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THE MODEL OF CHALLENGES OF SMART CONTRACT BASED ON BLOCKCHAIN TECHNOLOGY AND DISTRIBUTED LEDGER USING META-SYNTHESIS RESEARCH METHOD

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Abstract: Many believe that smart contract can provide an innovative solution to some of the real-world problems. Thus, it is expected that blockchain-based smart contracts can dramatically increase economic efficiency and productivity in financial, banking and capital markets.

In fact, smart contracts are a powerful novel tool for major changes in the financial, legal and contractual systems of the future, which will change the business model, create efficiency and added value, reduce legal disputes and increase the speed and transparency of financial transactions.

Another innovative solution of smart contracts is their wide application in the internet of objects (IoT). For example, smart contract can be used to track goods in smart transport system, or it can be applied in future smart cars without a driver in order to pay for gasoline when fueling or pay for the insurance in the case of an accident automatically and immediately.

Due to the widespread applications of smart contract in e-government, supply chain, intellectual property creation, patient electronic records, electronic voting, electronic insurance, smart transport and so on, its importance is clearly identified. Therefore, considering the emergence of smart contracts and given the scattered studies in this field, an attempt has been made to present a

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comprehensive and systematic model of the challenges of smart contract based on blockchain technology and the distributed ledger by the systematic review of previous studies (papers published in internationally accredited journals and theses reviewed between 2016 and 2019), using a meta-synthesis qualitative research method and Sandelowski and Barroso's (2006) seven-step model.

Keywords: Smart Contract Barriers, Small Contract Challenges, Limitations of Blockchain-Based Smart Contract, Smart Contract Problems, Smart Contract and Blockchain and General Ledger.

1. Introduction

Decentralized systems face major problems, including scalability and privacy as well as multi-identity issues. Nowadays, experts are trying to design decentralized protocols like blockchain that are scalable and optimized in addition to being resistant against attacks. Analysis of such protocols requires extensive knowledge in areas such as distributed systems, cryptography, game theory, and information theory concepts. The transfer of power from closed, unclear mechanisms to people and the society is one of the most important concepts in the new world. In this regard, blockchain technology can facilitate the move toward a more uniform and equal society.

The vast scope of blockchain technology applications, including smart contracts, goes back to its basic concept of a fully transparent, publicly accessible, secure, decentralized database without the need to trust a third party or central entity.

Smart contract eliminates the supervisory interface and thus reduces costs. Other benefits include the automatic payment of contract fees and its transparent as well as decentralized nature. However, despite the benefits and considerable applications of smart contracts, they face a variety of challenges in practice, since they are new emerging technologies. Thus, this study aims at presenting a systematic and comprehensive model of challenges of smart contract based on the blockchain technology and distributed ledger, using a meta-synthesis qualitative research

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method and Sandelowski and Barroso's (2006) seven-step model.

2. Literature

2.1. Smart Contract

The term smart contract was first coined by computer and cryptography scientist, Nick Szabo, in 1994. He outlined the general principles, but there was no adequate space and infrastructure at that time for the realization of his ideas. With the advent of blockchain technology, the idea of smart contracts became operational. As the world's first decentralized digital currency, Bitcoin was the foundation of some kind of contract in the blockcahin, but the Bitcoin protocol was only designed to create a private currency and could not fulfill all the needs and processes. Ethereum platform made smart contracts possible for most projects, taking a new step toward globalization.

Smart contracts are the digitalized model of traditional contracts, and can be defined as blockchain-based computer software whose contents in the "source code" are automatically executed and cannot be modified by the parties because of storage in the blockchain. In fact, smart contract is a tool through which trading is possible transparently and without conflict or the need to intermediary services, money, assets, stocks, or anything valuable.

2.2. Blockchain

Given that the smart contract is incorporated in blockchain, blockchain can be called a distributed database of documents or a general ledger of "all digital events or transactions" jointly executed by its constituents. Each transaction is recorded in the general ledger by the agreement of the majority of system components. Information once entered into the system, will never be removed. In fact, blockchain can be considered as a data storage structure based on chains of interrelated data blocks that are collectively generated, retrieved and maintained by the nodes participating in the system. Changes to each block will cause invalidity of the following blocks. Each new block is prepared and added to the chain from the new data generated in the system in a competitive mechanism by one of the participants. New blocks are accessible and verifiable by other people

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participating in the system. If a block contains a storage error, it is detected by other nodes in the network and is not registered in the main chain. As long as more than 50% of the network nodes agree on the current chain, the chain will be valid. Due to the chain structure and each block's close association with its previous blocks, changing the data agreed upon by the majority of the network requires enormous computational power which cannot be supplied and in turn, makes the system resistant to cyber-attacks.

Smart contracts have lower legal and transaction costs than traditional contracts, since the consumer relates directly to the centralized currency exchange.

