

Hongfeng CHAI, Xiaohong CHEN, Hongwei WANG

## Special issue: Blockchain technology application

© Higher Education Press 2020

As a game-changer, the emergence of blockchain technology is profoundly shaping the business, organization, economy, and society around the world. The blockchain is an open, distributed ledger that records transactions between two parties efficiently and in a verifiable and permanent way. It exhibits a chain structure composed of increasing blocks. The transaction data per unit time is encrypted into the block for that time period and used to generate a cryptographic hash of the next block. Underlying the novel technology, there are several distinguished features including distributed database, peer-to-peer transmission, transparency with pseudonymity, irreversibility of records, and computational logic. With blockchain, a new world could be imaged in which all form of transactions are embedded in digital code and protected from deletion, tampering and revision. The trust could be perfectly established by using the “algorithmic proof mechanism” in an asymmetric, uncertain, and insecure environment.

Given the promise and peril of such a disruptive technology, various industries, such as network security, medicine and health care, financial services, manufacturing, philanthropy, retail, real estate, transportation, tourism, and media, have begun to actively embrace the blockchain to gain the competitive edge by discovering its immense potential. Therefore, this special issue on *Frontiers of Engineering Management* aims to demonstrate the cutting-edge advances in blockchain and its cross-disciplinary theoretical research and applications. After several cycles of rigorous peer review, ten outstanding papers were finally accepted for publication. These papers not only present a series of innovative blockchain-based projects, but also bring the voices of diverse disciplines and shed a light into the progress in the very hot field.

In its original field, blockchain technology has provided ideal solutions to the innovation logjam in finance. Its unstoppable force is barreling down on the infrastructure of modern finance. The established trust by cryptography and network consensus facilitates all kinds of assets’ (e.g., money, equities, bonds, titles, deeds, and contracts) secure movements. To cite unprecedented opportunities to reduce friction and costs, **Chai et al.** use the UnionPay network as basis to systematically propose a digital currency information system from three aspects, namely, digital currency account opening, exchange, and use. Moreover, their study expounds on the operation mechanism of a digital currency information system prototype, and also discusses how to apply blockchain technology to digital currency, such as using distributed ledger for digital currency confirmation and registration and using blockchain-enabled smart contracts to realize the forward guidance function of the central bank digital currency.

---

Received September 11, 2020

Hongfeng CHAI (✉)  
China UnionPay Co., Ltd., Shanghai 201201, China  
E-mail: hfchai@unionpay.com

Xiaohong CHEN (✉)  
Institute of Big Data and Internet Innovation, Hunan University of Technology and Business, Changsha 410205, China  
E-mail: csu\_cxh@163.com

Hongwei WANG (✉)  
School of Management, Huazhong University of Science and Technology, Wuhan 430074, China  
E-mail: hwwang@hust.edu.cn

Concentrating on the technical operation aspect, **Tian et al.**'s study contributes to filling the gap in understanding how blockchain technology can be implemented to finance infrastructure. They analyze the first US Securities and Exchange Commission (SEC)-compliant energy asset security token, ZiyenCoin, from the perspective of key participants, relevant regulations, and procedures of the token offering process, and conclude that tokenization has the capability to enhance the liquidity of infrastructure assets, and transaction efficiencies and transparency across intermediaries in this case. Benefits and barriers of tokenizing infrastructure projects have been thoroughly discussed.

Regarding the rapid development of supply chain finance (SCF), **Li et al.** provide a blockchain-driven SCF solution for small and medium enterprises. They analyze the coupling between SCF and blockchain technology, present the conceptual framework of blockchain-driven SCF platform (BcSCFP) and finally propose the operation process of three SCF models on the BcSCFP. This novel kind of technology solution would significantly lower financing costs and improve business efficiency for buyers and sellers linked in all sorts of transactions.

Beyond the financial nature of blockchain, it would erect a trustworthy infrastructure for information management among participants showing peer-to-peer communications. This merit is beneficial to construction projects where people are working closely together throughout all life-cycle stages. Bringing blockchain to bear on construction management is a natural next step. As the most important issue of construction management, quality would certainly benefit from preferable information exchanges. To address this challenge, **Zhong et al.** explore a blockchain-based framework for construction quality information management as well as a consensus process aiming to address the problem of information fraud. They realize that blockchain can facilitate mutual trust in construction quality management by providing distributed, encrypted, and secure information records and supporting automated compliance checking of construction quality.

**Zhang et al.** propose a framework of quality traceability system for precast components based on blockchain technology. The system framework adopts a hybrid blockchain architecture and dual storage mode, defines three types of smart contracts, and creates an interactive and efficient source tracing query method, which could effectively achieve the goals of decentralization, openness, and non-tamperability, as well as efficient traceability. Besides quality issues, blockchain is changing the operation pattern of construction industry. While the information exchanges across organizational boundaries are much more frequent than before, the advantage of blockchain could ensure secure storage of data sensitive to privacy. Based on these un-constraining characteristics, **Tezel et al.** investigate the preparation of construction supply chains for blockchain technology through an explorative analysis. Alongside presenting a strengths, weaknesses, opportunities, and threats analysis (SWOT), their study exhibits the requirements for and steps toward a construction supply structure facilitated by blockchain technology. Also, **Shemov et al.** investigate blockchain applied to the construction supply chain (CSC) and regard blockchain as a viable solution to the challenges in the CSC regardless of the risks associated with the security and robustness of the flow of information and data protection. They also introduce a threat analysis of applying blockchain model on the CSC industry.

