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IMPACT OF BLOCKCHAIN TECHNOLOGY ON THE OPERATIONAL EFFICIENCY OF CROWDFUNDING PLATFORMS

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Abstract. Recently, crowdfunding platforms have become more attractive because of their advantages comparing to traditional funding sources. Nevertheless, the further potential of crowdfunding platforms development remains unclear due to worries related to reliability, transparency and trustworthiness as well as limitations attracting investments. Employing an online survey approach and questioning the targeted experts, the most important criteria for blockchain technology implementation into crowdfunding platforms were discussed. A VAS (visual analogue scale) matrix for criteria weighting (VASMA weighting) methodology was chosen to find out the main factors that affect crowdfunding platforms the most when implementing blockchain technology. The main findings reveal that Cybersecurity risks, no specific laws to respect all terms of funding and Complex cryptocurrency regulations are the most important for the crowdfunding platforms employees. Accordingly, this study identifies both benefits through blockchain technology and barriers of the application of blockchain technology in terms of legal requirements and development costs.

Keywords: blockchain-based crowdfunding, success factors, VASMA weighting, funding, risk, legal requirements.

JEL Classification: G17, G23.

Introduction

Crowdfunding proved as being an operative approach for gaining funds for new businesses and projects from a wide variety of individual investors (Mollick, 2013). Especially, crowdfunding allows for amateur investors to invest in possible campaigns from the very start of development (Nguyen et al., 2021). In addition, the crowdfunding platform assists as a means of removing barriers to the capital possessed by individual investors and cultivating investment industry (Lehner, 2014). Moreover, investments and funding through crowdfunding platforms can be made using innovative technologies and creative approaches.

However, crowdfunding platforms face numerous difficulties that impede development and limit their capacity. For instance, asymmetric information among users can weaken transparency, reputation, and trustworthiness (Lehner, 2014; Mollick & Nanda, 2016). Related financial requirements and regulations in every country also must be addressed (Zheng & Boh, 2021). Additionally, brokerage costs such as fees for online payment agencies, currency exchange costs, and commission fees can occur on both funding seekers and backers, following on additional expenses and lessening the available funds to back up crowdfunding campaigns (Kumar et al., 2019; Meyskens & Bird, 2015). In the meantime, potential risks related to counterfeit investment campaigns, fraud, and investment contract violations can damage a funding platform in the same way as its users. Consequently, broad investment and systematic work are necessary, creating high costs for the funding platform owners.

Recent studies have underlined how above-mentioned challenges might be addressed by application of blockchain technology (Cai, 2018; Lu et al., 2018; Zhu & Zhou, 2016). The potential value of blockchain technology is that it is able to improve decentralization, democratization, financial inclusion transparency, trustworthiness, and reliability (Hartmann et al., 2019; Lu et al., 2018; Muneeza et al., 2018). The exclusive characteristics

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of blockchain technology might assist crowdfunding platforms to take care of various matters. For example, smart contracts might be employed to distribute funds according to the growth of individual projects (Zhu & Zhou, 2016) while cryptocurrency transactions can support crowdfunding platforms in reducing risks and intermediary expenses as they allow transferring of funds on a peer-to-peer basis rather than via financial intermediaries (Muneeza et al., 2018).

Therefore, knowing the critical factors of crowdfunding platforms containing blockchain technology may offer new perceptions into the developing applications of this technology. The aim of this study is to find out those critical factors. In order to achieve this goal, a VAS (visual analogue scale) matrix for criteria weighting (VASMA weighting) methodology was exploited. This methodology can detect subjective and objective elements of criteria weighting. The subjective element of VASMA method is the weighted aggregated sum product assessment by single-valued neutrosophic sets (WASPAS-SVNS), while the objective part is defined by entropy weights (Zavadskas et al., 2022).

This research is constructed as follows: First, the literature review of financing crowdfunding projects and blockchain technology is analyzed, following with applied methodology. Finally, results, discussion, limitations and conclusions are given.

1. Literature review

1.1. Crowdfunding and crowdfunding platform

Crowdfunding has become a recent and widespread financing channel internationally (Vroomen & Desa, 2018). Crowdfunding is defined as an instrument where the capital should be invested from a large number of people in some business ventures (Gierczak et al., 2014; Jenik et al., 2017; Kang et al., 2016; Madaan et al., 2022; Thies et al., 2014). Crowdfunding was born during the financial crisis of 2008 (Kirby & Worner, 2014). With the help of technology, crowdfunding made it more convenient and effective to raise funds and actually did the same job of what traditional intermediaries did (Belleflamme et al., 2014). The crowdfunding is very popular due to its simplicity to use for both fundraisers and investors (Rossi & Vismara, 2018). Most of the times crowdfunding contains three main parts: the platform, project owners and backers or investors (Venslavienė et al., 2021).

