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Blockchain Service Architecture for Public Payment Services

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Abstract

Blockchain technology holds transformative potential across various sectors, including finance, healthcare, supply chain management, and the Internet of Things, offering exceptional transparency, security, and efficiency. However, its practical adoption is restrained by challenges such as technical complexities, regulatory uncertainties, and a lack of clear implementation frameworks. In order to address these challenges, this study introduces the Process Model for the Implementation of Blockchain-Based Systems (PM-IBS), a structured methodology guiding organizations through blockchain adoption. The PM-IBS model encompasses decision trees for assessing suitability, comprehensive criteria for platform selection, strategies for high-level architectural design, operational cost estimation techniques, and best practices for implementation. In order to validate the PM-IBS model, this study conducted two distinct evaluations: (1) a real-world use case implementation of a Blockchain-Based Property Registration and Succession System, demonstrating the model's practical applicability, and (2) a feedback survey involving 20 blockchain experts, providing critical insights into the model's relevance, comprehensiveness, and usability. These evaluations highlight the model's strengths, identify areas for refinement, and support its potential to facilitate effective and efficient blockchain adoption.This thesis contributes to blockchain technology adoption by offering a novel process model, a functional prototype, an illustrative real-world application, and expert-driven feedback. The findings advance academic discourse on blockchain implementation strategies while providing practical tools and frameworks for industry practitioners aiming to harness blockchain's transformative capabilities.

Keywords: modeling paradigms, blockchain suitability, blockchain adaptability, blockchain platforms, architecture design, cost estimation, best practices

1 Abstrakt

Technológia blockchain má transformačný potenciál v rôznych sektoroch, vrátane financií, zdravotníctva, riadenia dodávateľského reťazca a Internetu vecí, pričom ponúka výnimočnú transparentnosť, bezpečnosť a efektivitu. Jej praktické prijatie je však obmedzené výzvami, ako sú technická zložitosť, regulačné neistoty a nedostatok jasných implementačných rámcov.

Na riešenie týchto výziev predstavuje táto práca Procesný model pre implementáciu systémov založených na blockchaine (PM-IBS), čo je štruktúrovaná metodológia usmerňujúca organizácie pri adopcii blockchainu. Model PM-IBS zahŕňa rozhodovacie stromy na hodnotenie vhodnosti, komplexné kritériá na výber platformy, stratégie pre návrh architektúry na vysokej úrovni, techniky na odhad operačných nákladov a osvedčené postupy implementácie.

Na validáciu modelu PM-IBS boli vykonané dve samostatné hodnotenia: (1) implementácia reálneho prípadu systému registrácie nehnuteľností a dedenia založeného na blockchaine, ktorá demonštruje praktickú aplikovateľnosť modelu, a (2) prieskum spätnej väzby od 20 odborníkov na blockchain, poskytujúci kľúčové poznatky o relevantnosti, komplexnosti a použiteľnosti modelu. Tieto hodnotenia zdôrazňujú silné stránky modelu, identifikujú oblasti na zlepšenie a podporujú jeho potenciál uľahčiť efektívnu a účinnú adopciu blockchainu.

Táto dizertačná práca prispieva k prijatiu blockchainovej technológie tým, že ponúka nový procesný model, funkčný prototyp, ilustratívnu reálnu aplikáciu a spätnú väzbu od odborníkov. Výsledky posúvajú akademickú diskusiu o stratégiách implementácie blockchainu a zároveň poskytujú praktické nástroje a rámce pre odborníkov z priemyslu, ktorí chcú využiť transformačné schopnosti blockchainu.

Kľúčové slová: Modelovacie paradigmy, návrh procesov, vhodnosť blockchainu, adaptabilita blockchainu, blockchainové platformy, návrh architektúry, odhad nákladov, osvedčené postupy

2 Problem Statement

Blockchain technology offers transformative potential across sectors such as finance, healthcare, and supply chain management. However, practical adoption remains challenging due to several factors. First, organizations often lack clear criteria to determine blockchain's suitability for their use cases, leading to ineffective implementations. Second, selecting an appropriate blockchain platform is complex because of numerous options with distinct capabilities, scalability, and costs, compounded by a lack of structured compari-

son guidelines. Third, organizations face difficulties in accurately estimating implementation costs, including smart contract development, transaction fees, and maintenance. Lastly, the scarcity of standardized best practices and design principles impedes secure and efficient blockchain deployment. Existing research addresses these challenges individually, but there is currently no comprehensive, systematic approach that integrates suitability assessment, platform selection, cost estimation, and implementation strategies to facilitate effective blockchain adoption.

