Analysis of a Blockchain-based website using the technology acceptance model: the case of Save Ideas

Taşkın Dirsehan

Faculty of Business Administration,
Marmara University,
Kadıköy, 34722, Istanbul, Turkey
Email: taskin.dirsehan@marmara.edu.tr

Abstract: Nowadays, blockchain applications appear as a new technology which disrupts traditional centralised authorities. Even though this technology has huge potential and receives increasing investments, researches are mostly limited to bitcoin, and they are limited. With subjective knowledge about blockchain and individual trust, this study attempts to focus on the technology acceptance model in order to understand the dynamics behind its use by individuals. A quantitative research study was conducted with 94 users of Save-Ideas.com, which is a blockchain-based website, and the results were analysed by Partial Least Squares Structural Equation Modelling (PLS-SEM). The findings indicate that individuals with knowledge of blockchain technology will have greater trust in these websites and will perceive these websites as more useful. Then, people will be more likely to accept the website.

Keywords: blockchain; technology acceptance; digital marketing.

Reference to this paper should be made as follows: Dirsehan, T. (2020) 'Analysis of a Blockchain-based website using the technology acceptance model: the case of Save Ideas', *Int. J. Diplomacy and Economy*, Vol. 6, No. 1, pp.17–25.

Biographical notes: Taşkın Dirsehan received his BA in Business Administration from Galatasaray University, his MA in Production Management and Marketing from Marmara University and PhD in Marketing from Istanbul University. Currently, he has been working as an Associate Professor of Marketing at Marmara University. His research and teaching interests are in the areas of product and brand management, innovation/ technology acceptance, and marketing research. His researches have been published in various national and international academic journals. He has also presented his researches at various academic conferences.

1 Introduction

In today's digitalised world, new methods are needed to regulate and control contracts, transactions, and records. One way to meet this need is blockchain, which records the transactions in a verifiable and permanent way, based on its open distributed ledger (Iansiti and Lakhani, 2017). Owing this nature, blockchain records are immutable and transparent, providing confidence to its users. For this reason, blockchain technology

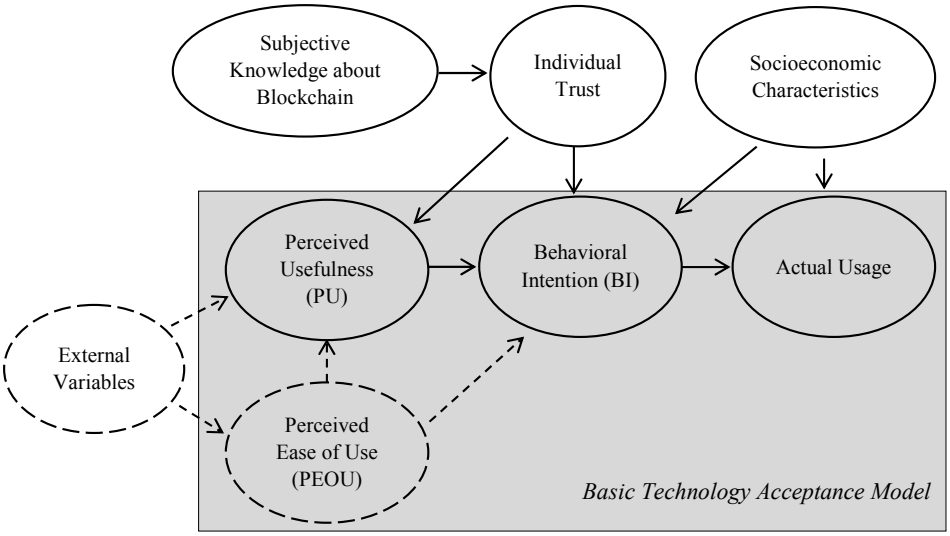
expected to revolutionise various industries beyond finance, even though blockchain technology was first recognised when used with cryptocurrencies, such as Bitcoin (Underwood, 2016). Blockchain technology deserves investment as it has huge potential to grow entirely new disruptive businesses (Morkunas et al., 2019). Indeed, countries heavily invest in blockchain technology. 550 million dollars of investments in blockchain related start-up companies was boosted in 2016. This exceeded 4 billion dollars in 2018 (Statista, 2018). Moreover, blockchain technologies are useful in achieving United Nations Sustainability Development Goals (Hughes et al., 2019b).