The crowdfunding platform always matches the services between the fundraisers and the contributors (Baber, 2020). The first studies that concentrated on equity crowdfunding platforms analyzed the overall functioning of this new financing form and linked the decision-making process of equity crowdfunding with the traditional venture capital funding (Hagedorn & Pinkwart, 2016; Salomon, 2016; Venslavienė & Stankevičienė, 2021). Therefore, crowdfunding platform can be considered as a community connecting entrepreneurs, investors and project owners working toward the specific goal (Cecere et al., 2017; Nucciarelli et al., 2017). Recently, crowdfunding campaigns face plentiful obstacles securing financial support from common financing sources (Nguyen et al., 2021). Such financial restrictions mainly come from information asymmetries, that create difficulties for risk evaluation (Cecere et al., 2017). The internet provides platforms for crowdfunding without any regulatory intermediary needs. While this works well for the business sector, it also raises arguments relating to policy regulations and the security of transacting parties (Gebert, 2017).

According to the research, operation of crowdfunding is negatively impacted by involved third parties such as financial intermediaries' fees and related commissions and transaction costs (Moritz & Block, 2016). Certainly, those fees decrease the available funding amount to finance the projects and also the operational expenses and investments which might be used to elevate or increase the capabilities of crowdfunding platforms. The participation of such third parties might also reduce the trustworthiness of crowdfunding platforms (Nguyen et al., 2021). For example, due to the tight relation, the confidential information of crowdfunding users can be accidentally shared with third parties (Cai, 2018; Cai & Zhu, 2016). It is an increase in crowdfunding dependency on financial intermediaries (Mollick, 2013). Moreover, connection with third parties and dependency on them may increase the complexity of crowdfunding operations, possibly dropping operational efficiency (Nucciarelli et al., 2017).

Though, similar as reliability, transparency is crucial to the crowdfunding systems success. Transparency guarantee that information is shared equally between fundraisers and supporters, thus removing information asymmetry, ensuring trustworthiness, and enabling social democracy in backing (Medina-Molina et al., 2019). Corporate reputation and trustworthiness are essential to the ability of crowdfunding platform to retain user support (Liang et al., 2019). Nevertheless, user fraud regularly harms the reputation of crowdfunding platforms (Zhao et al., 2017). Since crowdfunding platforms function through internet, investment suggestions and other documents can be copied much easier, consequently creating more verification challenges. These challenges generate extra expenses and might result in the funding loss from backers and ruin the crowdfunding platform reputation (Liang et al., 2019).

1.2. Blockchain technology

Blockchain is best defined as a decentralize database with sequence of digitally signed transaction, a list of transaction records that are linked using cryptography (Ahmad & Rahman, 2021; Nguyen & Dang, 2018; Sultan et al., 2018). It is a tamper resistant digital ledgers applied in distributed way where each block gathers the transaction information and the timestamp of the previous block. The protection of blockchain is guaranteed with its relation to the previous block, this time stamping feature, and its dualistic setup, thus the data from a block cannot be modified selectively (Gebert, 2017; Reijers & Coeckelbergh, 2018). Blockchain might be public, private or

hybrid. Public blockchain allows everyone to contribute and is accessible to everyone while private blockchain controls the access rights and hybrid blockchain refers to the mechanism of consensus managed by established privileged servers using a group of rules accepted by both parties (Puthal et al., 2018; Zhao et al., 2017).

The blockchain's reliability is its potential to connect sponsors and fundraisers without any documentation. All transaction data and information related to backing campaign are recorded and easily reachable (Mukkamala et al., 2018). Data cannot be replaced without moving all of the subsequent records in the chain. Thus, crowdfunding platforms can keep data and develop growth using blockchain technology, that is more reliable and secure compared to other databases (Centobelli et al., 2021). However, such reliability not always can be extended to all blockchain technology adaptation. For example, cryptocurrency, which is the most well-known blockchain technology application, is not regulated in all countries and still is treated as illegal sources of money, following in uncertainty regarding cryptocurrency transactions for both the investors and project owners of cryptocurrency-based crowdfunding platforms (Chang et al., 2020). Uncertainty in cryptocurrency transactions is combined by volatility. Cryptocurrencies are much more volatile than most other currencies due to its digital nature, the moderately small degree of regulation and insignificant market size (Yen & Cheng, 2021).

