

Blockchain Technology for University Diploma Certificate

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Keywords: Blockchain, University Certificate Diploma, Simulation Test, Blockchain for Publishing Certificate, Multi-Chain

Abstract: University Diploma certification is the valuable document published one time by university for student who graduated and never generated twice. The worthy of university Diploma Certification document brings a lot of changes for owner; therefore, many people try to falsify the university diploma certification. Several falsify university diploma certification founded by ministry of higher education in Indonesia for the last several years, and recently, this study tries to explore the new Blockchain technology as facilitator to solve the problem and due to the characteristic of Blockchain that immutable, peer-to-peer, distributed possible to apply. Several early studies found and reported theoretically, Blockchain technology is possible to solve the falsify university diploma certificate issues. Therefore, this business process simulation testing tries to explore the possibility of using Blockchain Technology for university certificate, McRhys model used as framework for publishing the university certificate diploma and the result of this study may increase the likelihood of implementation of Blockchain Technology to produce the university certification diploma that immutable and reduce the forgery of university certificate diploma.

1 INTRODUCTION

University certification diploma (UCD) that produce once by university is a valuable document for the university student for his/her future career and might possible to use for identity as well. The UCD might not likely to produce twice. Somehow, several people try to fabricate the UCD. In the last several year higher ministry of education in Indonesia was found and some technic to fabricate UCD found (Adiya, 2017) (Agriesta, 2017) and the similar case was found in 2015 as well (Linggasari, 2015).

Contemporary, the ministry of higher education in Indonesia is trying to prevent the fabricate UCD in the future. Blockchain technology founded by Satoshi Nakamoto (unknown as a group name or a person name) in 2008 (Nakamoto et al., 2008) that have characteristic immutable, unchangeable, distributed, peer-to-peer, consensus might be facilitated to solve the issues.

Early research reported that new Blockchain technology might be apply in several indus-

try such as enterprise system (Swan, 2015), Health/medicine (Vruddhula, 2018) (Syilm et al., 2018), Governance (Paech, 2017), Supply Chain Management (Kayikci, 2018) (Fernando et al., 2018) (Meyliana et al.,) and education as well (Palma et al., 2019) (Grech and Camilleri, 2017) (Devecchi et al., 2017) in education sector thermionically reported Blockchain Technology very possible to facilitate the issue of falsify university certificate diploma. This ongoing experimental study will focus on the usage of Blockchain for publishing UCD, the private and permissioned Blockchain called Multichain (Greenspan, 2015) used in this simulation test study, McRhys as a framework used in this study, especially part of publish process of university certificate diploma (Meyliana et al.,), this is research is a continuation of previous research who successfully create the McRhys framework, in this research will try to simulation of implement to one of Blockchain system and applications which is Multichain, the system and applications will use "asis" condition no modification has been made. The research tries to

explore the possibility of using “asis” Blockchain for university certificate diploma.

Focus group discussion have been made with several parties that capable in UCD production such as Rectorate unit manager, academic supporting unit manager, student registration and scheduling unit manager, academic operation manager, Student Advisory Unit manager. Thus, the study will show the result of using Blockchain technology to enhance the existing system to produce UCD become robust.

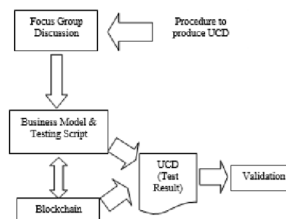


Figure 1: Research Design & Simulation Step

2 LITERATURE REVIEW AND METHODOLOGY

In this section will explain about Blockchain, Private and Permissioned Blockchain, Research Design, Business Process Simulation Testing, and Distributed monitoring and one-time process publish diploma certificate method.

2.1 Blockchain

Blockchain is a new technology found in 2008 by a person or a group that commonly known as Satoshi Nakamoto and since 2014 Blockchain with the smart contract feature makes Blockchain possible to implement or use for enterprise system (Swan, 2015), such as for Supply Chain Management logistic (Sadouskaya, 2017) (Marr, 2018) (Meyliana et al.,), health industry (Kumar and Tripathi, 2019) (Tseng et al., 2018) and Education sector (Palma et al., 2019) (Turkanović et al., 2018).