The dramatic increase in blockchain investments and blockchain technology's potential in the global economy necessitates an investigation about its acceptance with individuals in order to predict the return on these investments. One of the most acknowledged tools in understanding the social mechanisms of technology adoption is the Technology Acceptance Model (TAM) (Folkinshteyn and Lennon, 2016). Thus, this study tries to understand a blockchain-based website by applying TAM.

2 TAM constructs and subjective knowledge about blockchain

The TAM is an information systems theory which attempts to explain how individuals adopt and use a technology (Choi and Ji, 2015). It has been developed from the theory of reasoned action, which is used to estimate human behaviour (Ajzen and Fishbein, 1980) by defining two new constructs, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). While PU means "the degree to which a person believes that using a particular system would enhance his or her job performance," PEOU refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p.320). The TAM model has been criticised for not providing applicable guidance for organisations (Lee et al., 2003). Although the TAM2 and TAM3 models offer a deeper understanding of the technology acceptance constructs, the models are still not fully capable of explaining how usage intention is determined for various technological innovations. For this reason, extended models have been proposed with different variables in various industries (Featherman and Pavlou, 2003; Folkinshteyn and Lennon, 2016; Panagiotopoulos and Dimitrakopoulos, 2018; Venkatesh and Morris, 2000). This study adds two more constructs to the main model: subjective knowledge about blockchain and individual trust. Since this study considers a website as previous research suggests including trust in technology acceptance (Gefen et al., 2003). Lastly, this study examines the role of socioeconomic characteristics of individuals in behavioural intention and actual usage. Since blockchain applications are verifiable and can be downloadable by anyone to track the origins of transactions, the system is reliable (Folkinshteyn and Lennon, 2016). Individuals who know about the blockchain system may trust more and they may perceive more the usefulness of a website implementing this technology. So, as the main contributions of the study are on these dimensions, other external variables and perceived ease of use are not considered in testing the model and remain as propositions in the conceptual model as indicated in Figure 1.

Figure 1 Conceptual model developed based on the extant literature



Note: *Dashed lines represent the constructs and the propositions which are not included in model testing.

3 Background information about Save Ideas

Blockchain technology applications go beyond the finance industry by creating value in various industries (Hughes et al., 2019a). Since Bitcoin is the most discussed application of blockchain technology (Morkunas et al., 2019), other applications need to be examined further in order to fill the gap in the extant literature. So, a blockchain-based website, Save-Ideas.com was preferred to test the model of this study.

Save-Ideas.com (n.d.) founded in Australia, uses the technology to protect uploaded ideas by providing a digital Time Stamp Certificate® to certify the time and the originality of submitted ideas in order to prove rightful ownership of intellectual property. When we think about the long procedures for applying for patent protection, this service can be considered to be a good application of blockchain technology in idea protection.

4 Research methodology

4.1 Research instrument to collect data

A survey was developed based on the basic constructs of TAM (Venkatesh and Bala, 2008). Each PU and BI consisted of four items. Then, seven items of the individual trust developed by Bhattacherjee (2002) was added to the survey. The scales used to measure TAM constructs have been shown as reliable and valid in several studies (Bhattacherjee, 2002; Davis and Venkatesh, 1996). In addition to these items, the ones about subjective knowledge were adapted from the study of Flynn and Goldsmith (1999). These items

were measured on a 7-point scale as in the original studies. Lastly, in order to see the actual behaviour of respondents, they were asked a single question: how many ideas they uploaded on Save-Ideas.com. Single item measures are preferred by researchers for observable characteristics with practical considerations (Hair et al., 2014a).