3 Objective

a) Identify key challenges in blockchain adoption, emphasizing suitability assessment, platform selection, and best design practices.

b) Develop the PM-IBS model, a holistic framework integrating best practices, procedural steps, and core design principles for blockchain adoption.

c) Articulate blockchain-specific best practices and design principles to improve strategic decisions and implementations.

d) Conduct detailed cost analysis for blockchain implementation, examining platform and architectural factors.

e) Develop and deploy a functional prototype of the PM-IBS model through a blockchain-based property registration system.

f) Evaluate the PM-IBS model's suitability, user experience, and effectiveness in a real-world scenario, highlighting strengths and improvement areas.

4 Research Contributions

The research provides significant contributions across academic and practical domains:

- **PM-IBS Model Development:** Introduces the **Process Model for Implementation of Blockchain-Based Systems (PM-IBS)**, a structured framework addressing suitability, platform selection, cost estimation, and best practices for blockchain adoption.
- **Empirical Validation:** Validates PM-IBS through:
  - A practical case study (blockchain-based inheritance management system).
  - Expert feedback from 20 blockchain professionals assessing usability and effectiveness.

- **Insights into Blockchain Adoption Challenges:** Systematically identifies key adoption barriers (technical complexity, cost uncertainty, lack of guidelines) and provides strategic solutions through the PM-IBS model.
- **Practical Industry Tools:** Provides:
  - A functional PM-IBS prototype.
  - Blockchain-specific best practices and design principles.
  - A robust cost estimation framework for effective resource planning.
- **Foundation for Future Research:** Establishes groundwork for further studies on blockchain adoption, encouraging application in diverse use cases and continuous methodological refinement.

5 Limitations

While the study provides valuable insights, several limitations exist:

- **Single Use Case:** Evaluation focused on a blockchain-based inheritance system, limiting generalizability across diverse scenarios.
- **Prototype Challenges:** Technical complexities in scalability and user interface highlighted areas needing further refinement.
- **Survey Scope:** Feedback from 20 experts may not fully represent industry-wide perspectives or sector-specific needs.
- **Dynamic Blockchain Landscape:** Rapid technological evolution may require periodic updates to model components, like cost estimation.
- **Lack of Longitudinal Analysis:** Long-term sustainability and effectiveness of the PM-IBS model were not assessed.

6 Future Work

Future research directions include:

- Extending the PM-IBS model's application to additional use cases and industries to validate its versatility and adaptability.
- Enhancing the model with emerging blockchain technologies and addressing scalability and interoperability challenges.

- Further refining the cost analysis component to reflect dynamic market conditions and technological advancements.
- Conducting longitudinal studies to assess the sustainability and long-term effectiveness of blockchain systems developed with the PM-IBS model.

