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A Smart Contract Model in Knowledge-based Companies Based on Grounded Theory by Focusing on the Robotic Process Automation and Process Management Strategies

Zahra Moridi
Department of Information Technology Management, Qeshm Branch, Islamic Azad University, Qeshm, Iran
z.moridi@iauqeshm.ac.ir

Seyed Alireza Mousavi*
Department of Management, Firoozabad Branch, Islamic Azad University, Firoozabad, Iran
ar.moosavi@iauf.ac.ir

Abbas Toloie
Department of Industrial Management, Science and Research Branch, Islamic Azad University, Tehran, Iran
toloie@srbiau.ac.ir

Roya Soltani
Department of Industrial Engineering, Faculty of Engineering, Khatam University, Tehran, Iran
r.soltani@khatam.ac.ir

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Abstract—**A smart contract is a computer protocol for creating or improving a contract which makes it possible to create valid transactions without intermediaries. The most important feature is security and speed, because this technology runs on a blockchain platform and its information will remain confidential. Despite these benefits, unfortunately, companies still use paper contracts. Knowledge-based companies can save time and money by implementing smart contracts with their customers in the form of robotic process automation and process management, and by reducing errors and risks in processes. Increase productivity in business. The purpose of this study was to present a smart contract model in knowledge-based companies based on Grounded Theory by Focusing on the robotic process automation strategies and process management using qualitative and quantitative paradigms. The analysis approach in this research is quantitative-qualitative. To collect data in the qualitative part, semi-structured interviews were used. In the quantitative part, the structural equation method was used. The sample size was calculated according to confirmatory factor analysis of 110 experts. Based on the data analysis, due to the abnormality of the data distribution, the partial least squares method was used with the help of Smart PLS software version 2.**

Keywords—Smart contract, Robotic process automation, Process management,Grounded theory.

I. INTRODUCTION

Smart contracts are computer programs that are designed to execute the conditions of a contract automatically. If a condition in the contract is realized, a certain action is performed automatically and clearly (for example, paying for a certain service). Smart contracts can be utilized on numerous grounds such as financial, notary public, games (gambling and game

* Corresponding Author

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industry) (Bartoletti, Massimo & Livio, Pompianu, 2017).

According to proposed definitions for the smart contract, characteristics such as automatism, use of blockchain technology, and programming codes are highly addressed. In comparison to traditional contracts which are prepared on paper, this type of contract includes a set of certain commitments prepared electronically and necessary protocols for both parties in order to execute their commitments. Blockchain is among the protocols that are often used in order to prepare a smart contract. Today, this smart contract is used as a substitute for traditional legal contracts and lots of efforts are conducted in order to execute this contract. Often, smart contracts are also referred to as digital contracts or encrypted contracts that are executed automatically based on the pre-prepared conditions (for example, the guilty party will be automatically punished according to the contract) (Zheng, Zibin, et al, 2020). As a result of the smart contract, the intervention will decrease and parties will automatically put their trust in the smart contract (Alam, Nafis, Gupta, Lokesh, & Zameni, Abdolhossein, 2019).

A.The Smart Contract Process

The smart contract is founded on trust and it plays a crucial role in different industries in order to create a win-win situation for both parties to the contract. A smart contract is a self-executing contract where the terms of the agreement between the buyer and the seller are directly written into lines of code. According to the smart contract, any type of money, securities, assets, and any other valuable thing can be exchanged in a transparent form. As mentioned earlier, this conflict-free contract is designed to execute contracts or transactions based on trust and no intermediary, namely agent, lawyer, etc., will be needed. The smart contract can be concluded with a single signature or multiple signatures. Each contract includes details about the parties to the contract (seller/buyer, sender/receiver, exchange rate) and also data field including input data (such as necessary information to execute the contract conditions). For blockchain contracts, each user will be able to observe the contract function based on the input variables. The input variable is actually a node within the blockchain that should be confirmed by all members of the node within the blockchain network (Alam, Nafis, Gupta, Lokesh, & Zameni, Abdolhossein, 2019).

The objective of this research is to analyze the smart contracts written into the computer programs in two areas, namely communication and IT. In this regard, grounded theory was utilized and ultimately, the validity verification was executed using structural equation modeling (SEM) methods. In the course of the research, answering the following questions using the grounded theory approach was focused on:

1-What are the causal factors influencing smart contracts on the blockchain?