4.2 Sample design and fieldwork

As Save-Ideas.com was considered the sample platform in which users get a time certificate to protect their ideas via a blockchain application, the target population of this study was decided to be the users of Save-Ideas.com, who uploaded at least one idea on this platform. The sample size was determined according to 10 times rule criterion. It should be at least 10 times the largest number of structural paths in a PLS-SEM analysis (Hair et al., 2014b). Accordingly, a minimum of 60 respondents would be enough in order to measure six structural paths which exist in our research model.

Founder & CEO of Save-Ideas.com was contacted in order to conduct the survey, and it was distributed to all Save-Ideas.com subscribers as an online survey. A web-based survey was preferred because of its convenience, cost efficiency, and the high speed of collecting results (Boyer et al., 2002). Also, an online web survey where the researcher receives the coded responses eliminates the interviewer coding error. After receiving the complete data from 94 respondents, the researcher believed there was a large enough sample size for the purposes of this research.

4.3 Analytical methods

As our research model is explanatory in nature, data were analysed by using variance-based SmartPLS version 3.2.8. The most common reasons to use this tool include its applicability to non-normal data, small sample sizes, and formative data in addition to the reflective one (Farooq et al., 2018; Hair et al., 2014b). Another reason of selecting PLS-SEM is that it can handle single-item constructs with no identification problems (Hair et al., 2014a).

5 Research findings

5.1 Non-response bias test

In order to test non-response bias, the researcher used the extrapolation method, a common method for avoiding this bias. This method requires the comparison of early and late respondents to detect the differences in demographics and mean values of other key variables (Armstrong and Overton, 1977). So, an independent sample *t*-test was conducted to compare the results of the first 30 and the last 30 respondents. Findings of the analysis indicated that no significant 0.05 level differences existed between these groups. It was concluded that no problem of non-response bias occurred in this research.

5.2 Descriptive analysis

Before testing the structural model of the study, the sample characteristics were described in terms of their gender, age, and education level. Out of a total of 94 respondents, 47.9%

were female and 52.1% were male. The majority of the respondents (almost 44%) were aged between 20 and 23 years. Furthermore, 51.1% of the respondents had a bachelor's degree and 22.3% had a master's degree. The descriptive statistics are summarised in the Table 1.

Table 1 Users' attribute descriptive characteristics

Attributes	*Distribution*	*Frequency*	*%*
Gender	Female	45	47.9
	Male	49	52.1
Age	20–23 years	41	43.6
	24–30 years	30	31.9
	Above 31 years	23	24.5
Education level	High school	18	19.2
	Bachelor's degree	48	51.1
	Master's degree	21	22.3
	Doctoral degree	7	7.4

5.3 Data analysis of the reflective constructs

Before testing the structural model, reliability and validity of the constructs were examined. Two items were removed from the subjective knowledge construct due to the low Cronbach's Alpha value and the analyses were performed with the three remaining items.

The results indicate that all the factor loadings were acceptable the range of 0.77–0.96. All of the constructs were also analysed for their Composite Reliability (CR) and Cronbach's Alpha values, and the results exceeded the critical value of 0.70 as suggested by Cohen (1988). Moreover, Average Variance Extracted (AVE) of each construct exceeded the critical value of 0.50 as suggested by Hair et al. (2014b). The validity and reliability scores are presented in Table 2.

Table 2 Validity and reliability of reflective constructs

Latent constructs	*Cronbach's alpha*	*CR*	*AVE*
Perceived usefulness	0.93	0.95	0.84
Behavioural intention	0.96	0.97	0.89
Individual trust	0.93	0.95	0.71
Subjective knowledge about blockchain	0.81	0.89	0.72
Socioeconomic characteristics	0.81	0.89	0.72

The cross loadings were examined for the discriminant validity of the constructs. Accordingly, all the outer loadings of the associated construct have exceeded their loadings on the other constructs. Thus, the findings provide evidence for discriminant validity (Hair et al., 2014a).