Blockchain technology improves transparency. An agreement must be found before any transaction can proceed, with the transaction information at the same time documented by numerous computers in a network rather than kept in a single database (Nguyen et al., 2021). Therefore, because of the absolute features of blockchain technology, any information modification, involvement records and transaction errors can be traced, identified, and verified, thus allowing public control over crowdfunding platform (Garg et al., 2021).

Misleading and fraud are recognized as critical challenges in crowdfunding arrangements. Consequently, in order to preventing fraud, crowdfunding platforms implement blockchain technology expecting that it will improve trust between backers and project owners, provide technical solutions for anti-fraud review, and upgrade the platform's security and trustworthiness (Daim et al., 2020; Nguyen et al., 2021). Furthermore, blockchain can create trust by encrypting, enabling parties to share value securely without the usage of a middle entity (Sultan et al., 2018). Therefore, blockchain technology becomes safer.

Finally, by applying blockchain technology, operational costs might be reduced as a result of the cryptocurrencies and reduced commission and connection fees from third parties and financial intermediaries. Diminished costs usually mean more funding to crowdfunding campaigns. Moreover, documentation might be reduced as well, as a result operational processes for crowdfunding platforms will be simplified (Cai & Zhu, 2016). In the meantime, the well-established cybersecurity abilities of blockchain technology applications allow crowdfunding platforms to increase the trust and attention of investors and fundraisers. As a result, this creates sustainable revenue and improves the creation of social value.

2. Methodology and data

2.1. VASMA weighting methodology

VASMA weighting methodology is a survey-based criteria-weighting method. This methodology was recently proposed by (Lescauskiene et al., 2020) to analyze collected data via matrix questions containing of the visual analogue scales (VAS scales). This survey-based criteria weighting method associates objective entropy weights and subjective criteria weights calculated by WASPAS-SVNS multicriteria decision-making technique to imitate the psychometric features of the VAS Scales (Venslavienė et al., 2021; Zavadskas et al., 2022). Moreover, VASMA does not require the respondent to answer all the questions in the VAS matrix and even exploits the non-response data information for the objective weight calculations. Recently, WASPAS-SVNS has been used for various multi-criteria decision-making tasks (Baušys et al., 2020; Friesner et al., 2016; Mardani et al., 2020; Zavadskas et al., 2019) and its application possibilities

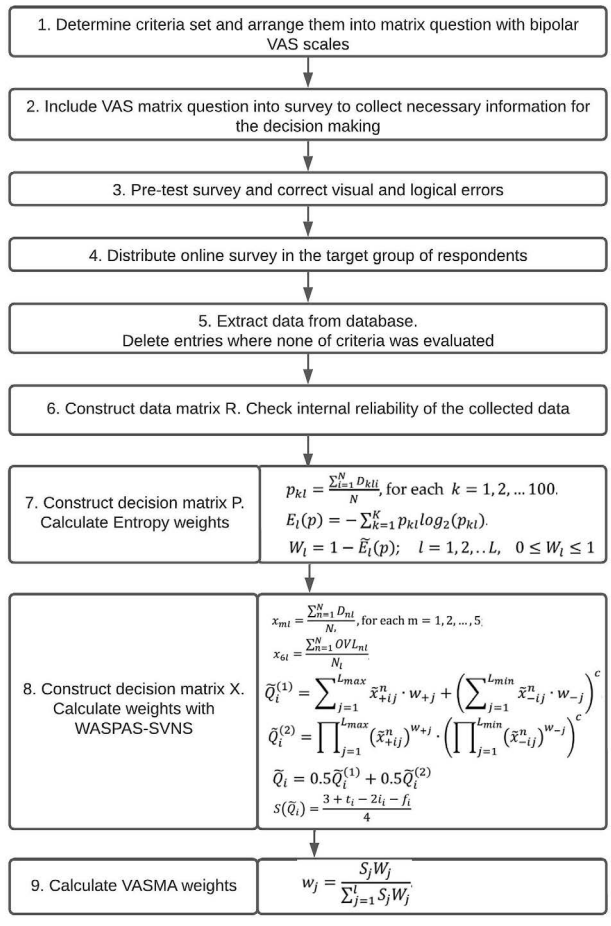

Figure 1. VASMA weighting methodology (source: Lescauskiene et al., 2020)

continue to grow. VASMA weighting is constructed to diminish the uncertainties originated in survey-based criteria assessment. The complete VASMA weighting methodology is discussed in depth by (Lescauskiene et al., 2020; Venslavienė et al., 2021) and is shown in Figure 1. Thus, it will not be repeated in this study because of being outside the scope of this study.

2.2. Data

Initially the data was collected in discussed literature to find out all relevant criteria for blockchain technology to impact crowdfunding platforms. The final list of 11 criteria that was used in the survey are given in Table 1.