2-What strategies do the smart contract on blockchain result in?

3-What are the contextual and intervening factors that influence the strategies?

4-What are the consequences of the strategies of the smart contract on the blockchain?

II. LITERATURE REVIEW

A. Smart Contract

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Smart contracts have been well-received due to two reasons: they have the potential to decrease the complexity of different contracts all around the financial industry and decreasing the costs of transactions. Therefore, smart contracts are highly safe and will cost less. However, there are some disadvantages to this type of contract as follows: the possibility of human errors (when programmers are writhing the codes of the contract), the existence of ambiguous legal laws of different countries concerning this type of contract, and higher fees are considered by programmers for writing the codes (Hewaa, Tharaka ., Mika, Ylianttilaa & Madhusanka, Liyanage, 2020).

Numerous researches have been conducted with different objectives in the field of smart contracts. In a research titled "Obstacles Preventing the Confirmation of Smart Contract and Electronic Commerce within Iranian Export Companies", Serlek et al. (2009) concluded that the following factors are influential in this field: website language, poor electronic banking system, lack of financial resources, incompatibility of organizational system with electronic commerce, lack of time to learn electronic commerce, lack of enough expertise and skill to design, teach, and implement electronic commerce, lack of support from managers, inadequate knowledge and understanding of opportunities and advantages, lack of professional and educate manpower within the organization, being unaware of the system desired by the customers or not using them at all, ambiguities in rules and laws established by the government, lack of trust in the smart contracts and inadequate security, and not receiving threats from the competitors (G, Harindranath, ., Dyerson, Romano., & Barnes, David, 2020).

Other researchers conducted in the same field are briefly illustrated in Table (1).

TABLE I. RESEARCHERS CONDUCTED CONCERNING SMART CONTRACT AND E-COMMERCE

Subject	Researcher	Year
A Model-Driven Approach to Smart Contract Development	Boogaard, K	2018
Formal Verification of Smart Contracts Based on Users and Blockchain Behaviors Models	Abdellatif, Tesnim. Brousmiche, Kei-Léo	2018
A conceptual framework for blockchain smart contract adoption to manage real estate deals in smart cities	Fahim, Ullah & Al-Turjman, Fadi	2021

In 2018, researchers conducted a study in order to review the legal policy of smart contracts. The results of this research are as follows (Mohsen, Sadeghi., Nasser Mehdi, 2018):

The researchers considered the following characteristics that will make the smart contract valid and legal: the existence of an agreement between the intention of the parties, the legality of parties to the contract, executory consideration, freedom of contract, determination and explanation of self-executing smart contract, security, speed, and accuracy.

III. METHOD

The research method is considered to be mixed research (qualitative-quantitative) and exploratory research in terms of information conclusiveness. Moreover, it is applied research in terms of objective. Since the research has exploratory nature, grounded theory was utilized in the process of modeling (here, the approach is focusing on theorizing and not testing the theory) (Gholipoor et al. 2016).

A. Qualitative Section

Open coding is initiated after conducting the interviews and interviews were reviewed multiple times and will continue until a general concept of the interview is obtained. According to axial coding, the concepts were placed in one category based on similarities and synonymy. In selective (theoretical) coding, the core variable or core process that is hidden among the data, stages of emergence and how it has emerged, and also its consequences were revealed (Haqiqi et al., 2017).

Open coding, axial coding, and selective coding were utilized in order to categorize the data (Aqazadeh et al., 2019). The data were categorized as follows in order to generate a resilience development model according to Strauss and Corbin's systematic grounded theory: casual conditions, intervening conditions, axial

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phenomenon, strategies, and consequences. This research proposes a method/ process that cannot arise from available data and it will be generated or conceptualized based on the data gathered from an interview with the participants who actually experienced the process under investigation.

Associated with the number of samples, it is better for the number of samples to not be determined at the beginning of the work. Hence, using the principle of saturation in order to determine the number of participants is recommended (Strauss and Corbin, 1998, 229). The current research, which is both explanatory and participatory research, conducted restructured interviews with the experts in a targeted manner. Then, the targeted sampling method was utilized until the theoretical saturation is realized.

