
Event Log Generation in a Health System: A Case Study.	505
<i>Simon Remy, Luise Pufahl, Jan Philipp Sachs, Erwin Böttinger, and Mathias Weske</i>	
Author Index	523