List of Published Works

1. **BAHAR, Muhammad Nasim; RIES, Michal; KOŠŤÁL, Kristián.** A Dynamic Decision Support System for the Best-Fitting Blockchain Platform Selection. In: 2023 Fifth International Conference on Blockchain Computing and Applications (BCCA). Danvers: Institute of Electrical and Electronics Engineers, 2023, p. 412–419. ISBN 979-8-3503-3923-9.
2. **KOŠŤÁL, Kristián; BAHAR, Muhammad Nasim; GAZDÍK, Richard; RIES, Michal.** Advancing Decentralized Finance: A Comprehensive Pool-Based Liquidity Protocol. In: 2023 Fifth International Conference on Blockchain Computing and Applications (BCCA). Danvers: Institute of Electrical and Electronics Engineers, 2023, p. 158–165. ISBN 979-8-3503-3923-9.
3. **BAHAR, Muhammad Nasim; RIES, Michal; KOŠŤÁL, Kristián.** Blockchain Suitability: A Decision-Making Flowchart and Web. In: MUŠTRA, Mario; VUKOVIĆ, Josip; BOŽEK, Jelena. Proceedings ELMAR-2023. Zadar: Croatian Society Electronics in Marine, 2023, p. 141–145. ISBN 979-8-3503-2511-9.
4. **ČUČVARA, Daniel; BAHAR, Muhammad Nasim.** The implementation of the notary-based scheme into the blockchain. Bachelor thesis. 2024. *Note: This bachelor thesis involved implementing a notary-based scheme using the proposed process model.*
5. **BAHAR, Muhammad Nasim; RIES, Michal; KOŠŤÁL, Kristián.** Keeping traders' privacy in blockchain-based energy-sharing system. In: SZABOVÁ, Miriam; PERNÝ, Milan; KOVÁČ, Zoltán. Inteligentné a bezpečné informačno komunikačné technológie a systémy. Bratislava: Vydavateľstvo Spektrum STU, 2022, p. 139–141. ISBN 978-80-227-5230-5.
6. **RIES, Michal; BAHAR, Muhammad Nasim; KORAUŠ, Anton.** Rethinking Blockchain Technology Suitability: A New Decision Flowchart for Diverse Use Cases. In: ZACHAR KUCHTOVÁ, Jana. Bezpečnosť elektronickej komunikácie 2023. Bratislava: Akadémia policajného zboru, 2023, p. 154–162. ISBN 978-80-8054-977-8.

7. **KOŠŤÁL, Kristián; BAHAR, Muhammad Nasim; NUMYALAI, Sultan; RIES, Michal.** Beyond Integration: Advancing Electricity Metering with Secure and Transparent Blockchain-IoT Solutions. In: HERENCSAR, Norbert. TSP 2024. Brno: Vysoké učení technické v Brně, 2024, p. 324–331. ISBN 979-8-3503-6559-7.

8.

References

References

1. S. Nakamoto, "Bitcoin: A peer-to-peer electronic cash system," *Decentralized Business Review*, 2008.
2. S. Wieninger, G. Schuh, and V. Fischer, "Development of a Blockchain Taxonomy," in 2019 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), IEEE, 2019, pp. 1–9.
3. W. Gao, W. G. Hatcher, and W. Yu, "A Survey of Blockchain: Techniques, Applications, and Challenges," in 2018 27th International Conference on Computer Communication and Networks (ICCCN), IEEE, 2018, pp. 1–11.
4. D. Allen and T. MacDonald, "The economic organisation of the entrepreneurial problem of blockchains," SSRN Electronic Journal, vol. 2749018, 2016.
5. M. Belotti, N. Bozic, G. Pujolle, and S. Secci, "A Vademecum on Blockchain Technologies: When, Which, and How," IEEE Communications Surveys & Tutorials, vol. 21, no. 4, pp. 3796–3838, 2019.
6. F. Casino, T. K. Dasaklis, and C. Patsakis, "A systematic literature review of blockchain-based applications: Current status, classification and open issues," Telematics and Informatics, vol. 36, pp. 55–81, 2019.
7. M. Krichen, M. Ammi, A. Mihoub, and M. Almutiq, "Blockchain for modern applications: A survey," Sensors, vol. 22, no. 14, p. 5274, 2022.
8. J. Abou Jaoude and R. G. Saade, "Blockchain applications–usage in different domains," IEEE Access, vol. 7, pp. 45360–45381, 2019.
9. P. Tasatanattakool and C. Techapanupreeda, "Blockchain: Challenges and applications," in 2018 International Conference on Information Networking (ICOIN), IEEE, 2018, pp. 473–475.
10. Z. Zheng, S. Xie, H.-N. Dai, X. Chen, and H. Wang, "Blockchain challenges and opportunities: A survey," *International Journal of Web and Grid Services*, vol. 14, no. 4, pp. 352–375, 2018.
11. E. B. Hamida, K. L. Brousmiche, H. Levard, and E. Thea, "Blockchain for enterprise: Overview, opportunities and challenges", in The Thirteenth International Conference on Wireless and Mobile Communications (ICWMC 2017), 2017.
12. R. Belchior, A. Vasconcelos, S. Guerreiro, and M. Correia, "A survey on blockchain interoperability: Past, present, and future trends", ACM Computing Surveys (CSUR), vol. 54, no. 8, pp. 1–41, 2021.