The interviews were conducted with managers and experts in the IT and communication area, who have 10 years of experience in the same field and at least a masters' degree. In this process, thirteen individuals were interviewed and theoretical saturation was reached after the 10th person. However, the interviews were kept going. The experts are introduced in Table (2) as follows:

TABLE II. AN INTRODUCTION TO THE EXPERTS

EXPERT	EXPERIENCE (YEAR)	EDUCATION	EXPERTISE	OCCUPATION
Expert number 1	17	Masters' degree	Industrial engineering	Industry
Expert number 2	12	Masters' degree	Entrepreneurial management	Industry
Expert number 3	10	Masters' degree	Governmental management	Industry
Expert number 4	11	Masters' degree	Chemical engineering	Industry
Expert number 5	10	Masters' degree	Mechanical engineering	Industry
Expert number 6	13	Masters' degree	IT engineering	Industry
Expert number 7	15	Masters' degree	Mechanical engineering	Industry
Expert number 8	11	Masters' degree	MBA management	Industry and university
Expert number 9	10	Doctor's degree	Computer engineering	Industry and university
Expert number 10	13	Doctor's degree	Industrial management	Industry and university
Expert number 11	10	Doctor's degree	Power engineering	Industry and university
Expert number 12	12	Doctor's degree	Business administration	Industry and university
Expert number 13	10	Doctor's degree	Power engineering	Industry and university

B. *Open Coding*

During open coding, concepts and topics and also their characteristics and dimensions were identified (Khaki, 2011). This matter is illustrated in Table (3) as follows:

TABLE III. OPEN CODING

ROW	CONCEPTS	TOPICS
1	-Utilizing machines instead of humans -Reactions similar to human behavior	Artificial Intelligence (AI)
2	-The characteristics of each service will be defined clearly. -The characteristics of each intervening phenomenon will be defined clearly.	Instructions
3	-The necessity to decrease the obstacles preventing the contract execution	Challenges of service-level agreement
4	-Creating social structures, e.g., service-level agreement -Globalization -Increasing the number of digital services	Trust-building among business customers
5	-The emergence of new technologies -Ever-growing new technologies	Digital innovation
6	-To provide service to a customer in a suitable time -To provide a service to a customer in a right place -To provide a service based on the customer needs	Focusing on customer services
7	-To determine the level of quality -Comparing the quality against the standards	Measuring the quality of services
8	-To provide service to a customer in a suitable time -To provide a service to a customer in a right place -To provide a service based on the customer needs	Focusing on customer expectations
9	-The challenges that parties are facing to implement their business	The challenges of digital business
10	-Focusing on the support group -Preparing the required equipment, software to hardware	Infrastructure
11	-Expectations and necessities of both receivers should be in agreement with that of service providers	Compatible objectives