Ethereum is currently the most advanced smart contract platform. This blockchain protocol has been designed to solve the fundamental constraints of Bitcoin in programming. Ethereum aimed primarily at storing and executing smart contracts. It supports the full Turing feature, allowing for advanced and customized contracts. In theory, full Turing means the capability of being used to solve any computational problem. Ethereum is prominent because, unlike Bitcoin, it is aimed not only at creating a crypto-currency, but also acts as an alternative protocol for creating decentralized applications.

The smart contract code stored in blockchain on the Ethereum platform is first called, verified, and then executed on the Ethereum virtual machine, after satisfying the usual contract terms (Figure 1).

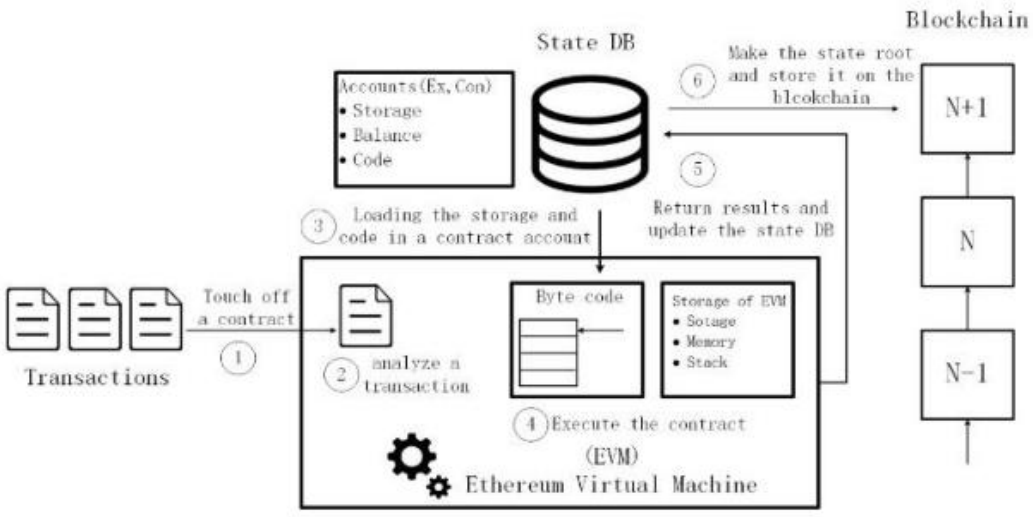

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Figure 1. Execution of Smart contract in Ethereum platform and interaction with blockchain technology

With the growing need for data flows to blockchain followed by smart contracts, discussions and innovations around Oracle have formed. Oracles are data sources of external systems that import critical information into the blockchains. Smart contracts need these data to run. In fact, oracle is authentic information outside of the system, used to execute smart contracts. Oracles retrieve and verify data from external sources through web APIs and market data sections for blockchains and smart contracts. The data required by smart contracts include information such as prices, weather, and so on.

As shown in Figure 2, financial transactions and events are represented as input and output in smart contract, where oracle is used if the input is from external credible sources. In addition, the output of the smart contract is stored in the smart contract blockchain or can be used as another smart contract input.

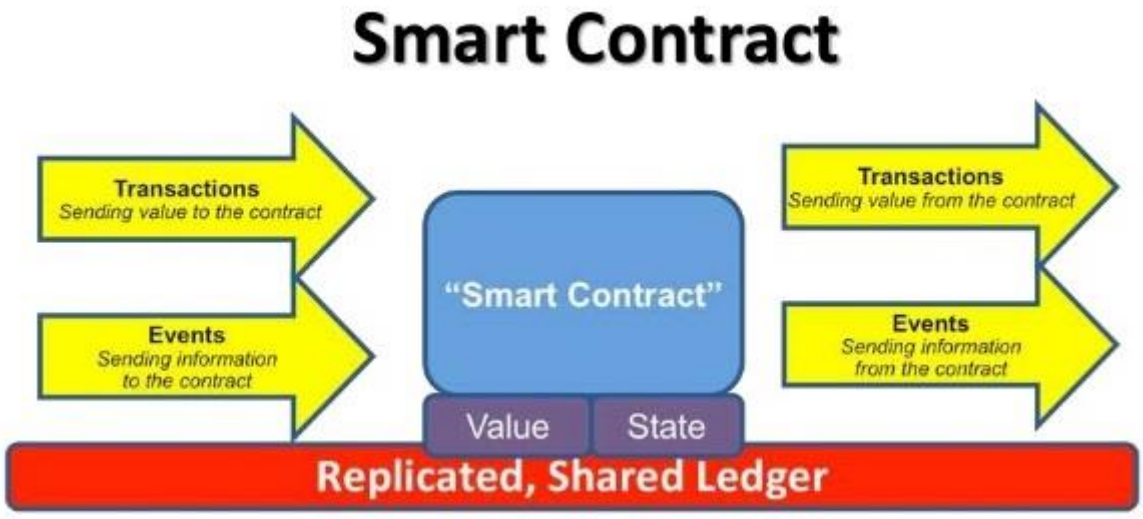


Figure 2. Smart Contract

Considering the numerous legal, civil, technical, and organizational challenges to implementing smart contracts and given the scattered studies in this field, it is imperative to have a comprehensive and systematic approach to identifying and classifying the challenges of small contracts based on