As an alternative method to assess the discriminant validity, Fornell-Larcker criterion was used as presented in the Table 3. The bold figures in the diagonal stand for the square-root of AVE, and they exceed the estimated correlation values, so the discriminant validity was established (Hair et al., 2014a).

Table 3 Discriminant validity of the constructs

Latent constructs	*1*	*2*	*3*	*4*	*5*
1. Perceived usefulness	0.91				
2. Behavioural intention	0.78	0.94			
3. Individual trust	0.72	0.73	0.85		
4. Subjective knowledge about blockchain	0.49	0.51	0.61	0.85	
5. Socioeconomic characteristics	–0.06	0.17	0.02	0.05	0.85

Note: Bold values are square root of AVE.

5.4 Analysis of the structural model

The structural model was tested with PLS-SEM. Table 4 summarises the findings. According to the R^2 results, explanatory powers of individual actual usage, behavioural intention, perceived usefulness, and individual trust were 20.8%, 71%, 52% and 37%, respectively.

Table 4 Hypothesis assessment

Hypothesised path		*β-value*	*t-value*	*p-value*	*Decision*
H_1	Perceived usefulness → Behavioural intention	0.560	5.752	.000	supported***
H_2	Behavioural intention → Actual usage	0.301	3.357	.001	supported**
H_3	Individual trust → Perceived usefulness	0.721	13.639	.000	supported***
H_4	Individual trust → Behavioural intention	0.334	3.216	.001	supported**
H_6	Subjective knowledge about blockchain → Individual trust	0.608	9.748	.000	supported***
H_7	Socioeconomic characteristics → Behavioural intention	0.202	3.169	.002	supported**
H_8	Socioeconomic characteristics → Actual usage	0.294	2.449	.014	supported*

Note: $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

5.5 Model's goodness of fit

In PLS-SEM, Goodness of Fit (GoF) should be assessed differently than fit measures in Covariance Based (CB) SEM as it is not able to separate valid and invalid models like it does in CB-SEM (Hair et al., 2014a). So, a measurement tool proposed by Tenenhaus et al. (2005) was used in order to assess the model fit in this study. This measurement tool uses the geometric mean value of the Average Communality Score (AVE values) and the average R^2 values (for endogenous constructs). The result can then be assessed based on the following cut-off values proposed by Wetzels et al. (2009): $GoF_{small} = 0.1$;

GoF_{medium} = 0.25; GoF_{large} = 0.36. So, the GoF was calculated and the value of 0.59 indicates a very good model fit. In other terms, it can be concluded that the model proposed in this study has significant predictive relevance and explanatory power.

Table 5 Factor loadings in the measurement of variables

Variable	*Item*	*Content description*	*Factor loading*
Perceived usefulness	PU1	Using Save-Ideas improves my performance	.918
	PU2	Using Save-Ideas increases my productivity	.915
	PU3	Using Save-Ideas enhances my effectiveness	.933
	PU4	I find Save-Ideas useful	.892
Behavioural intention	BI1	I intend to continue using this website (Save-Ideas) in the future	.949
	BI2	I expect my use of this website (Save-Ideas) to continue in the future	.961
	BI3	I will frequently use this website (Save-Ideas) in the future	.937
	BI4	I will strongly recommend others to use this website (Save-Ideas)	.916
Individual trust	ITR1	This website (Save-Ideas) has the skills and expertise to perform transactions in an expected manner	.852
	ITR2	This website (Save-Ideas) has access to the information needed to handle transactions appropriately	.863
	ITR3	This website (Save-Ideas) is fair in its conduct of customer transactions	.872
	ITR4	This website (Save-Ideas) is fair in its customer service policies following a transaction	.852
	ITR5	This website (Save-Ideas) is open and receptive to customer needs	.826
	ITR6	This website (Save-Ideas) makes good-faith efforts to address most customer concerns	.851
	ITR7	Overall, this website (Save-Ideas) is trustworthy	.798
Subjective knowledge about blockchain	SKNW1	I think I have enough knowledge about blockchain	.863
	SKNW 2	I know pretty much about blockchain	.891
	SKNW3	Among my circle of friends, I'm one of the "experts" on blockchain	.791
Socioeconomic Characteristics	SC1	Monthly Income	.863
	SC2	Age	.915
	SC3	Education	.769