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12	-In all periods, the provision of services by the host should continue. -These services will be measured on a daily, hourly, weekly basis or in long-term periods.	Continuation of Service
13	-Cheating (when the dealers provide false information) -Management errors -Technical errors resulting from a defect in information and transaction processing.	Operational risks
14	-Vulnerability -The existence of a defect in the implementation, exploitation, and management of a system	Implementation risks
15	-Rational errors -Destructive errors -Non- destructive errors -Errors that might happen due to the programmer's mistake in designing the algorithm of the application. -Errors that might happen due to not considering certain conditions in the program.	Design errors
16	-If a smart contract is already registered on blockchain despite its errors, no one can change it anymore. -Human errors while writing the codes of the contract -Human actions that can result in the generation of false results -The syntax error is the first and most common, even simplest type of error.	Human factors
17	-Currently, none of the smart contracts are prepared by the government. -If government organizations decide to create a legal framework for smart contracts, it can create lots of problems. -Different countries may have nontransparent laws	Uncertain legal conditions
18	-The costs of implementing the activities -The costs of purchasing equipment	Implementation costs
19	-Analyzing the data that are obtained after evaluating the processes -Supervising the quality of products	Controllers
20	-Completing the daily exhausting processes -Decreasing the manual works -Focusing on the main subject without making complicated decisions -Certain coding is not necessary. -Cost-effective prices -Personnel will show less resistance. -The organization will focus on automation.	Robotic process automation
21	-Providing services to the customers -Increasing employee satisfaction -Decreasing operating costs -Information security -Increasing the level of precision in affairs -Flexibility -On-time monitoring/controlling	Automation of process management
22	-Replacing the components of old systems with new software or hardware	Improving the speed
23	-Decreasing the resource waste to carry out a certain activity -Efficiency represents the performance peak, where the least amount of input is used in order to obtain the highest amount of output.	Efficiency enhancement
24	-High level of focus and precision -Accuracy	Improved precision
25	-To be able to trust -To be able to rely on -Honesty -Being certain -To be able to believe -To be able to rely on	Improvement of trust
26	-Blockchain provides transparency, enabling each party to control the transactions anytime they want. -Contract conditions and terms are completely transparent for both parties. -Since certain information is needed in order to execute the smart contract, users will approve any information provided by the other party that might directly influence either party.	More transparency
27	-Existence of suitable interactions in competitive conditions -Increasing the performance of service delivery	Competitive advantage
28	-The demands of customers should be paid attention to from the beginning to the end.	Increasing customer satisfaction
29	-Product differentiation -Customer retention -Focusing on the customer to turn him or her into a loyal customer	Customer orientedness
30	-Risk-free condition -A branch of computer science that is dealing with risks, threats, and mechanisms associated with using computational systems. -Data security -Protection against cyber attack -Document privacy -To prevent hacking	Enough security
31	-To utilize the time optimally -To quickly execute the activities	Saving time
32	-Not wasting the resources	Saving expenses

C. *Axial Coding*

Axial coding is carried out according to Table (4) as follows:

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TABLE IV. AXIAL CODING TABLE 4. AXIAL CODING

ROW	TOPIC	AXIS
1	Artificial intelligence (AI)	Casual
2	Instructions	Casual
3	Challenges of service-level agreement	Casual
4	Trust-building among business customers	Casual
5	Digital innovation	Casual
6	Focusing on customer services	Casual
7	Measuring the quality of services	Casual
8	Focusing on customer expectations	Casual
9	The challenges of digital business	Casual
10	Infrastructure	Contextual
11	Compatible objectives	Contextual
12	Continuation of Service	Contextual
13	Operational risks	Intervening
14	Implementation risks	Intervening
15	Design errors	Intervening
16	Human factors	Intervening
17	Uncertain legal conditions	Intervening
18	Implementation costs	Intervening
19	Controllers	Strategy
20	Robotic process automation	Strategy
21	Automation of process management	Strategy
22	Improving the speed	Consequence
23	Efficiency enhancement	Consequence
24	Improved precision	Consequence
25	Improvement of trust	Consequence
26	More transparency	Consequence
27	Competitive advantage	Consequence
28	Increasing customer satisfaction	Consequence
29	Customer orientedness	Consequence
30	Enough security	Consequence
31	Saving time	Consequence
32	Saving expenses	Consequence

IV. FINDINGS

After executing both axial coding and selective coding at the same time, the final model of research is as follows:

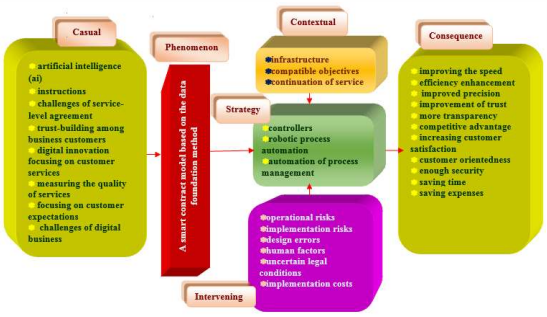

Figure 1. Final Model of Research.