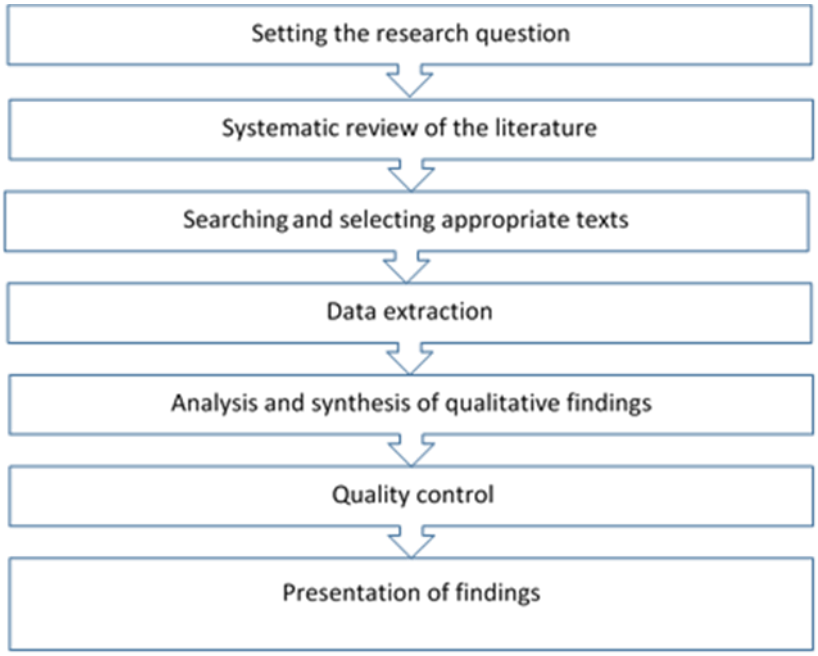
blockchain technology and the distributed ledger in order to provide a systematic and holistic model. Therefore, the present study has provided this model based on the Sandelowski and Barroso's (2006) seven-step model in addition to introducing the meta-synthesis qualitative method.

3. Research Methodology

The research method of this study is qualitative and a kind of meta-study called meta-synthesis. In the application of meta-synthesis to identify factors influencing the challenges of smart contract based on blockchain technology and the general ledger, similar to meta-analysis, it is used to integrate multiple studies and generate comprehensive and interpretive findings. Since most of the articles in the field of study are qualitative without quantitative data, the meta-synthesis method has been used as a suitable method to obtain a comprehensive combination of this topic based on the translation of limited qualitative studies. As stated, meta-synthesis is a type of secondary study, with the aim of structured review of qualitative studies, focusing on the qualitative findings derived from related and similar studies. On the other hand, meta-synthesis is not an integrated review of the associated qualitative literature and does not necessarily involve much of the related literature on the topic. Also, it is not an extract from the interpretations of similar studies, but rather an integration of the interpretation of the main findings of the studies selected to create comprehensive and interpretative findings [17], indicating a deep understanding of the researcher [18]. That is, instead of providing a comprehensive summary of the findings, it creates an interpretive combination of them. Meta-synthesis explores new and fundamental metaphors and themes by providing a systematic approach to researchers by combining various qualitative research, thereby expanding current knowledge and providing a holistic and comprehensive view. Meta-synthesis requires that the researchers show a more comprehensive representation of the phenomenon under investigation [17]. In this research, the seven-step method of Sandelowski and Barroso, summarized in Table 1, has been used.

Moreover, each step has been discussed in detail in the following sub-sections [19]:

Table 1. Sandelowski and Barroso's (2006) seven-step model



3.1. The First Step: Setting the Research Question

Various parameters were used to set the research question, such as the population under study, the method and time of the study. The following question was explored in the present research:

1. Identification and grouping of smart contract challenges to provide the model of challenges of smart contract based on blochchain and the general ledger

The study population consisted of articles published in internationally accredited journals and theses that were reviewed between 2016 and 2019. Selection was performed by purposeful sampling and census based on inclusion and exclusion criteria.

It is worth noting that the last 4 years (from 2016 to 2019) were considered for the selection of the articles in order to collect the most up-to-date scientific results in the field under study.

3.2. The Second Step: Systematic Review of the Literature

At this step, the researcher focused on the systematic search based on internationally accredited scientific journal articles and theses reviewed between 2016 and 2019 to select the relevant keywords. The related articles were investigated using the keywords of Smart Contract Barriers- Smart Contract Challenges – Smart Contract Limitation on Blockchain Technology- Smart Contract Problem – Smart Contract and Blockchain and Distributed Ledger Technologies in data bases of OATD (Open Access Theses and Dissertations), Proquest, Science Direct, Springer, Scopus, Civilica, SID, IRANDOC, ISC, Emerald, IEEE, as well as Google scholar specialized database.

