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Blockchain Technologies in Enterprise Modeling and Enterprise Information Systems

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Blockchains constitute a new paradigm for decentralized information systems with implications both on a managerial and a technical level (Iansiti and Lakhani 2017). At their core, blockchains are distributed, decentralized electronic registers that store information in an append-only fashion, secured by strong cryptographic mechanisms (Narayanan et al. 2016). In the case of *public or permissionless blockchains*, the access to blockchains is not regulated, i. e. everyone can issue transactions and retrieve the current state of the blockchain from other participating nodes. To achieve consensus on valid transactions, particular decentralized consensus protocols are put in place that are capable of ensuring the correctness of transactions in terms of the rules set for the blockchain and for preventing fraudulent information to be stored on the blockchain without the requirement of a trusted third party (Xiao et al. 2020). In addition, transactions may contain programs denoted as *smart contracts* that can be stored on the blockchain and executed upon request (Antonopoulos and Wood 2018). The execution of these programs can equally be verified by all participating nodes. They may contain statements for issuing transactions, performing calculations or processing information on the blockchain. When access to the blockchain is restricted, e. g. to the members of an organization or individuals, they are denoted as *private or permissioned blockchains*. Also, in this variant, participants typically have at least full read access to the contents of the blockchain.

After a first hype that originated mainly from their successful use in cryptocurrencies, blockchains are now being evaluated for innovative enterprise applications (Fill and Meier 2020). Today, it is studied for example how blockchains can be applied in domains such as enterprise resource planning systems (Linke and Strahringer 2020), for business process execution (Fatz et al. 2019; López-Pintado et al. 2019; Mendling et al. 2018), for interorganizational collaboration (Di Ciccio et al. 2018; Härer 2018) or for the distributed storage of organizational knowledge (Fill and Härer 2018). These developments have already resulted in several real-world enterprise applications such as the TradeLens blockchain for sharing shipment information of containers between different logistics partners,[1] the integration of cryptocurrency payments for public transport ticketing[2] or the Bloxberg infrastructure for exchanging research results.[3]

In this context, the use of conceptual modeling techniques plays an important role for the well-structured design, evaluation, and deployment of such applications (Ellervee et al. 2017;

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[1] See https://www.tradelens.com/platform (accessed 2020-10-13).
[2] See https://www.sbb.ch/en/station-services/at-the-station/services-from-the-ticket-machine/bitcoin.html (accessed 2020-10-10)
[3] See https://bloxberg.org/ (accessed 2020-10-14)

Olive 2020). This concerns both the use of general-purpose modeling methods as well as domain-specific modeling methods. In addition, blockchain technologies may support the exchange and processing of information contained in models, e. g. for distributed workflows and collaboration scenarios.

With this opening editorial we introduce the first contributions to a special issue in EMISAJ, which targets specifically the combination of blockchain technologies and enterprise modeling and enterprise information systems. The papers in this special issue have undergone a rigorous double-blind peer review process with at least three reviewers per paper.

Overall, the three contributions to the special issue address the appropriateness and usage of Blockchain technologies for decentralized process support (aka process collaborations or inter-organizational processes). On top of conceptual contributions, several highly interesting use cases and application scenarios are presented.

The first paper by Felix Härer deals with *"Process Modeling in Decentralized Organizations Utilizing Blockchain Consensus"*. This work addresses collaborative process scenarios and how they can be modeled in a decentralized way. In particular, the decentralized characteristics of such scenarios demand for blockchain support. The approach covers modeling of private and public processes as well as the execution of process instances during runtime. The approach has been prototypically implemented and is illustrated based on a supply chain scenario.

The second paper by Joerg Evermann and Henry Kim addresses *"Workflow Management on BFT Blockchains"*. This work is motivated by the observation and claim that blockhain-based solutions for inter-organizational processes are more efficient based on Byzantine Fault Tolerance (BFT) consensus than on proof-of-work based. The authors provide an architecture and prototypical implementation for such a BFT consensus based Blockchain solution. Its application is illustrated based on a inter-organizational process from resource extraction.

The third paper on *"Decentralized Business Process Control using Blockchain: Learnings from two applications: Food Supply Chain and Car Registration"* has been contributed by Sérgio Guerreiro, Diogo Silva, Tiago Rosado, André Vasconcelos, Miguel Correia, and Pedro Sousa. This work features two experiments in the application scenarios of food supply chain and car registration, using DEMO and BPMN for modeling and Hyperledger Fabric for implementation. The experiments yield insights and lessons learned on the modeling and implementation choices.

The first part of the special issue is concluded with a Catchword highlighting the research opportunities in the context of enterprise modeling and blockchains.

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