6 Discussion and conclusions

The main purpose of this study is to investigate the dynamics of individuals' acceptance of a website based on blockchain technology. For this purpose, the technology acceptance model was used as the underlying model and some extensions were proposed after the literature review. They were tested with the users of Save-Ideas.com, a blockchain-based website.

The research findings confirm the core technology acceptance model, the relationship between perceived usefulness, behavioural intention, and actual behaviour. Moreover, this study applies individual trust as the antecedent of perceived usefulness and behavioural intention as predicted in previous adaptation of TAM for website use. The main contribution of this study is the addition of a new variable, subjective knowledge about blockchain, as an antecedent for both individual trust and perceived usefulness.

The tested model provided evidence about the effect of subjective knowledge of blockchain on behavioural intention to use a blockchain-based website through perceived usefulness and individual trust as moderators. This result means that if individuals have knowledge about blockchain, they will have greater trust in these websites and will perceive these websites as more useful, which consequently, will increase the website's use. So, a basic challenge for blockchain developers is to create an awareness and knowledge of this technology among people. The same challenge may also be valid for governments that want to apply blockchain technologies in bureaucratic operations.

The examined model shows also a positive relationship between socioeconomic characteristics and technology acceptance. So, older and more educated people with higher income levels tend to use more the blockchain-based website (Save-Ideas.com).

This study has several limitations. Only one website was used in order to test the model proposed in this study. Moreover, the sample size is limited, thus generalisations of the findings should be approached with caution. Further research is needed to extend the acceptance model of blockchain-based applications in different industries. More variables such as risk and benefits may be included in the model to examine technology acceptance of blockchain-based web sites in more details.

References

Ajzen, I. and Fishbein, M. (1980) *Understanding Attitudes and Predicting Social Behavior*, Englewood Cliffs, NJ Prentice-Hall.

Armstrong, J.S. and Overton, T.S. (1977) 'Estimating nonresponse bias in mail surveys', *Journal of Marketing Research*, Vol. 14, No. 3, pp.396–402.

Bhattacherjee, A. (2002) 'Individual trust in online firms: scale development and initial test', *Journal of Management Information Systems*, Vol. 19, No. 1, pp.211–241.

Boyer, K.K., Olson, J.R., Calantone, R.J. and Jackson, E.C. (2002) 'Print versus electronic surveys: a comparison of two data collection methodologies', *Journal of Operations Management*, Vol. 20, No. 4, pp.357–373.

Choi, J.K. and Ji, Y.G. (2015) 'Investigating the importance of trust on adopting an autonomous vehicle', *International Journal of Human-Computer Interaction*, Vol. 31, No. 10, pp.692–702.

Cohen, J. (1988) *Statistical Power Analysis for the Behavioral Sciences*, Routledge, Abingdon, UK.

Davis, F.D. (1989) 'Perceived usefulness, perceived ease of use, and user acceptance of information technology', *MIS Quarterly*, pp.319–340.

Davis, F.D. and Venkatesh, V. (1996) 'A critical assessment of potential measurement biases in the technology acceptance model: three experiments', *International Journal of Human-Computer Studies*, Vol. 45, No. 1, pp.19–45.