3.3. The Third Step: Searching and Selecting Appropriate Texts

In this step, the researcher removed a number of articles in each review, which would not be considered in the meta-synthesis. Articles were evaluated based on inclusion and exclusion criteria (study parameters) and according to Table 2. The inclusion criteria for this study were the followings:

1. Articles published in internationally accredited journals and theses reviewed between 2016 and 2019;
2. Articles related to the title and research question as well as articles published with valid scientific research methods;
3. Articles approved by expert referees and published in journals confirmed by the ministries.

Exclusion criteria for this study included the followings:

1. Articles irrelevant to the title and research question as well as articles published with invalid scientific research methods;
2. Articles lacking the necessary scientific quality and published in invalid journals;
3. Articles with similar titles and objectives.

Based on the inclusion and exclusion criteria (study parameters) and according to Table2, 32 articles were eventually left from the initial 119 articles found for data extraction.

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Table 2. Steps taken to investigate the articles found

The first step: Review of the titles		
119 articles found	38 articles removed	81 articles left
The first step: Review of the abstracts		
81 articles found	36 articles removed	55 articles left
The first step: Review of the results		
55 articles found	13 articles removed	42 articles left
The first step: Review of the content		
42 articles found	10 articles removed	32 articles left

Once the articles have been reviewed to fit the study parameters, the methodological quality of the studies should be then evaluated. This step aims at removing articles whose findings are not reliable; therefore, articles which should be included are also likely to be removed. Critical Appraisal Skills Program (CASP) is used for early investigations of qualitative studies. CASP is a tool commonly used for evaluation through 10 questions, and helps the researchers determine the accuracy, reliability, and importance of qualitative research studies. These questions focus on the following items: 1. Research objectives; 2. The logic of the method; 3. Research design; 4. Sampling method; 5. Data collection; 6. Reflectiveness (including the relationship among the researcher and participants); 7. Ethical considerations; 8. Accuracy of data analysis; 9. Clear and transparent statement of the findings; and 10. Research value. At this point, the researcher gives each of these questions a quantitative score, and then creates a form. So it is possible to review the collection of articles and observe the evaluation results. The scores given to each article are then summed and the articles with scores lower than 21 are easily removed based on CASP 50-point Rubric: scores of 41-50 are excellent, 31-40 very good, 21-30 good, 11-20 poor, and 0-10 very poor. According to scores given to each article, the minimum mean score was respectively 18 and 19 and the maximum was 45; as a result, during the CASP evaluation process, two articles

were removed from the 32 remained articles and finally, a total number of 30 articles were left for data analysis.

3.4. The Fourth Step: Data Extraction

Across the meta-synthesis, the researcher repeatedly reviewed the selected and finalized articles in order to gain insights into the individual content in which the original studies were conducted. In the present study, the information of the articles has been categorized as follows: The reference to each article, including article code, article name, author's name, year of publication, and type of research was recorded.

Table 3. Information on selected and finalized articles

No.	Article's Title	Author	Year of Publication	Journal or COnference
1	Security, Performance, and Applications of Smart Contracts: A Systematic Survey	SARA ROUHANI AND RALPH DETERS	2019	IEEE
2	DLT/BLOCKCHAIN ARCHITECTURE AND REFERENCE FRAMEWORK	Claudio Lima, Ph.D. Blockchain Engineering Council – BEC, Co-Founder IEEE DLT/Blockchain Standards, Vice-Chair, Chair	2018	IEEE
3	An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends	Zibin Zheng1, Shaoan Xie1, Hongning Dai2, Xiangping Chen4, and Huaimin Wang3	2017	IEEE 6th Internationa l Congress
4	An Overview of Smart Contract: Architecture,	Shuai Wang1,2, Yong Yuan*1,3	2018	IEEE,Intelli gent

	Applications, and Future Trends	(Corresponding author, Senior Member, IEEE), Xiao Wang1,3, Juanjuan Li1,3,Rui Qin1,3, Fei-Yue Wang1,3,4(Fellow, IEEE)		Vehicles Symposium
5	The Use of Smart Contracts and Challenges	YINING HU,MADHUSANKA LIYANAGE,	2018	publishing on arxiv
6	A Vademecum on Blockchain Technologies: When,Which and How	Marianna Belotti, Nikola Božić, Guy Pujolle, Stefano Secci	2019	SUBMISSION TO IEEE COMMUNICATIONS SURVEYS AND TUTORIALS 1
7	Blockchain-based Smart Contracts - Applications and Challenges	Madhusanka Liyanage- Ahsan Manzoor- Kanchana Thilakarathna- Guillaume Jourjon	2019	researchgate
8	BLOCKCHAIN-BASED SMART CONTRACTS : A SYSTEMATIC MAPPING STUDY	Maher Alharby1,2 and Aad van Moorsel1	2017	researchgate
9	Bitcoin: Vulnerabilities and Attacks	Richa Kaushal	2016	Imperial Journal of Interdisciplinary