A. Quantitate Section

Verifying the Model Quantitate Validity

Structural equation modeling (SEM) method is used in order to verify the model quantitative validity. According to the law of structural equation modeling, the number 10 will be multiplied by the highest number of variable components in the model that is 11 in this case. This way, the number of samples will be 110 and hence, 110 individuals were chosen among the experts and managers of the knowledge-based companies that are active in the field of IT and communications. After that, questionnaires were distributed between these individuals. Experts were asked for help in order to test the questionnaire validity and slight changes were applied to the questionnaire. Next, discriminant validity (Table 1) and divergent validity (Table 6) were calculated and both of them were approved. To approve discriminant validity, it is necessary for the number in the main diagonal to be more than numbers presented on the right and bottom side and related to divergent validity, values of average variance extracted (AVE) indexes should be more than 0.5. Lastly, the coefficient of Cronbach's alpha should be more than 0.7 in order to approve the reliability.

TABLE V. DISCRIMINANT VALIDITY

Casual	0.71					
Contextual	0.26	0.81				
Phenomenon	0.62	0.26	0.73			
Facilitation	0.38	0.71	0.21	0.75		
Strategy	0.48	0.63	0.39	0.68	0.72	
Consequence	0.39	0.25	0.47	0.27	0.21	0.77
Factors	**Casual**	**Contextual**	**Phenomenon**	**Facilitation**	**Strategy**	**Consequence**

TABLE VI. CRONBACH'S ALPHA & DIVERGENT VALIDITY

FACTORS	CRONBACH'S ALPHA	DIVERGENT VALIDITY
Casual conditions	0.721	0.504
Main Phenomenon	0.736	0.656
Contextual conditions	0.814	0.532
Intervening/ facilitating conditions	0.726	0.562
Strategy	0.781	0.518
Consequence	0.792	0.592

Concerning the measurement of variable distribution and use of a suitable statistical method, Kolmogorov–Smirnov test (Table 7) was utilized. The data distribution is not normal considering that the significant values are less than 0.05. Hence, the partial least squares method was utilized in order to measure the relationship between the variables.

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TABLE VII. NORMALITY TEST

VARIABLE	LEVEL OF SIGNIFICANCE	RESULTS
Casual conditions	0.000	Not normal
Main Phenomenon	0.000	Not normal
Contextual conditions	0.000	Not normal
Intervening/ facilitating conditions	0.000	Not normal
Strategy	0.000	Not normal
Consequence	0.000	Not normal

The model of partial least squares is presented in two forms, namely level of significance and coefficients of standard estimation ("Fig. 2&3"):

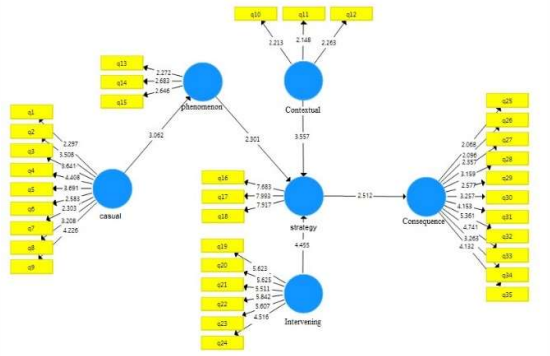

Figure 2. Level of Significance Model.

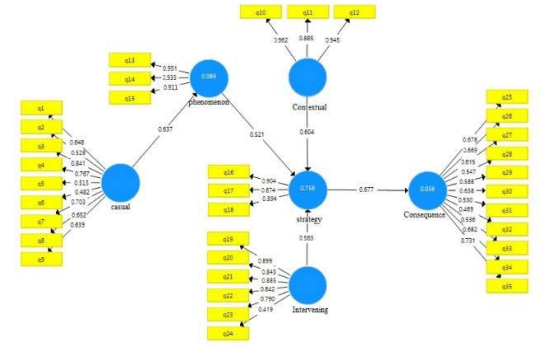

Figure 3. Model of standard estimation.

The values of significance and standard coefficients are illustrated in a diagram according to Table (8):

TABLE VIII. GEOMETRICAL PARAMETERS OF THE DESIGNED ANTENNA

Table 8. The values of significance and standard estimation

Effect	Significance	Standard estimation	Results
The effect of casual conditions on the main phenomenon	3.062	0.637	Approved
The effect of the main phenomenon on strategy	2.301	0.521	Approved
The effect of contextual conditions on strategy	3.557	0.604	Approved
The effect of intervening conditions on strategy	4.455	0.583	Approved
The effect of strategy on the outcome	2.512	0.677	Approved

As it can be seen, all values of significance are more than1.96 ("Fig. 2") and standard coefficients (factor loading) is also more than 0.4 ("Fig. 3"). Hence, the research model is approved and considered valid. The goodness of fit (GOF) is calculated to be 0.603, which is more than 0.36, and the fitness of the model is approved. Therefore, the final model is approved in terms of quantity.