13. D. Khan, L. T. Jung, and M. A. Hashmani, "Systematic literature review of challenges in blockchain scalability", Applied Sciences, vol. 11, no. 20, p. 9372, 2021.

14. Y. Zhou, Y. S. Soh, H. S. Loh, and K. F. Yuen, "The key challenges and critical success factors of blockchain implementation: Policy implications for singapore's maritime industry", Marine policy, vol. 122, p. 104 265, 2020.

15. S. Farshidi, S. Jansen, S. Espa˜na, and J. Verkleij, "Decision support for blockchain platform selection: Three industry case studies", IEEE transactions on Engineering management, vol. 67, no. 4, pp. 1109–1128, 2020.

16. C. C. Agbo, Q. H. Mahmoud, and J. M. Eklund, "Blockchain technology in healthcare: A systematic review", in Healthcare, MDPI, vol. 7, 2019, p. 56.

17. B. Kaye, "Insight: Australian stock exchange's blockchain failure burns market trust", Reuters, 2022. [Online]. Available: https://www.reuters.com/article/australian-stock-exchange-blockchain-failure-idUSKBN2JX0A0.

18. M. J. M. Chowdhury, M. S. Ferdous, K. Biswas, et al., "A comparative analysis of distributed ledger technology platforms", IEEE Access, vol. 7, pp. 167 930–167 943, 2019.

19. W. Gao, W. G. Hatcher, and W. Yu, "A survey of blockchain: Techniques, applications, and challenges", in 2018 27th international conference on computer communication and networks (ICCCN), IEEE, 2018, pp. 1–11.

20. H. F. Atlam, M. A. Azad, A. G. Alzahrani, and G. Wills, "A review of blockchain in internet of things and ai", Big Data and Cognitive Computing, vol. 4, no. 4, p. 28, 2020.

21. S. Wieninger, G. Schuh, and V. Fischer, "Development of a blockchain taxonomy", in 2019 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), IEEE, 2019, pp. 1–9. J. Mattila, "The blockchain phenomenon–the disruptive potential of distributed consensus architectures", ETLA working papers, Tech. Rep., 2016.

22. D Allen and T. MacDonald, "The economic organisation of the entrepreneurial problem of blockchains", Allen D., MacDonald TJ [online] Available from: http://ssrn. com/abstract, vol. 2749018, 2016.

23. S. Khezr, M. Moniruzzaman, A. Yassine, and R. Benlamri, "Blockchain technology in healthcare: A comprehensive review and directions for future research", Applied sciences, vol. 9, no. 9, p. 1736, 2019.

24. B. Shrimali and H. B. Patel, "Blockchain state-of-the-art: Architecture, use cases, consensus, challenges and opportunities", Journal of King Saud University-

Computer and Information Sciences, vol. 34, no. 9, pp. 6793–6807, 2022. BIBLIOGRAPHY 73

25. D. Mingxiao, M. Xiaofeng, Z. Zhe, W. Xiangwei, and C. Qijun, "A review on consensus algorithm of blockchain", in 2017 IEEE international conference on systems, man, and cybernetics (SMC), IEEE, 2017, pp. 2567–2572.
26. M. Crosby, P. Pattanayak, S. Verma, V. Kalyanaraman, et al., "Blockchain technology: Beyond bitcoin", Applied Innovation, vol. 2, no. 6-10, p. 71, 2016.
27. S. Zhai, Y. Yang, J. Li, C. Qiu, and J. Zhao, "Research on the application of cryptography on the blockchain", in Journal of Physics: Conference Series, IOP Publishing, vol. 1168, 2019, p. 032 077.
28. R. Zhang, R. Xue, and L. Liu, "Security and privacy on blockchain", ACM Computing Surveys (CSUR), vol. 52, no. 3, pp. 1–34, 2019.
29. A. M. Antonopoulos and D. A. Harding, Mastering bitcoin. " O'Reilly Media, Inc.", 2023.
30. C. CFE et al., "Blockchain basics: A non-technical introduction in 25 steps", The CPA Journal, vol. 93, no. 3/4, pp. 13–13, 2023.
31. A. T. Norman, Blockchain technology explained: The ultimate beginners guide About blockchain wallet, mining, bitcoin, ethereum, litecoin, zcash, monero, ripple, dash, iota and smart contracts. CreateSpace Independent Publishing Platform, 2017.
32. T. M. Fern´andez-Caram´es and P. Fraga-Lamas, "A review on the use of blockchain for the internet of things", Ieee Access, vol. 6, pp. 32 979–33 001, 2018.
33. N. Deepa, Q.-V. Pham, D. C. Nguyen, et al., "A survey on blockchain for big data: Approaches, opportunities, and future directions", Future Generation Computer Systems, vol. 131, pp. 209–226, 2022.
34. R. Yang, F. R. Yu, P. Si, Z. Yang, and Y. Zhang, "Integrated blockchain and edge computing systems: A survey, some research issues and challenges", IEEE Communications Surveys Tutorials, vol. 21, no. 2, pp. 1508–1532, 2019.
35. Y. Liu, D. He, M. S. Obaidat, N. Kumar, M. K. Khan, and K.-K. R. Choo, "Blockchain-based identity management systems: A review", Journal of network and computer applications, vol. 166, p. 102 731, 2020.
36. D. Knezevic, "Impact of blockchain technology platform in changing the financial sector and other industries", Montenegrin Journal of Economics, vol. 14, no. 1, pp. 109–120, 2018.

