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Blockchain-based tripartite evolutionary game study of manufacturing capacity sharing

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ABSTRACT

In the context of the new round of manufacturing innovation, the sharing economy drives the transformation of manufacturing industry to accelerate the integration and development. However, there are some problems in the process of manufacturing capacity sharing, such as information privacy and security, and difficulty in tracing the sharing process, etc. The application of blockchain technology can effectively solve these problems. To explore the capacity sharing behaviour of manufacturing enterprises from the perspective of blockchain, the article combines evolutionary game theory and constructs a tripartite game model of manufacturing capacity sharing. The replication dynamics and evolutionary stability of the model are analysed using evolutionary game theory, and numerical simulations are carried out using MATLAB software to analyse the impact of parameter changes on the evolutionary outcome. The research results show that the incentive and penalty coefficients under blockchain technology have a facilitating effect on enterprises to carry out sharing, and the enhancement of reputation gain coefficient and loss can promote positive services on the platform.

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References

[1] Dai, H.-N., Zheng, Z., Zhang, Y. (2019). Blockchain for Internet of things: A survey, *IEEE Internet of Things Journal*, Vol. 6, No. 5, 8076-8094, doi: 10.1109/JIOT.2019.2920987.

[2] Hariri, R.H., Fredericks, E.M., Bowers, K.M. (2019). Uncertainty in big data analytics: Survey, opportunities, and challenges, *Journal of Big Data*, Vol. 6, No. 1, Article No. 44, doi: 10.1186/s40537-019-0206-3.

[3] Zhang, C., Lu, Y. (2021). Study on artificial intelligence: The state of the art and future prospects, *Journal of Industrial Information Integration*, Vol. 23, Article No. 100224, doi: 10.1016/j.jii.2021.100224.

[4] Abhishek, V., Guajardo, J.A., Zhang, Z. (2021). Business models in the sharing economy: Manufacturing durable goods in the presence of peer-to-peer rental markets, *Information Systems Research*, Vol. 32, No. 4, 1450-1469, doi: 10.1287/isre.2021.1034.

[5] Ojstersek, R., Javernik, A., Buchmeister, B. (2021). The impact of the collaborative workplace on the production system capacity: Simulation modelling vs. real-world application approach, *Advances in Production Engineering & Management,* Vol. 16, No. 4, 431-442, doi: 10.14743/apem2021.4.411.

[6] Guo, L., Wu, X. (2018). Capacity sharing between competitors, *Management Science*, Vol. 64, No. 8, 3554-3573, doi: 10.1287/mnsc.2017.2796.

[7] Chen, J., Wang, X., Chu, Z. (2020). Capacity sharing, product differentiation and welfare, *Economic Research-Ekonomska Istraživanja*, Vol. 33, No. 1, 107-123, doi: 10.1080/1331677X.2019.1710234.

[8] Fang, D., Wang, J. (2020). Horizontal capacity sharing between asymmetric competitors, *Omega*, Vol. 97, Article No. 102109, doi: 10.1016/j.omega.2019.102109.