V. CONCLUSION AND SUGGESTION

A smart contract is a protocol to prepare the contracts in which all the anticipated actions will be automatically executed according to contract conditions. Using this type of contract, no search party will be able to intervene in the execution of the valid transaction. In other words, it is a computer program designed to simplify, approve, or execute a negotiation in digitalized manner. Moreover, these transactions can be traceable and reversible in this process. Since the emergence of blockchain technology, changes have been done and Bitcoin has turned into the basis of blockchain smart contracts. Smart contracts applications are mostly known as "decentralized programs" or just applications and include decentralized finance technology (Defi); the objective of such technology is to transform into the banking industry. Knowledge-based companies that are active in fields of information technology and communications will be able to generate new ideas and create value by incorporating science and wealth, develop a knowledge-based economy, realize scientific and economic objectives, and optimally use innovation and to-date knowledge-based technologies. Robotic process automation and process management is a new topic that will help expand automation and transfer it to new grounds. Hence, it will help design more efficient and precise smart contracts for businesses, due to the fact that digital businesses will soon replace traditional businesses in the near future.

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Just like human resources in organizations and companies, these strategies will soon be considered as virtual robotic resources/forces. By automating the repetitive processes, all businesses will be able to save their time and costs and this will in turn help create value in the main areas of their businesses. If the robots do not have the intelligence required by any type of process, not only using robots will not make any help but also result in more damages and losses. This event can be explained by the fact that a set of the process needs a certain algorithm and procedure in order to be carried out in a repetitive manner. Also, some processes, analyses, and tasks can only be carried out by human intelligence.

A. Part One: Qualitative Section

The objective of this research is to present a model of smart contract based on grounded theory by focusing on the role of robotic process automation and process management. First, a targeted non-probability sampling method was utilized in order to choose the group of experts. The number of experts was more than 12 individuals and theoretical saturation was reached after the 10th person. The framework of the interview includes 4 main questions that were presented at the beginning of this article. Then, all the recorded interviews were written on paper and then, analyzed. The concepts and topics were reviewed in the open coding section. In the next step, Strauss and Corbin's approach and open coding, selective coding, and axial coding were used, and after which the research model was designed. According to the interviews and their coding, a total of 78 concepts and 32 topics were obtained that have been shown in the model.

Based on the final model, causal factors are as follows: artificial intelligence (AI), instructions, challenges of service-level agreement, trust-building among business customers, digital innovation, focusing on customer services, measuring the quality of services, focusing on customer expectations, and the challenges of digital business. Moreover, the strategies are as follows: controllers, robotic process automation, and automation of process management. Interviewing and contextual factors are given as follows: infrastructure, compatible objectives, the continuation of service, operational risks, implementation risks, design errors, human factors, uncertain legal conditions, and implementation costs. Ultimately, consequences are as follows: improving the speed, efficiency enhancement, improved precision, improvement of trust, more transparency, competitive advantage, increasing customer satisfaction, customer orientedness, enough security, saving time, and saving expenses.

B. Part Two: Quantitative Section

The objective of robotic process automation is to improve the processes of business within organizations. Robotic process automation is a new technology through which repetitive and numerous insignificant tasks can be executed automatically. Robots are able to mimic the behavior of users and learn how the users execute certain tasks such as filling in a form. It is natural that robots will be able to execute repetitive activities at a higher speed and quality in comparison to the user and this will help save and create more value within the organization. Blockchain smart contracts can provide numerous advantages for potential programs, some of which are explained as follows:

-Speed and real-time updating. Since a number of lines of codes are written for smart contracts in order to execute certain tasks, which can be done manually, they can speed up different business processes. It must be noted that, however, not only are automatic deals executed much faster, they are also susceptible to manual errors.

-Automating these tasks will decrease the risk of errors and nonfunctioning since the task will be managed by the network and not a third party.