Table 1. Criteria that impact crowdfunding platforms (source: literature review)

No.	Criteria that impact crowdfunding platforms
1	Operational costs
2	Marketing costs
3	Development costs
4	Potential losses due to the volatility of cryptocurrency
5	Potential losses due to the exchange rate
6	Market size
7	Investment success (trading activity, portfolio diversification, investments in lottery-type tokens)
8	Complex regulations associated with cryptocurrencies in different countries result in huge costs
9	No law that can force CF users to respect all terms of funding
10	Storage of required documents using Blockchain technology
11	Cybersecurity risks

3. Research results and discussion

Numerous critical factors like transparency, reliability, purpose and trustworthiness are very important for crowdfunding platforms (Kumar et al., 2019; Nguyen et al., 2021). Regardless of an emerging attention on the possible involvement of blockchain for evolving crowdfunding platforms, the link among characteristics of blockchain and the most important factors of crowdfunding platforms have not explored a lot yet (Cai, 2018; Chang et al., 2020). Therefore, understanding the critical factors of crowdfunding platforms containing blockchain may offer new insights of this technology. The online survey with seven questions was drawn up and sent to target group of respondents. The fourth question of the survey was a VAS matrix query, where respondents were asked to specify how important are the specific criteria impacting blockchain-based crowdfunding platforms. Overall, 19 experts responded to the online survey. The demographic profile of respondents is provided in Table 2, and the status about crowdfunding platform is exposed in Table 3.

Table 2. Demographic profile of survey respondents (source: author calculation)

Category		%
Gender	Male	52.6%
	Female	47.4%
Age	<24	47.4%
	25–30	10.5%
	31–35	15.8%
	36–40	5.3%
	41–50	15.7%
	>51	5.3%
Education	Bachelor	68.4%
	Masters	21.1%
	Doctor	5.3%
	I don't want to disclose it	5.2%

Table 3. Status about Crowdfunding platform (source: author calculation)

Question	Answer	%
How are you related with Crowdfunding platform?	Crowdfunding platform owner	0.0%
	Work at crowdfunding platform	100.0%
	Project owner	0.0%
Is your crowdfunding platform blockchain-based?	Yes	0.0%
	No	100.0%
Are there any plans to implement Blockchain technology in near future?	Yes	36.8%
	No	63.2%

The demographic profile of respondents (Table 2) shows that employees of Crowdfunding platform are mainly males (52.6%) aged up to 24 years old. Moreover, these employees are highly educated of at least bachelor's or master's degree. When considering the status of Crowdfunding platform, all crowdfunding platform employees denied that their current platform is blockchain-based. However, 36.8% of respondents agreed that there are plans to implement Blockchain technology in their crowdfunding platform in near future. Since the blockchain technology is very new and not tested so much, it is normal that the market is not ready yet for this change.

Collected data from the VAS matrix was automatically transformed to the data matrix, where columns characterize the set of factors, and rows show the ID of respondents. This matrix was used for further calculations and analysis. Descriptive statistics of the data was calculated using one of statistical software packages and are represented in Table 4. As can be found, all the criteria were assessed by all 19 respondents participated in survey.

Entropy weights always include the objective element of VASMA weighting procedure. Decision matrix was designed from the first data matrix. In this entropy matrix,

Table 4. Descriptive statistics of selected factors from online survey (source: author calculation)

ID	Criteria	Mean	Median	SD	Min	Max	Count
FA1	Operational costs	71.74	72	11.79	37	87	19
FA2	Marketing costs	46.89	41	15.72	27	82	19
FA3	Development costs	60.79	63	11.91	31	76	19
FA4	Potential losses due to the volatility of cryptocurrency	56.42	62	15.09	34	74	19
FA5	Potential losses due to the exchange rate	55.68	61	13.76	34	73	19
FA6	Bigger market size	58.95	61	13.91	33	80	19
FA7	Investment success (trading activity, portfolio diversification, investments in lottery-type tokens)	68.26	70	13.60	35	92	19
FA8	Complex regulations associated with cryptocurrencies in different countries	72.26	72	8.05	62	86	19
FA9	No law that can force Crowdfunding users to respect all terms of funding	70.11	69	7.29	59	87	19
FA10	Storage of required documents using Blockchain technology	73.00	74	6.30	59	83	19
FA11	Cybersecurity risks	86.58	87	4.03	77	93	19

Table 5. Entropy weights calculated from survey data for selected factors (source: author calculation)