37. S. Saberi, M. Kouhizadeh, J. Sarkis, and L. Shen, “Blockchain technology and its relationships to sustainable supply chain management”, International journal of production research, vol. 57, no. 7, pp. 2117–2135, 2019.

38. A. Gurtu and J. Johny, “Potential of blockchain technology in supply chain management: A literature review”, International Journal of Physical Distribution Logistics Management, vol. 49, no. 9, pp. 881–900, 2019.

39. M. M. Queiroz, R. Telles, and S. H. Bonilla, “Blockchain and supply chain management integration: A systematic review of the literature”, Supply chain management: An international journal, vol. 25, no. 2, pp. 241–254, 2020. 74 BIBLIOGRAPHY

40. S. Chakraborty, S. Aich, and H.-C. Kim, “A secure healthcare system design framework using blockchain technology”, in 2019 21st International Conference on Advanced Communication Technology (ICACT), IEEE, 2019, pp. 260–264.

41. S. Angraal, H. M. Krumholz, and W. L. Schulz, “Blockchain technology: Applications in health care”, Circulation: Cardiovascular quality and outcomes, vol. 10, no. 9, e003800, 2017.

42. N. A. Dawit, S. S. Mathew, and K. Hayawi, “Suitability of Blockchain for Collaborative Intrusion Detection Systems”, in 2020 12th Annual Undergraduate Research Conference on Applied Computing (URC), IEEE, 2020, pp. 1–6, isbn: 978-1-7281-9789-0. doi: 10.1109/URC49805.2020.9099189.

43. J. J. Hunhevicz and D. M. Hall, “Do you need a blockchain in construction? Use case categories and decision framework for DLT design options”, Advanced Engineering Informatics, vol. 45, p. 101 094, 2020, issn: 14740346. doi: 10.1016/ j.aei.2020.101094.

44. S. K. Lo, X. Xu, Y. K. Chiam, and Q. Lu, “Evaluating Suitability of Applying Blockchain”, in 2017 22nd International Conference on Engineering of Complex Computer Systems (ICECCS), IEEE, 2017, pp. 158–161, isbn: 978-1-5386-2431- 9. doi: 10.1109/ICECCS.2017.26.

45. M. E. Peck, “Blockchain world - Do you need a blockchain? This chart will tell you if the technology can solve your problem”, IEEE Spectrum, vol. 54, no. 10, pp. 38–60, 2017, issn: 0018-9235. doi: 10.1109/MSPEC.2017.8048838.

46. K. Wust and A. Gervais, “Do you Need a Blockchain?”, in 2018 Crypto Valley Conference on Blockchain Technology (CVCBT), IEEE, 2018, pp. 45–54, isbn: 978-1-5386-7204-4. doi: 10.1109/CVCBT.2018.00011.

47. X. Xu, I. Weber, and M. Staples, “Design Process for Applications on Blockchain”, in Architecture for Blockchain Applications, Cham: Springer International Publishing, 2019, pp. 93–111. doi: 10.1007/978-3-030-03035-3_6.