[9] Nofer, M., Gomber, P., Hinz, O., Schiereck, D. (2017). Blockchain, *Business & Information Systems Engineering*, Vol. 59, No. 3, 183-187, doi: 10.1007/s12599-017-0467-3.
[10] Berdik, D., Otoum, S., Schmidt, N., Porter, D., Jararweh, Y. (2021). A survey on blockchain for information systems management and security, *Information Processing & Management*, Vol. 58, No. 1, Article No. 102397, doi: 10.1016/j.ipm.2020.102397.
[11] Karamchandani, A., Srivastava, S.K., Kumar, S., Srivastava, A. (2021). Analysing perceived role of blockchain technology in SCM context for the manufacturing industry, *International Journal of Production Research*, Vol. 59, No. 11, 3398-3429, doi: 10.1080/00207543.2021.1883761.
[12] Catalini, C., Gans, J.S. (2020). Some simple economics of the blockchain, *Communications of the ACM*, Vol. 63, No. 7, 80-90, doi: 10.1145/3359552.
[13] Wang, X.L. (2021). Game-based hybrid particle swarm optimization of job-shop production control, *International Journal of Simulation Modelling*, Vol. 20, No. 2, 398-409, doi: 10.2507/IJSIMM20-2-CO9.
[14] Xiao, M.; Tian, Z.Y. (2022). Evolutionary game analysis of company collaborative strategy in cloud manufacturing platform environment, *Advances in Production Engineering & Management*, Vol. 17, No. 3, 295-310, doi: 10.14743/apem2022.3.437.
[15] Xiong, H., Dalhaus, T., Wang, P., Huang, J. (2020). Blockchain technology for agriculture: Applications and rationale, *Frontiers in Blockchain,* Vol. 3, No. 7, doi: 10.3389/fbloc.2020.00007.
[16] Yang, S.Y, Tan, C. (2022). Blockchain-based collaborative management of job shop supply chain, *International Journal of Simulation Modelling,* Vol. 21, No. 2, 364-374, doi: 10.2507/IJSIMM21-2-CO10.
[17] Chang, V., Baudier, P., Zhang, H., Xu, Q., Zhang, J., Arami, M. (2020). How blockchain can impact financial services– The overview, challenges and recommendations from expert interviewees, *Technological Forecasting and Social Change*, Vol. 158, Article No. 120166, doi: 10.1016/j.techfore.2020.120166.
[18] Yan, K., Cui, L., Zhang, H., Liu, S., Zuo, M. (2022). Supply chain information coordination based on blockchain technology: A comparative study with the traditional approach, *Advances in Production Engineering & Management*, Vol. 17, No. 1, 5-15, doi: 10.14743/apem2022.1.417.
[19] Abeyratne, S.A., Monfared, R.P. (2016). Blockchain ready manufacturing supply chain using distributed ledger, *International Journal of Research in Engineering and Technology*, Vol. 5, No. 9, 1-10, doi: 10.15623/ijret.2016.0509001.
[20] Leng, J., Ruan, G., Jiang, P., Xu, K., Liu, Q., Zhou, X., Liu, C. (2020). Blockchain-empowered sustainable manufacturing and product lifecycle management in industry 4.0: A survey, *Renewable and Sustainable Energy Reviews*, Vol. 132, Article No. 110112, doi: 10.1016/j.rser.2020.110112.
[21] Li, J., Maiti, A., Springer, M., Gray, T. (2020). Blockchain for supply chain quality management: Challenges and opportunities in context of open manufacturing and industrial internet of things, *International Journal of Computer Integrated Manufacturing*, Vol. 33, No. 12, 1321-1355, doi: 10.1080/0951192X.2020.1815853.
[22] Tian, C. (2020). Study of innovation manufacturing capacity sharing mode based on blockchain, *Science and Technology Management Research*, Vol. 40, No. 11, 9-14, doi:10.3969/j.issn.1000-7695.2020.11.002.
[23] Wang, T., Zhang, H. (2022). Evolutionary game study on manufacturing capacity sharing based on block chain, In: *Proceedings of 2022 3rd International Conference on Electronics, Communications and Information Technology (CECIT),* Sanya, China, 373-378, doi: 10.1109/CECIT58139.2022.00071.
[24] Hao, J.-Q., Zhao, D.-Z. (2021). Tripartite-players evolutionary game analysis of the manufacturing capacity sharing in the environment of sharing economy, *Operations Research and Management Science*, Vol. 30, No. 2, 1-7.
[25] Xin, Y.-L. (2020). Evolutionary game analysis of manufacturing enterprise capacity sharing strategy from the perspective of competition and cooperation, *Technology and Innovation Management,* No. 4, 375-379, doi: 10.14090/j.cnki.jscx.2020.0409.
[26] Zhu, L.-L., Rong, J.-M., Zhang, S.-Y. (2021). Three-party evolutionary game and simulation analysis of drug quality supervision under the government reward and punishment mechanism, *Chinese Journal of Management Science*, Vol. 2021, No. 11, 55-67, doi: 10.16381/j.cnki.issn1003-207x.2019.0481.