-Fewer intermediaries. Smart contracts will decrease the dependence on the third party, who is offering “trust” services such as depositing, or will completely eliminate this dependence.

-Costs will decrease. New processes that are activated by smart contracts will require less human intervention and intermediary. In other words, the expenses will decrease.

-Business or operating new models. Since a smart contract is a cost-effective method in order to execute their transactions completely and according to the agreement, other types of occupation will be created, such as renewable energy business, automatic access to the vehicles, and the storing units.

One of the main strategies obtained from the research model is robotic process automation. This strategy combines AI and machine learning in order to create significant innovations and led to the constant growth of this industry. Robots are able to mimic the behavior of users and learn how the users execute certain tasks such as filling in a form. It is natural that robots will be able to execute repetitive activities at a higher speed and quality in comparison to a user and this will help save and create more value within the organization. Another important strategy is the automation of process management using which processes and organization activities will be managed in a better and efficient manner. Automation of process

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management guides technology and human resources to conclude organization processes in the least time possible. After this process is finished, Kolmogorov–Smirnov test illustrated that the data distribution is not normal, and also the data analysis was carried out using the partial least squares method and SmartPLS. Since all values of significance are more than 1.96 and the coefficient of standard estimation was more than be 0.4, the research model was concluded to be valid. Findings of this research, concerning the impact of causal factors on the main phenomenon, are in agreement with the following works: Jalili et al. (2019), Taslimi et al. (2018), Alam, Nafis, Gupta, Lokesh, & Zameni, Abdolhossein, 2019. Also, findings related to consequences of the main phenomenon and strategies are compatible with the following works: Haqiq et al. (2016), Zheng, Zibin et al. (2020), and Abdellatif, Tesnim. Brousmiche, Kei-Léo (2018).

C. *Part Three: Responding to the Questions*

Four main questions were stated at the beginning of this research and during the process of research, answers to the questions were provided gradually. In general, the response to these questions can be found in the final model and also, explanations given in order to design the model using different tables and coding techniques.

The most important conclusion and suggestion of this research is to consider the presented model in order to understand and implement the concept of blockchain smart contract. Also, it is suggested that characteristics such as speed and real-time updating should be considered in order to have a better performance. The data should be entered via a computer in order to minimize problems and human errors. Compatible expectations and necessities of both receivers and providers of service should be taken into account in the contacts. The characteristics of each service that are mentioned in the smart contract should be completely clear and phenomenal that may intervene in the service delivery should be taken into account in the body of the contract. The research has encountered some limitations; for example, there are other variables that need to be reviewed in order to help explore the concept of blockchain smart contracts. However, these variables are not reviewed in this study. It is recommended that other researchers should review other possible factors in the concept of the smart contract. It is also recommended that such research should be done in other organizations and then, compared with each other.

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Zahra Moridi received her B.Sc. in English Translation from Islamic Azad University of Shiraz and the M.Sc. degree in Information Technology Management from e-Campus Islamic Azad University. Currently she is a Ph.D. candidate in Information Technology Management (BI), Islamic Azad University of Qeshm. Her research interests include Data Mining, Blockchain and Cryptocurrency, Digital Banking, Information and Communication Technology and Cyber Security.

Seyyed Alireza Mousavi received his Ph.D. degree in Business Management from Iran University of Science and Technology. He is currently an assistant Professor with Faculty of Management in Islamic Azad University of Firoozabad. His current research interests include Behavioral-quantitative Approaches to Firm Strategies, Enterprise Exchanges and the Role of Marketing in them and Psychology and Consumer Behavior.

Roya Soltani received her Ph.D. degree in Industrial Engineering from Iran University of Science and Technology. She is currently an Assistant Professor at the Department of Industrial Engineering, Khatam University, Tehran, Iran. Her current research interests include Operations Research and Management Science, Robust and Stochastic optimization, Reliability optimization, Logistics and Supply chain network design, Heuristics and Meta-heuristics applications, Business Analytics, Business Process Management.

Abbas Toloie Eshlaghy received his Ph.D. degree in Industrial Management from Science and Research Islamic Azad University. He is currently a Full Professor with Faculty of Industrial Management in Science and Research Islamic Azad University. His current research interests include Simulation, Data Science and Artificial Intelligence.

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