Entropy weights	FA1	FA2	FA3	FA4	FA5	FA6	FA7	FA8	FA9	FA10	FA11
El(p)	0.54	0.68	0.61	0.51	0.62	0.55	0.66	0.46	0.43	0.47	0.27
Wl	0.46	0.32	0.39	0.49	0.38	0.45	0.34	0.54	0.57	0.53	0.73
Rank	6	11	8	5	9	7	10	3	2	4	1

Table 6. WASPAS-SVNS weights calculated from survey data for selected factors (source: author calculation)

WASPAS-SVNS weights	FA1	FA2	FA3	FA4	FA5	FA6	FA7	FA8	FA9	FA10	FA11
S(Qi)	0.76	0.59	0.72	0.68	0.68	0.72	0.75	0.76	0.76	0.77	0.80
Rank	5	11	7	9	10	8	6	3	4	2	1

Table 7. Final VASMA weights and ranks for selected criteria of blockchain technology (source: author calculation)

ID	Criteria	VASMA	Rank
FA1	Operational costs	0.092	5
FA2	Marketing costs	0.049	11
FA3	Development costs	0.073	8
FA4	Potential losses due to the volatility of cryptocurrency	0.088	6
FA5	Potential losses due to the exchange rate	0.068	9
FA6	Bigger market size	0.085	7
FA7	Investment success (trading activity, portfolio diversification, investments in lottery-type tokens)	0.067	10
FA8	Complex regulations associated with cryptocurrencies in different countries	0.108	3
FA9	No law that can force Crowdfunding users to respect all terms of funding	0.113	2
FA10	Storage of required documents using Blockchain technology	0.106	4
FA11	Cybersecurity risks	0.152	1

columns characterize sets of factors and rows specify the possible values of VAS. The final parameters of entropy weights and their ranks were calculated from decision matrix and are given in Table 5. The precise estimates of these weights were described in (Lescauskiene et al., 2020).

The WASPAS-SVNS weighting technique is part of the multi-criteria decision-making duty, that involves the subjective side of VASMA weighting methodology. In order to calculate WASPAS-SVNS weights, another matrix is built from the first data matrix. Again, the detailed matrix construction and weights calculation is given in (Lescauskiene et al., 2020). WASPAS-SVNS weights are calculated as the score function for generalized factors and are presented in Table 6 as well as the ranks for the weights.

VASMA weights were estimated from WASPAS-SVNS and Entropy weights by multiplying each weight together and then dividing by multiplication sum. The full equation and total calculation of VASMA weights is provided in (Lescauskiene et al., 2020). The last VASMA weights and their ranks are given in Table 7.

Results from the Table 7 show that the most important criteria for employees of crowdfunding platforms are Cybersecurity risks (FA11) with weight 0.152, No law that can force CF users to respect all terms of funding

(FA9) with weight 0.113 and Complex regulations associated with cryptocurrencies in different countries (FA8) with weight 0.108. These factors have the highest first three rankings from all the criteria. On the contrary, the least important criteria are Marketing costs (FA2), Investment success (FA7) and Potential losses due to the exchange rate (FA5). They have the lowest ranks and weights 0.049, 0.067 and 0.068 respectively.

Conclusions, proposals, recommendations

This research proves that the blockchain technology can support crowdfunding platforms in several ways. First, this research proves that blockchain offer a different base for crowdfunding platforms. Second, the findings of this research promote the thought that blockchain applications can help the development of crowdfunding and expand the transparency and trustworthiness of crowdfunding platforms (Ahluwalia et al., 2020; Zhao et al., 2017). Though, further efforts are required to find out the blockchain technology potential and its application (Chang et al., 2020; Hartmann et al., 2019).

The VAS matrix can be efficiently used for the survey-based criteria weighting assignment, as both importance value and ranking information can be composed from one sole question. The results showed that respondents were able to easily evaluate and compare factors when they saw them in one question. The data was collected from expert evaluation and online survey. The specific target group was questioned – employees from crowdfunding platforms. The results specify that the most important factors to implement blockchain technology are related to Cybersecurity risks, no specific laws to respect all terms of funding and Complex cryptocurrency regulations. These three factors had the highest weights and ranks. These results are quite expected having in mind the structure of crowdfunding platform.

This research has some limitations. Crowdfunding has three parties: project owner, investors and crowdfunding platform. All analysis was made only from crowdfunding platform perspective whether to implement blockchain technology. In the future it would be valuable to check campaign owners and investors choice in different contexts – like developing countries, legal support for blockchain-based technology crowdfunding platforms and with or without regulations – and whether their decisions might be impacted by blockchain technology. Another limitation might be the number of respondents, that could be higher, with different choice of criteria. Finally, the selected factors might be transformed due to initial and other literature review.