48. M. Belotti, N. Bo˘zi´c, G. Pujolle, and S. Secci, "A vademecum on blockchain technologies: When, which, and how", IEEE Communications Surveys Tutorials, vol. 21, no. 4, pp. 3796–3838, 2019.

49. N. A. Dawit, S. S. Mathew, and K. Hayawi, "Suitability of blockchain for collaborative intrusion detection systems", in 2020 12th Annual Undergraduate Research Conference on Applied Computing (URC), IEEE, 2020, pp. 1–6.

50. J. J. Hunhevicz and D. M. Hall, "Do you need a blockchain in construction? use case categories and decision framework for dlt design options", Advanced Engineering Informatics, vol. 45, p. 101 094, 2020.

51. S. K. Lo, X. Xu, Y. K. Chiam, and Q. Lu, "Evaluating suitability of applying blockchain", in 2017 22nd international conference on engineering of complex computer systems (ICECCS), IEEE, 2017, pp. 158–161.

52. M. E. Peck, "Blockchain world-do you need a blockchain? this chart will tell you if the technology can solve your problem", IEEE Spectrum, vol. 54, no. 10, pp. 38–60, 2017. BIBLIOGRAPHY 75

53. K. W¨ust and A. Gervais, "Do you need a blockchain?", in 2018 crypto valley conference on blockchain technology (CVCBT), IEEE, 2018, pp. 45–54.

54. X. Xu, I. Weber, M. Staples, X. Xu, I. Weber, and M. Staples, "Design process for applications on blockchain", Architecture for Blockchain Applications, pp. 93– 111, 2019.

55. S. Farshidi, S. Jansen, S. Espana, and J. Verkleij, "Decision Support for Blockchain Platform Selection: Three Industry Case Studies", IEEE Transactions on Engineering Management, vol. 67, no. 4, pp. 1109–1128, 2020, issn: 0018-9391. doi: 10.1109/TEM.2019.2956897.

56. A. Hofmann, "Building Scalable Blockchain Applications - A Decision Process", in Designing for Digital Transformation. Co-Creating Services with Citizens and Industry, Springer, 2020, ch. Internatio, pp. 309–320, isbn: 9783030648220. doi: 10.1007/978-3-030-64823-7_28.

57. P. Frauenthaler, M. Borkowski, and S. Schulte, "A Framework for Blockchain Interoperability and Runtime Selection", arXiv, vol. 1905, no. 7014, p. 10, 2019. arXiv: 1905.07014. [Online]. Available: http://arxiv.org/abs/1905.07014.

58. M. C¸ olak, ˙I. Kaya, B. Ozkan, A. Budak, and A. Kara¸san, "A multi-criteria eval- ¨ uation model based on hesitant fuzzy sets for blockchain technology in supply chain management", Journal of Intelligent Fuzzy Systems, vol. 38, no. 1, C. Kahraman, Ed., pp. 935–946, 2020, issn: 10641246. doi: 10.3233/JIFS-179460.

59. N. Six, N. Herbaut, and C. Salinesi, “Which Blockchain to choose? A decision support tool to guide the choice of a Blockchain technology”, arXiv, vol. 2004, no. 6080, p. 16, 2020. arXiv: 2004.06080. [Online]. Available: http://arxiv.org/abs/2004.06080.

60. F. Wessling, C. Ehmke, M. Hesenius, and V. Gruhn, “How much blockchain do you need?”, in Proceedings of the 1st International Workshop on Emerging Trends in Software Engineering for Blockchain, New York, NY, USA: ACM, 2018, pp. 44–47, isbn: 9781450357265. doi: 10.1145/3194113.3194121.

61. S. M. R. Chirra and H. Reza, “A survey on software cost estimation techniques”, Journal of Software Engineering and Applications, vol. 12, no. 06, p. 226, 2019.

62. Y. F. Li, M. Xie, T. N. Goh, and Ieee, “A study of analogy based sampling for interval based cost estimation for software project management”, in IEEE International Conference on Management of Innovation and Technology, NEW YORK: Ieee, 2008, pp. 281–286, isbn: 978-1-4244-2329-3. [Online]. Available: ¡GotoISI¿://WOS:000262920500051.