Farooq, M.S., Salam, M., Fayolle, A., Jaafar, N. and Ayupp, K. (2018) 'Impact of service quality on customer satisfaction in Malaysia airlines: a PLS-SEM approach', *Journal of Air Transport Management*, Vol. 67, pp.169–180.

Featherman, M.S. and Pavlou, P.A. (2003) 'Predicting e-services adoption: a perceived risk facets perspective', *International Journal of Human-Computer Studies*, Vol. 59, No. 4, pp.451–474.

Flynn, L.R. and Goldsmith, R.E. (1999) 'A short, reliable measure of subjective knowledge', *Journal of Business Research*, Vol. 46, No. 1, pp.57–66.

Folkinshteyn, D. and Lennon, M. (2016) 'Braving bitcoin: a technology acceptance model (TAM) analysis', *Journal of Information Technology Case and Application Research*, Vol. 18, No. 4, pp.220–249.

Gefen, D., Karahanna, E. and Straub, D.W. (2003) 'Trust and TAM in online shopping: an integrated model', *MIS Quarterly*, Vol. 27, No. 1, pp.51–90.

Hair, J., Hult, G., Ringle, C. and Sarstedt, M. (2014a) *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Sage, Thousand Oaks.

Hair, J.F., Sarstedt, M., Hopkins, L. and G. Kuppelwieser, V. (2014b) 'Partial least squares structural equation modeling (PLS-SEM) an emerging tool in business research', *European Business Review*, Vol. 26, No. 2, pp.106–121.

Hughes, A., Park, A., Kietzmann, J. and Archer-Brown, C. (2019a) 'Beyond Bitcoin: what blockchain and distributed ledger technologies mean for firms', *Business Horizons*, Vol. 62, No. 3, pp.273–281.

Hughes, L., Dwivedi, Y.K., Misra, S.K., Rana, N.P., Raghavan, V. and Akella, V. (2019b) 'Blockchain research, practice and policy: applications, benefits, limitations, emerging research themes and research agenda', *International Journal of Information Management*, Vol. 49, pp.114–129.

Iansiti, M. and Lakhani, K.R. (2017) 'The truth about blockchain', *Harvard Business Review*, Vol. 95, No. 1, pp.118–127.

Lee, Y., Kozar, K.A. and Larsen, K.R. (2003) 'The technology acceptance model: past, present, and future', *Communications of the Association for Information Systems*, Vol. 12, No. 1, pp.752–780.

Morkunas, V.J., Paschen, J. and Boon, E. (2019) 'How blockchain technologies impact your business model', *Business Horizons*, Vol. 62, No. 3, pp.295–306.

Panagiotopoulos, I. and Dimitrakopoulos, G. (2018) 'An empirical investigation on consumers' intentions towards autonomous driving', *Transportation Research Part C: Emerging Technologies*, Vol. 95, pp.773–784.

Save-Ideas. (n.d.) *Frequently asked questions*. Available online at: https://save-ideas.com/faq

Statista (2018) *Blockchain*. Available online at: https://www.statista.com/study/39859/blockchain-statista-dossier/

Tenenhaus, M., Vinzi, V.E., Chatelin, Y-M. and Lauro, C. (2005) 'PLS path modeling', *Computational Statistics and Data Analysis*, Vol. 48, No. 1, pp.159–205.

Underwood, S. (2016) 'Blockchain beyond bitcoin', *Communications of the ACM*, Vol. 59, No. 11, pp.15–17.

Venkatesh, V. and Bala, H. (2008) 'Technology acceptance model 3 and a research agenda on interventions', *Decision Sciences*, Vol. 39, No. 2, pp.273–315.

Venkatesh, V. and Morris, M.G. (2000) 'Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior', *MIS Quarterly*, pp.115–139.

Wetzels, M., Odekerken-Schröder, G. and Van Oppen, C. (2009) 'Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration', *MIS Quarterly*, pp.177–195.