References

Ahluwalia, S., Mahto, R. V., & Guerrero, M. (2020). Blockchain technology and startup financing: A transaction cost economics perspective. *Technological Forecasting and Social Change*, *151*, 119854. https://doi.org/10.1016/j.techfore.2019.119854

Ahmad, N. A. N., & Rahman, S. A. H. S. A. (2021). *Applying Ethereum smart contracts to blockchain-based crowdfunding system to increase trust and information symmetry.* https://oa.mg/work/10.1145/3477911.3477920

Baber, H. (2020). *Blockchain-based crowdfunding* (pp. 117–130). Springer. https://doi.org/10.1007/978-981-15-1137-0_6

Baušys, R., Juodagalvienė, B., Žiūrienė, R., Pankrašovaitė, I., Kamarauskas, J., Usovaitė, A., & Gaižauskas, D. (2020). The residence plot selection model for family house in Vilnius by neutrosophic WASPAS method. *International Journal of Strategic Property Management*, *24*(3), 182–196. https://doi.org/10.3846/ijspm.2020.12107

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing, 29*(5), 585–609. https://doi.org/10.1016/j.jbusvent.2013.07.003

Cai, Y., & Zhu, D. (2016). Fraud detections for online businesses: A perspective from blockchain technology. *Financial Innovation, 2*, 20. https://doi.org/10.1186/s40854-016-0039-4

Cecere, G., le Guel, F., & Rochelandet, F. (2017). Crowdfunding and social influence: An empirical investigation. *Applied Economics, 49*(57), 5802–5813. https://doi.org/10.1080/00036846.2017.1343450

Centobelli, P., Cerchione, R., Esposito, E., & Oropallo, E. (2021). Surfing blockchain wave, or drowning? Shaping the future of distributed ledgers and decentralized technologies. *Technological Forecasting and Social Change*, *165*, 120463. https://doi.org/10.1016/J.TECHFORE.2020.120463

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*, *158*, 120166. https://doi.org/10.1016/j.techfore.2020.120166

Daim, T., Lai, K. K., Yalcin, H., Alsoubie, F., & Kumar, V. (2020). Forecasting technological positioning through technology knowledge redundancy: Patent citation analysis of IoT, cybersecurity, and Blockchain. *Technological Forecasting and Social Change*, *161*, 120329. https://doi.org/10.1016/J.TECHFORE.2020.120329

Friesner, D., Valente, F., & Bozman, C. S. (2016). Using entropy-based information theory to evaluate survey research. *Journal of Marketing Development and Competitiveness*, *10*(3), 32–48.

Garg, P., Gupta, B., Chauhan, A. K., Sivarajah, U., Gupta, S., & Modgil, S. (2021). Measuring the perceived benefits of implementing blockchain technology in the banking sector. *Technological Forecasting and Social Change*, *163*, 120407. https://doi.org/10.1016/J.TECHFORE.2020.120407

Gebert, M. (2017, March). *Application of blockchain technology in crowdfunding.* https://www.researchgate.net/publication/318307115_APPLICATION_OF_BLOCKCHAIN_TECHNOLOGY_IN_CROWDFUNDING

Gierczak, M. M., Bretschneider, U., & Leimeister, J. M. (2014). *Is all that glitters gold? Exploring the effects of perceived risk on backing behavior in reward-based crowdfunding* [Conference presentation]. 35th International Conference on Information Systems "Building a Better World Through Information Systems", ICIS 2014.

Hagedorn, A., & Pinkwart, A. (2016). The financing process of equity-based crowdfunding: An empirical analysis. In *FGF studies in small business and entrepreneurship* (pp. 71–85). Springer. https://doi.org/10.1007/978-3-319-18017-5_5

Hartmann, F., Grottolo, G., Wang, X., & Lunesu, M. I. (2019). Alternative fundraising: Success factors for blockchain-

based vs. conventional crowdfunding. In *2019 IEEE 2nd International Workshop on Blockchain Oriented Software Engineering* (*IWBOSE*) (pp. 38–43), Hangzhou, China. https://doi.org/10.1109/IWBOSE.2019.8666515

Jenik, I., Lyman, T., & Nava, A. (2017, March). *Crowdfunding and financial inclusion* (Working Paper). https://www.cgap.org/sites/default/files/Working-Paper-Crowdfunding-and-Financial-Inclusion-Mar-2017.pdf

Kang, M., Gao, Y., Wang, T., & Zheng, H. (2016). Understanding the determinants of funders' investment intentions on crowdfunding platforms: A trust-based perspective. *Industrial Management & Data Systems, 116*(8), 1800–1819. https://doi.org/10.1108/IMDS-07-2015-0312