				Research (IJIR)
10	Towards Global Asset Management in Blockchain Systems	Victor Zakhary, Mohammad Javad Amiri ,Sujaya Maiyya	2019	publishing on arxiv
11	A Strongly typed DSL for Smart Legal Contracts	Jerome Simeon,Kartik Chandra	2018	clause
12	A Scalable Security Analysis Framework for Smart Contracts	Lexi Brent,Anton Jurisevic,Michael Kong-others	2018	publishing on arxiv
13	Music Copyright Management on Blockchain: Is it legally viable?	Sadia Sharmin	2018	uppsala university-Master's Thesis
14	Overview of Blockchain and Possible Use Cases in the Thai Payment System	Yupawadee Srisukvattananan	2016	THE MIT SLOAN SCHOOL OF MANAGEMENT IN PARTIAL
15	Blockchain 2.0, smart contracts and challenges	Martin von Haller Grønbæk	2016	The SCL Magazine
16	Blockchain-oriented Software Engineering: Challenges and New Directions	Simone Porru,Andrea Pinna,others	2017	researchgate
17	Blockchain and Building Information Modeling (BIM): Review and	Nawari O. Nawari * and Shriraam Ravindran	2019	mdpi

	Applications in Post-Disaster Recovery			
18	A Survey of Blockchain Security Issues and Challenges	Iuon-Chang Lin and Tzu-Chun Liao 2	2017	International Journal of Network Security
19	THREE ESSAYS ON AUDIT TECHNOLOGY: AUDIT 4.0 , BLOCKCHAIN, AND AUDIT APP	JUN DAI	2017	The State University of New Jersey - degree Doctor of Philosophy
20	Blockchain challenges and opportunities: a survey	International Journal of Web and Grid Services	2018	International Journal of Web and Grid Services
21	Software Engineering Research for Blockchain-Based Systems	Dr Mark Staples	2018	csiro
22	Smart contract legal policy considerations	Mohsen Sadeghi, Mehdi Nasser	2018	Journal of Public Policy Research
23	Smart Contracts and Distributed Ledger – A Legal Perspective	Whitepaper	2017	ISDA
24	A Platform for Confidentiality-	Raymond Cheng Fan Zhang	2019	publishing on arxiv

	Preserving, Trustworthy, and Performant Smart Contracts	Jernej Kos Warren He Nicholas Hynes Noah Johnson		
25	Smart Contracts for Machine-to-Machine Communication: Possibilities and Limitations	Yuichi Hanada,Luke Hsiao,Philip Levis	2019	publishing on arxiv
26	Securify: Practical Security Analysis of Smart Contracts	Petar Tsankov,Andrei Dan,Dana Drachsler-Cohen	2018	publishing on arxiv
27	The Blockchain Model of Cryptography and Privacy-Preserving Smart Contracts	Ahmed Kosba∗ , Andrew Miller∗ , Elaine Shi , Zikai Wen , Charalampos Papamanthou	2016	2016 IEEE Symposium on Security and Privacy
28	Scalable, private smart contracts	Harry Kalodner, Steven Goldfeder, Xiaoqi Chen, S. Matthew Weinberg, and Edward W. Felten, Princeton University	2018	27th USENIX Security Symposium
29	T HE LAW AND LEGALITY OF S MART C ONTRACTS	Max Raskin	2017	researchgate
30	ON SMART CONTRACTS AND ORGANISATIONAL PERFORMANCE: A	ZAHEER ALLAM	2018	review economy and business study

	REVIEW OF SMART CONTRACTS THROUGH THE BLOCKCHAIN TECHNOLOGY			

3.5. The Fifth Step: Analysis and Synthesis of the Qualitative Findings

Meta-synthesis aims at creating a new and integrated interpretation of the findings. This method is adopted to clarify concepts, patterns and results in refining existing states of knowledge and the emergence of operational models and theories [20]. Throughout the analysis, the researcher looks for themes that have emerged among the studies in the meta-synthesis. These cases are known as "thematic investigations". When the themes are identified, a categorization is formed after which similar and associated categories are placed in a theme which can best describe them. Themes provide the foundation for creating "explanations, models, and theories or assumptions" [19]. In the present study, all the factors extracted from the studies are considered as open codes. Then, the game codes that have a common concept or related task in a similar concept (axial code) are categorized by considering the concept of each of these codes. Eventually similar concepts create categories (domains) to form the research model. The open codes extracted from the final articles are presented in Table4 along with categorization of the concepts (axial code) and categories (domains).