Blockchain's potential is infinite, far more than just a payment or information tool. Entering segments of the economy, blockchain is sparking the imaginations of incumbents and helping organizations and industries to become more concerted. Every field could benefit from the improved governance whether machine- or people-related. **Zhang et al.** analyze the application of blockchain in the field of intelligent manufacturing. They introduce the basic connotation and applications of blockchain, propose the theoretical basis for the application of blockchain, and point out the realistic plights and provide some suggestions to promote the application of blockchain in the field of intelligent manufacturing. **Ren et al.** propose a data-sharing mechanism of various mineral resources based on blockchain and provide implementation suggestions and technical key points. **Gong and Zhao** identify the blockchain-based healthcare industry projects and startups in the areas of health insurance, pharmacy, and health treatment, analyze the fundamental principles of Health Data Bank (HDB) and point out four challenges faced by HDB's sustainable development in healthcare industry.

In addition to the topics covered by the above published articles, there are still some promising and worthwhile areas for future research, for instance, the application of blockchain in social governance as well as the integration of blockchain and other emerging information technology. We hope to see high-quality studies on them in the future. Finally, we would like to express our sincere gratitude to all the contributors for their outstanding work. We are also indebted to all the reviewers who provided expert reviews to improve the quality of the submitted papers.

**Guest Editors-in-Chief****Hongfeng CHAI**

China UnionPay Co., Ltd., China

**Xiaohong CHEN**

Hunan University of Technology and Business, China

**Hongwei WANG**

Huazhong University of Science and Technology, China



**Hongfeng CHAI** serves as academician of Chinese Academy of Engineering, visiting professor of Fudan University, adjunct professor of Shanghai Jiao Tong University, adjunct professor of Beijing University of Posts and Telecommunications and doctoral supervisor of South-western University of Finance and Economics. He was awarded by the State Council of China to enjoy government subsidies since 1997. During his career, he successively worked in State Administration of Foreign Exchange Information Center, China Foreign Exchange Trade Center and China UnionPay. At present, he is president and director of National Engineering Laboratory of Electronic Commerce and Electronic Payment.

Since 1986, he has been engaged in financial information engineering research for over 30 years, focusing on the design of financial trading mechanisms, the development of financial system information engineering and the corresponding engineering management. To meet the needs of economic and financial development, he, together with the technical team, hosted and engaged in the development of a number of major national financial information projects, and achieved a series of groundbreaking results. All of these achievements are in accordance with national strategic decision-making, and under the leadership of the corresponding national coordination group of engineering, which contributed to promoting the informatization in the financial sector and the overall development of the bankcard industry.

Among them, the Bankcard Information Switching System is the first engineering project to realize the inter-networking of national-level bankcard systems, which wins the provincial and ministerial level special award and the second prize of the National Science and Technology Progress Award. The National Interbank Funds Lending System, together with the National Debt Trading and Settlement System Project, is the first information project to realize the unification of the interbank money market. The China Gold Trading System is the first information system to serve China's gold trading. The China Foreign Exchange Trading System is the foundation project for the formation mechanism of the CNY exchange rate between banks and won the second prize of the National Science and Technology Progress Award.



**Xiaohong CHEN** is an academician at the Chinese Academy of Engineering and an expert on management and science and engineering. She is currently president of Hunan University of Technology and Business, the winners of "Outstanding Young Investigator Award", the academic and technical leader of national first and second level trans-century "Millions of Talents Project", the leading personnel of the "Millions of Plan" of philosophy and social sciences of the Central Organization Department, the member of the Social Science and Technology Commission, the National Excellent Teacher, the National March Eighth Red Banner holder, and the leader of the innovative research group of the National Natural Science Foundation of China.

She has presided more than 30 national and major projects; successfully developed China's first decision-making application software platform for the development and utilization of metal mineral resources with independent intellectual property rights; and won the second prize of National Science and Technology Progress Award, one first prize and two second prizes for outstanding achievements in humanities and social sciences of the Ministry of Education (China), Hunan Guangzhao Science and Technology Award, Hunan Science and Technology Progress Award, etc., and 14 research awards at the provincial and ministerial levels.



**Hongwei WANG** is currently a professor of the School of Management, Huazhong University of Science and Technology. He is the leader of the innovative research group of the National Natural Science Foundation of China. He was awarded the National Science Fund for Distinguished Young Scholar in 2011. He is vice president of the Systems Engineering Society of China, and president of Hubei Institute of Systems Engineering. He is also the executive deputy Editor-in-Chief of *Frontiers of Engineering Management*, and the editorial board member of several journals, e.g., *Engineering*, *Systems Engineering-Theory & Practice*, *Journal of Systems Engineering*, *Journal of Systems Management*, *Control and Decision*, and *Information and Control*.

He focuses on the research of system engineering for a long time, and his interested research fields are engineering management, logistics and supply chain management, and public safety and emergency management. For the national economic mobilization, he developed the first National Economy Mobilization Simulation and Training System, and achieved the First Prize of Science and Technology Progress Award of the Ministry of Education (1st completed) in 2010. He has participated in the investigation of the management issues of Three Gorges Project and Hong Kong–Zhuhai–Macao Bridge Project, and the related achievements were awarded the First Prize of Science and Technology Progress Award of the Ministry of Education in 2000 and 2018, respectively.