63. P. Rimba, A. B. Tran, I. Weber, M. Staples, A. Ponomarev, and X. Xu, “Quantifying the cost of distrust: Comparing blockchain and cloud services for business process execution”, Information Systems Frontiers, vol. 22, no. 2, pp. 489–507, 2020, issn: 1572-9419.

64. L. V. Patil, R. M. Waghmode, S. Joshi, and V Khanna, “Generic model of software cost estimation: A hybrid approach”, in 2014 IEEE International Advance Computing Conference (IACC), IEEE, pp. 1379–1384, isbn: 1479925721. 76 BIBLIOGRAPHY

65. P. Rimba, A. B. Tran, I. Weber, M. Staples, A. Ponomarev, and X. Xu, “Comparing blockchain and cloud services for business process execution”, in 2017 IEEE international conference on software architecture (ICSA), IEEE, pp. 257– 260, isbn: 1509057293.

66. M. Marchesi, L. Marchesi, and R. Tonelli, “An Agile Software Engineering Method to Design Blockchain Applications”, in Proceedings of the 14th Central and Eastern European Software Engineering Conference Russia on ZZZ - CEE-SECR ’18, New York, New York, USA: ACM Press, 2018, pp. 1–8, isbn: 9781450361767. doi: 10.1145/3290621.3290627.

67. J. Lockl, V. Schlatt, A. Schweizer, N. Urbach, and N. Harth, “Toward Trust in Internet of Things Ecosystems: Design Principles for Blockchain-Based IoT Applications”, IEEE Transactions on Engineering Management, vol. 67, no. 4, pp. 1256–1270, 2020, issn: 0018-9391. doi: 10.1109/TEM.2020.2978014.

68. S. Porru, A. Pinna, M. Marchesi, and R. Tonelli, “Blockchain-Oriented Software Engineering: Challenges and New Directions”, in 2017 IEEE/ACM 39th International Conference on Software Engineering Companion (ICSE-C), IEEE, 2017, pp. 169–171, isbn: 978-1-5386-1589-8. doi: 10.1109/ICSE-C.2017.142.

69. N. Vu, A. Ghadge, and M. Bourlakis, “Evidence-driven model for implementing blockchain in food supply chains”, International Journal of Logistics Research and Applications, vol. 26, no. 5, pp. 568–588, 2023.

70. N. Vu, A. Ghadge, and M. Bourlakis, “Blockchain adoption in food supply chains: A review and implementation framework”, Production Planning Control, vol. 34, no. 6, pp. 506–523, 2023.

71. A. Ghadge, M. Bourlakis, S. Kamble, and S. Seuring, “Blockchain implementation in pharmaceutical supply chains: A review and conceptual framework”, International Journal of Production Research, vol. 61, no. 19, pp. 6633–6651, 2023.

72. M. N. Bahar, M. Ries, and K. Koˇst’´al, “Blockchain suitability: A decision-making flowchart and web”, in 2023 International Symposium ELMAR, IEEE, 2023, pp. 141–145.

73. M. N. Bahar, M. Ries, and K. Koˇst’´al, “A dynamic decision support system for the best-fitting blockchain platform selection”, in 2023 Fifth International Conference on Blockchain Computing and Applications (BCCA), IEEE, 2023, pp. 412–419.

Responses to Published Works

1. Chandra, Amarnath Reddy. "BLOCKCHAIN TECHNOLOGY: REVOLUTIONIZING REGULATORY COMPLIANCE THROUGH TRUST AND TRANSPARENCY."
2. Qi, Z., Luo, J., Li, X., Zhang, J., Luo, Y., Weligepola, C., Gooneratne, P., Liyanage, J., Domingo, P., Tennakoon, K. and Ranasinghe, P., 2024, November. Transforming Tourism Loyalty Programmes through Private Blockchain. In 2024 IEEE Conference on Engineering Informatics (ICEI) (pp. 1-11). IEEE.
3. Bahar, M.N., Ries, M. and Košťál, K., 2024. A Process Model for the Implementation of Blockchain-Based Systems. IEEE Access.
4. Yang, T. and Luo, X., 2024, September. Data Security Algorithm for Public Decision Support System Based on Blockchain Technology. In 2024 International Conference on Industrial IoT, Big Data and Supply Chain (IIoTBDSC) (pp. 402-407). IEEE.