Table 4. Results of analysis using meta-synthesis research method

Category (Domain)	**Concept (Axial Code)**	**Open Code**
Human	Standard Issues - Standardization	Lack of Standardization
	Laws Issues Legal, Public, and International Rules and Regulations	Obtain tax-Association with illegal activities-Identification of the parties-Governance and

		Regulation Compliance-Validation of digital signature in financial transactions-Digital Crime-The legality of digital currencies and the possibility of owning them
	Codifying Issues	Human error in contract code-Immutable-Complexity of programming languages--Difficulty of writing correct smart contracts-Inability to modify smart contracts-Lack of support to identify under-optimized smart contracts -inflexibility smart contract
	Education Issues	Lack of smart contract specialist-Learning- Lack of awareness of the smart contract-Awareness
Technology	Privacy Issues	Lack of transactional privacy-Lack of data feeds privacy-Lack of Privacy-Confidentiality
	Performance Issues	Sequential execution of smart contracts-Reduce latency, Increase throughput
	security issues	Smart Contract Vulnerabilities-reentrancy vulnerability-dependency vulnerability-Mishandled exception vulnerability-Lack of trustworthy data feeds Oracles-

		hack smart contract -Smart Contract Vulnerabilities-Consensus attacks -double spending attack-Selfish Mining-Transaction Ordering Dependence (TOD)-Timestamp Dependence-Risk of a 51% attack-Security concerns-
	Scalability Issues	storage optimization of blockchain-transaction per second-speed of execution-Lack of scalability
	Integration Issues	Lack of systems integration with smart contract structure-Oracles
Functional	Energy Issues	PoW- cost of mining-waste of electricity
	Cost Issues	Transaction costs-cost of transaction-GAS-Cost
	usability Issues	user interface-comfortable-Acceptance-reusable
Organization	Complexity of the Business ecosystem	Changing the business model--Complex organizational processes-Organizational Structure
	Culture Issues Organizational Culture	Lack of support for organization culture-Resistance to technology-Change culture-Employer's irrational expectations
	competition with traditional technology	traditional contract-contract-Manual contract

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3.6. The Sixth Step: Quality Control in Meta-Synthesis Method

The researchers considered the following procedures to maintain the quality of the study:

1. Throughout the research, it was tried to take steps by providing clear explanations for the options available in the research; 2. Researchers used both electronic and manual search strategies to find relevant articles; 3. Researchers applied the quality control methods used in original qualitative research studies; 4. Researchers used the CASP tool to evaluate meta-studies for synthesis of the main studies.

Validity and reliability of the designed model consisted of 4 categories (domains) and 15 axial codes (concepts). After completing the meta-synthesis methodology steps, the designed model was presented in focus group meetings with 5 experts. During these sessions, both two levels of the model were examined and no changes were made. In fact, new dimensions and components were not added or removed, indicating the validity of the designed model. Since in the model design process, the criteria of the previous models were considered as codes and considering the semantic similarities between the codes, they were merged and concepts were created. The kappa indicator was used to measure the reliability of the model. In this way, another person (from elites) attempted to classify the codes into concepts, without knowing how the codes and concepts had been merged by the researcher. Then the concepts presented by the researcher were compared with the concepts presented by this individual. Finally, the kappa indicator was calculated based on the number of similar and different concepts created. As can be seen in Table 5, the researcher created 15 concepts, while the other person from the elite created 12 concepts, of which 11 were common.

Table 5. Calculation of Kappa Coefficient to Measure Model Reliability

		Researcher's Opinion		
		Yes	No	Total
Another Person's Opinion	Yes	A=11	B=1	12

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	No	C=4	D=0	4
	Total	15	1	16

$$Observed\ Agreements = \frac{A+D}{N}$$

$$= \frac{16}{24} = .68$$

$$Random\ Agreements$$

$$= \frac{A+B}{N} \times \frac{A+C}{N} \times \frac{C+D}{N} \times \frac{B+D}{N}$$

$$K = \frac{Observed\ Agreements - Random\ Agreements}{1 - Random\ Agreement}$$

Random Agreements= $\frac{12}{16} * \frac{15}{16} * \frac{4}{16} * \frac{1}{16}$=.01

K= $\frac{.68-.01}{1-..01} = .67$

As shown below, the value of the kappa indicator was calculated to be 0.67, which is in valid agreement level according to Table 6.

Table 6. Status of Kappa Indicator

Agreement Status	Kappa Indicator Numerical Value
Poor	Less than zero
Unimportant	0-0.2
Average	0.21-0.4
Suitable	0.41-0.6
Valid	0.61-0.8
Excellent	0.81-1

3.7. The Seventh Step: Presentation of Findings

At this step of the meta-synthesis approach, the findings from the previous steps are presented. The 30 articles selected by the researchers were carefully reviewed and the required information was identified based on the main purpose of this paper, which was to identify and group the challenges of the smart contract based on the blockchain technology and distributed ledger. The findings were categorized into 4 categories (domains) and 15 concepts (axial codes) after application of the expert opinions (5 professors of IT and

management), which is presented in Table 4.