Kirby, E., & Worner, S. (2014). *Crowd-funding: An infant industry growing fast* (Staff Working Paper No. SWP3/2014). https://www.iosco.org/research/pdf/swp/Crowd-funding-An-Infant-Industry-Growing-Fast.pdf

Kumar, P., Langberg, N., & Zvilichovsky, D. (2019). Crowdfunding, financing constraints, and real effects. *Management Science*, *66*(8), 3561–3580. https://doi.org/10.1287/MNSC.2019.3368

Lehner, O. M. (2014). The formation and interplay of social capital in crowdfunded social ventures. *Entrepreneurship and Regional Development*, *26*(5–6), 478–499. https://doi.org/10.1080/08985626.2014.922623

Lescauskiene, I., Bausys, R., & Zavadskas, E. K. (2020). VASMA weighting: Survey-based criteria weighting methodology that combines ENTROPY and WASPAS-SVNS to reflect the psychometric features of the VAS Scales. *Symmetry*, *12*(10), 1641. https://doi.org/10.3390/sym12101641

Liang, T.-P., Wu, S. P.-J., & Huang, C.-C. (2019). Why funders invest in crowdfunding projects: Role of trust from the dual-process perspective. *Information and Management*, *56*(1), 70–84. https://doi.org/10.1016/J.IM.2018.07.002

Lu, Y., Chang, R., & Lim, S. (2018). Crowdfunding for solar photovoltaics development: A review and forecast. *Renewable and Sustainable Energy Reviews*, *93*, 439–450. https://doi.org/10.1016/j.rser.2018.05.049

Madaan, L., Jindal, D., Kumar, A., Kumar, S., & Naruka, M. S. (2022). Secure and enhanced crowdfunding solution using blockchain technology. In *Transforming Management with AI*, *Big-Data*, *and IoT* (pp. 293–310). Springer International Publishing. https://doi.org/10.1007/978-3-030-86749-2_17

Mardani, A., Saraji, M. K., Mishra, A. R., & Rani, P. (2020). A novel extended approach under hesitant fuzzy sets to design a framework for assessing the key challenges of digital health interventions adoption during the COVID-19 outbreak. *Applied Soft Computing Journal*, *96*, 106613. https://doi.org/10.1016/j.asoc.2020.106613

Medina-Molina, C., Rey-Moreno, M., Augusto Felício, J., & Romano Paguillo, I. (2019). Participation in crowdfunding among users of collaborative platforms: The role of innovativeness and social capital. *Review of Managerial Science*, *13*, 529–543. https://doi.org/10.1007/s11846-019-00329-4

Meyskens, M., & Bird, L. (2015). Crowdfunding and value creation. *Entrepreneurship Research Journal*, *5*(2), 155–166. https://doi.org/10.1515/erj-2015-0007

Mollick, E. (2013). The dynamics of crowdfunding: An exploratory study. *Journal of Business Venturing*, *29*(1), 1–16. https://doi.org/10.1016/j.jbusvent.2013.06.005

Mollick, E., & Nanda, R. (2016). Wisdom or madness? Comparing crowds with expert evaluation in funding the arts. *Management Science*, *62*(6), 1533–1553. https://doi.org/10.1287/mnsc.2015.2207

Moritz, A., & Block, J. H. (2016). *Crowdfunding: A literature review and research directions*. In Crowdfunding in Europe (pp. 25–53). Springer. https://doi.org/10.1007/978-3-319-18017-5_3

Mukkamala, R. R., Vatrapu, R., Ray, P. K., Sengupta, G., & Halder, S. (2018). Blockchain for social business: Principles and applications. *IEEE Engineering Management Review*, *46*(4), 94–99. https://doi.org/10.1109/EMR.2018.2881149

Muneeza, A., Arshad, N. A., & Arifin, A. T. (2018). The application of blockchain technology in crowdfunding: Towards financial inclusion via technology. *International Journal of Management and Applied Research*, *5*(2), 82–98. https://doi.org/10.18646/2056.52.18-007

Nguyen, L. T. Q., Hoang, T. G., Do, L. H., Ngo, X. T., Nguyen, P. H. T., Nguyen, G. D. L., & Nguyen, G. N. T. (2021). The role of blockchain technology-based social crowdfunding in advancing social value creation. *Technological Forecasting and Social Change*, *170*, 120898. https://doi.org/10.1016/j.techfore.2021.120898

Nguyen, Q. K., & Dang, Q. V. (2018). Blockchain technology for the advancement of the future. In *Proceedings 2018 4th International Conference on Green Technology and Sustainable Development* (pp. 483–486), Ho Chi Minh City, Vietnam. https://doi.org/10.1109/GTSD.2018.8595577

Nucciarelli, A., Li, F., Fernandes, K. J., Goumagias, N., Cabras, I., Devlin, S., Kudenko, D., & Cowling, P. (2017). From value chains to technological platforms: The effects of crowdfunding in the digital game industry. *Journal of Business Research*, *78*, 341–352. https://doi.org/10.1016/J.JBUSRES.2016.12.030

Puthal, D., Malik, N., Mohanty, S. P., Kougianos, E., & Das, G. (2018). Everything you wanted to know about the blockchain: Its promise, components, processes, and problems. *IEEE Consumer Electronics Magazine*, *7*(4), 6–14. https://doi.org/10.1109/MCE.2018.2816299

Reijers, W., & Coeckelbergh, M. (2018). The blockchain as a narrative technology: Investigating the social ontology and normative configurations of cryptocurrencies. *Philosophy & Technology*, *31*, 103–130. https://doi.org/10.1007/s13347-016-0239-x

Rossi, A., & Vismara, S. (2018). What do crowdfunding platforms do? A comparison between investment-based platforms in Europe. *Eurasian Business Review*, *8*(1), 93–118. https://doi.org/10.1007/S40821-017-0092-6/TABLES/6

Salomon, V. (2016). Emergent models of financial intermediation for innovative companies: from venture capital to crowdinvesting platforms in Switzerland. *Venture Capital*, *18*(1), 21–41. https://doi.org/10.1080/13691066.2015.1079953

Sultan, K., Ruhi, U., & Lakhani, R. (2018). *Conceptualizing blockchains: Characteristics & applications*.

Thies, F., Wessel, M., & Benlian, A. (2014, December). Understanding the dynamic interplay of social buzz and contribution behavior within and between online platforms: Evidence from crowdfunding. In *35th International Conference on Information Systems "Building a Better World Through Information Systems"*, *ICIS 2014* (pp. 1–18), Atlanta, GA. https://research.cbs.dk/en/publications/understanding-the-dynamic-interplay-of-social-buzz-and-contributi

Venslavienė, S., & Stankevičienė, J. (2021, May 13–14). Forecasting crowdfunding platform revenues using ARIMA model. In *International Scientific Conference "Contemporary Issues in Business, Management and Economics Engineering 2021"* (pp. 371–378), Vilnius, Lithuania. https://doi.org/10.3846/cibmee.2021.595

Venslavienė, S., Stankevičienė, J., & Vaiciukevičiūtė, A. (2021). Assessment of successful drivers of crowdfunding projects based on visual analogue scale matrix for criteria weighting method. *Mathematics*, *9*(14), 1590. https://doi.org/10.3390/MATH9141590

Vroomen, P., & Desa, S. (2018). Rates of return for crowdfunding portfolios: Theoretical derivation and implications. *Venture Capital*, *20*(3), 261–283. https://doi.org/10.1080/13691066.2018.1480265

Yen, K. C., & Cheng, H. P. (2021). Economic policy uncertainty and cryptocurrency volatility. *Finance Research Letters*, *38*, 101428. https://doi.org/10.1016/J.FRL.2020.101428

Zavadskas, E. K., Bausys, R., & Mazonaviciute, I. (2019). Safety evaluation methodology of urban public parks by multi-criteria decision making. *Landscape and Urban Planning*, *189*, 372–381. https://doi.org/10.1016/j.landurbplan.2019.05.014

Zavadskas, E. K., Lescauskiene, I., Juodagalviene, B., Bausys, R., & Keizikas, A. (2022). Comparison of the stair safety awareness in different target groups by applying the VASMA-C methodology. *Archives of Civil and Mechanical Engineering*, *22*(4), 1–11. https://doi.org/10.1007/s43452-022-00487-5

Zhao, Q., Chen, C. der, Wang, J. L., & Chen, P. C. (2017). Determinants of backers' funding intention in crowdfunding: Social exchange theory and regulatory focus. *Telematics and Informatics*, *34*(1), 370–384. https://doi.org/10.1016/j.tele.2016.06.006

Zheng, Y., & Boh, W. F. (2021). Value drivers of blockchain technology: A case study of blockchain-enabled online community. *Telematics and Informatics*, *58*, 101563. https://doi.org/10.1016/J.TELE.2021.101563

Zhu, H., & Zhou, Z. Z. (2016). Analysis and outlook of applications of blockchain technology to equity crowdfunding in China. *Financial Innovation*, *2*(1), 29. https://doi.org/10.1186/s40854-016-0044-7