Next page indicates the desired model in 4 categories (domains) and 15 concepts (axial codes) graphically.

Also, a summary of the model of challenges of smart contract based on the blockchain technology and distributed ledger is presented in Table7.

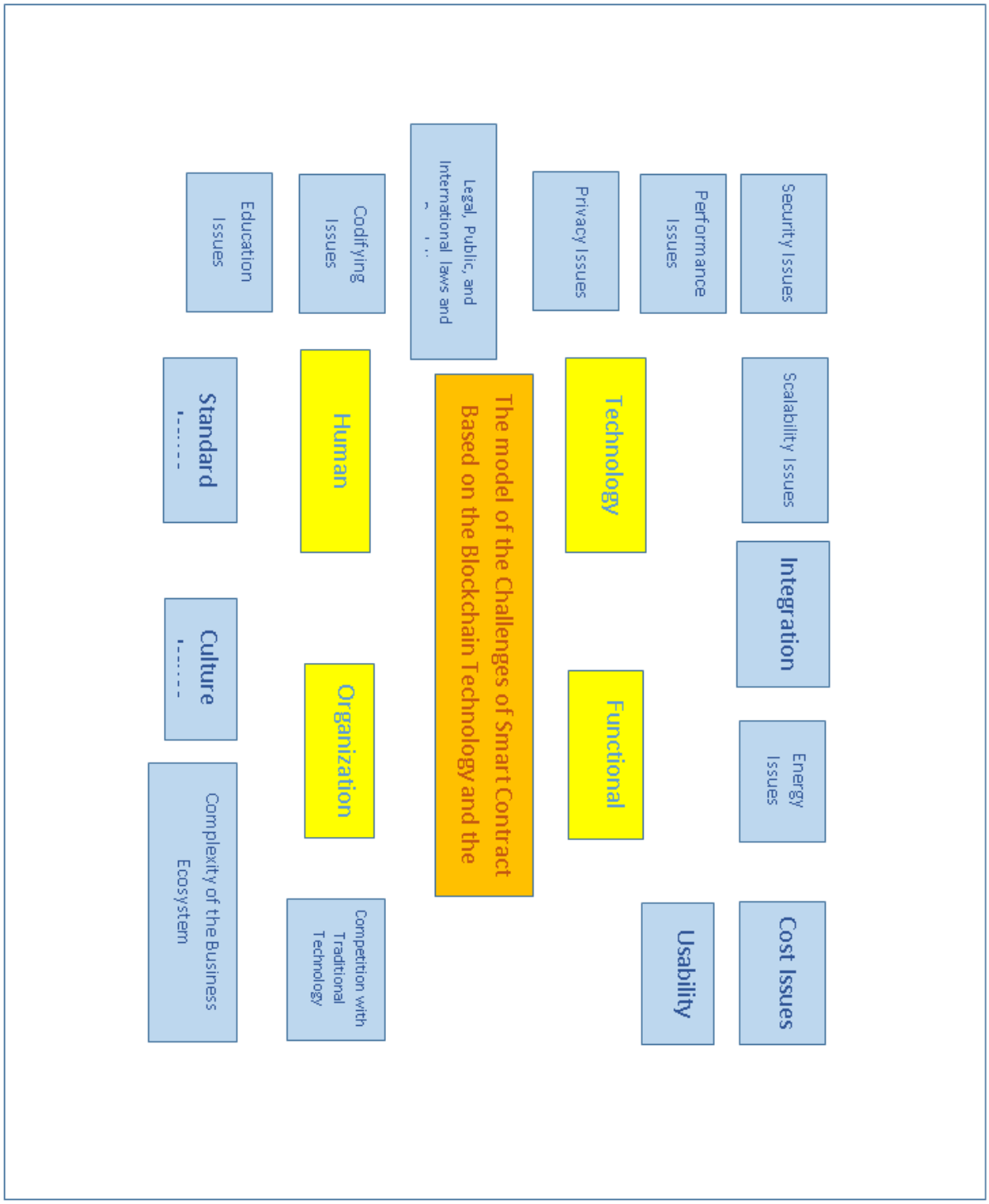

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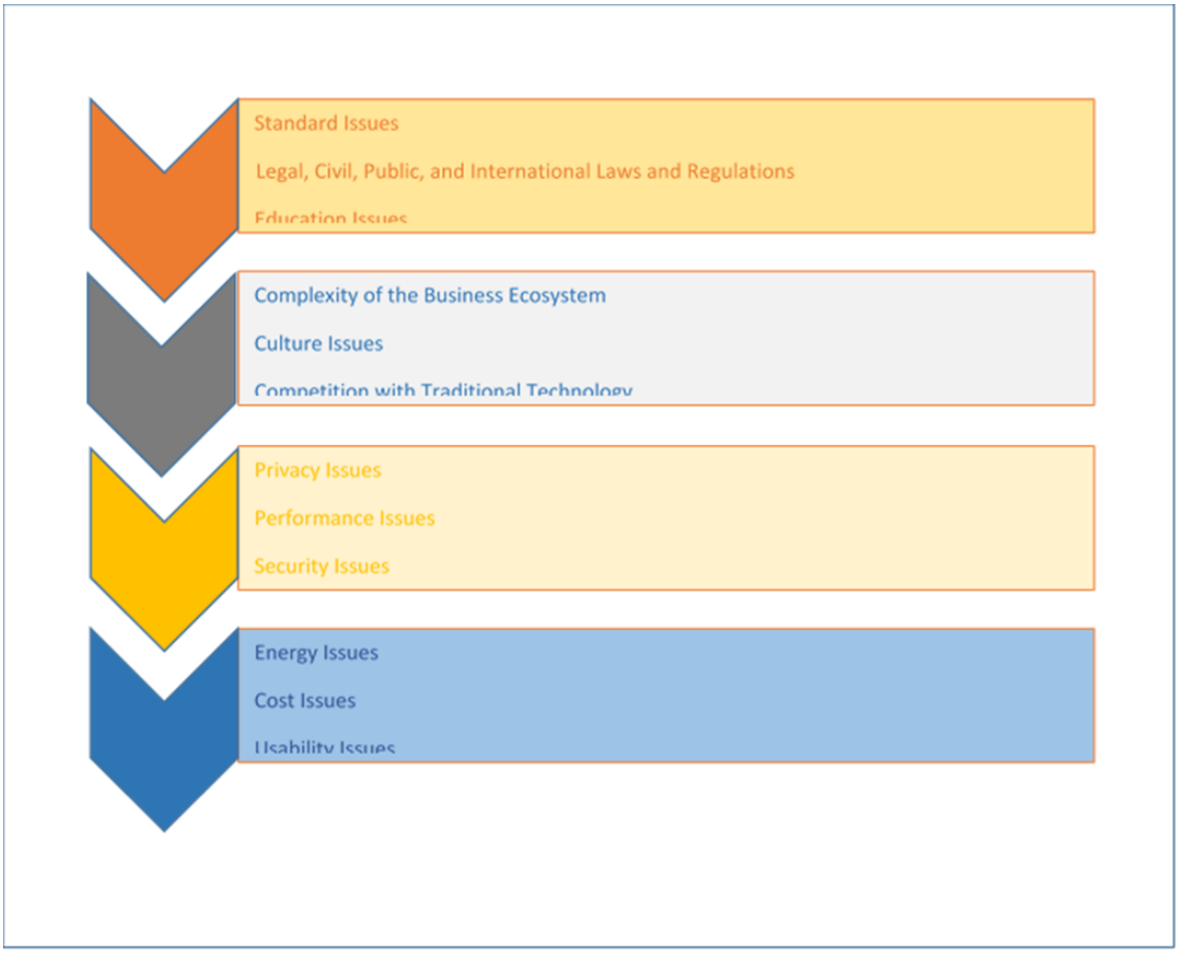
Table 7. Summary of the Model of the Challenges of Smart Contract Based on Blockchain Technology and Distributed Ledger



4. Conclusion

Meta-synthesis can lead to science generation through a systematic and novel method and also by careful investigation of the previous research. Given the growing future of blockchain applications such as smart contracts and the widespread use of smart contracts, it seems essential study the limitations and barriers to practical application of smart contracts and consequently provide solutions to deal with these challenges. In this regard, there is need for comprehensive and integrated research to systematically review past studies, provide interpretive perspectives and create new knowledge.

In this study, it gas been attempted to combine the qualitative findings of previous studies and different perspectives to present a comprehensive model on the challenges of smart

contracts on the blockchain platform and the distributed ledger. The study also has some limitations, most notably the lack of reliable sources and the limited number of experts in the field of smart contract.

It is recommended that at least technical, legal, educational and organizational infrastructures related to the implementation and realization of smart contracts should be set up as follows:

- Approving and assigning digital signatures to individuals and accepting its legal validity;
- Approving the laws associated with smart contract, domestic and international accreditation, and resolving legal conflicts;
- Registration of all documents and real estate in blockchain by state-approved cryptographic codes;
- Informing all members of the society about the legal process of the smart contract;
- Establishment of start – ups and knowledge-based companies related to smart contract to facilitate the creation and development of smart contract.

Based on the results of the study, the following suggestions are presented to other researchers:

- structural equation modeling to relate the identified categories;
- Using fator analysis to validate the model;
- Applicaion of fuzzy multi-criteria decision making methods to weigh and prioritize the identified factors;
- Using multi-criteria decision making methods to rank major factors;
- Using system dynamics modeling to analyze causes of factors in a systematic and fundamental manner and provide scenarios for solving it;

Using other meta-study methods to evaluate the results of research in this area.

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