2.2 Private and Permissioned Blockchain

Many types of Blockchain contemporary, permissionless Blockchain it means no permission rules on the Blockchain system, for example, is Bitcoin apps where everyone can see the transaction, and everyone can write or perform the operation. The other types of Blockchain is permission Blockchain, where there is permission or rule that can be set on the Blockchain. For example, MultiChain (Greenspan, 2015) it means everyone can write or make the transaction, but only particular person that have permission.

2.3 Research Design

The stage of research in this study start with focus group discussion to discuss about procedure to produce UCD, the detail can be seen at figure 1.

2.4 Business Process Simulation Testing

Business Process Simulation Testing (BPST) is a part of Business Process Reengineering. BPST is a method used in this research. BPST is one of the green testing methodologies that use minimum resources; the result of the test considers reliable and similar to real. Steps for BPST start with an explanation of the system used, business model, and scenario of testing, testing result and validation (Rosenthal et al., 2018).

2.5 Distributed Monitoring and Onetime Process Publish Diploma Certificate Method

This study used Blockchain Technology to issue university certificate. However, to minimize the forgery of diploma certificate, this study used the Distributed Monitoring method and one time publish certificate diploma.

Blockchain with distributed ledger system will share the absent student activity, student course score, thesis final exam result to all related parties (student center, judicium unit, academic service) to be monitored before the diploma certificate publish, if the student meet all conditions and agreed by all parties then the student data and information will be transferred to judicium unit and the diploma certificate will only publish 1 time in life from judicium unit to university student. The process exhibit in Figure 2, where all parties link in Blockchain and its model is part of McRhys Framework (Meyliana et al.,). By using the method, the falsify of diploma university can be minimized and not controlled by a single department that may cause the fraudulence.

Figure 2 shows the McRhys business process to produce university certificate diploma, from student activities such as course registration, student lecturing activities and so on will be recorded in Blockchain, the other activities that will be recorded in Blockchain such as Lecturer activities such as lecturing, giving

score of exam, and all the activities will be validated by respective department, for example, scoring exam from lecturer to student will be verified by academic operation, study activity will be confirmed by academic service, thesis defense will be approved by Faculty office, Academic service. However, after student can fulfil all requirement than the graduation will be prepared, faculty office together with rectorate office, student advisory center, and student activity unit will arrange the necessary document required until university certificate diploma publish.

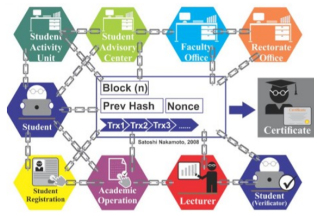


Figure 2: Blockchain Process to Publish Certificate

3 RESULT AND DISCUSSION

The environment of Blockchain laboratory will be described in this part from operating system usage, database, Blockchain setup environment. The procedure of this experiment is exploring the possibility of the design to fill the UCD information to Blockchain Database or field. In this stage, there is no communication or networking aspect has been discussed; web applications or mobile application will not be addressed or reported.

3.1 System Information of Operating Systems

An operating system is one of the essential parts. The Blockchain lab uses Ubuntu as an operating system and can be seen in Figure 3.

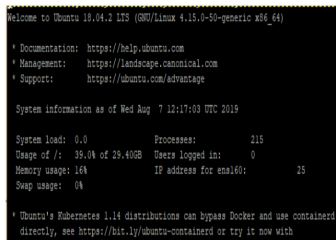


Figure 3: Operating System

3.2 System Information of Database

Beside operating system, another important aspect is a database, in this case, the Blockchain Lab using or-dinally database, which is an SQLite database.

3.3 Application Structure of a Node

My Node	
Name	devBeeBlock
Version	2.0.2
Protocol	20010
Node address	devBeeBlock@ 25:2881
Blocks	95
Peers	0
Connected Nodes	

Figure 4: Blockchain Node

The hierarchy of MultiChain is a node as a one Private Blockchain and is a node; there are many addresses can be created, and each address might possible to have an asset. In this Blockchain Lab, only single node applied in the server or single node. The picture captured from MultiChain dashboard menu, see in Figure 4.

Many addresses are possible to create in a node and address commonly known as pseudo-name that created by using hashing 256 technique, and in a single node, it possible to create many addresses.

In Figure 5 can be seen address and MultiChain allowed the set label to make it easy to identify the address, besides the Label, it can be seen the permission set for each address The last is an asset; asset can be transferred by assigned the ownership to address in this case address represent the university student see figure 6.

My Addresses	
Label	University NNNNNN - change_label
Address	17VwZVo5V69KusLCrJTfbpxnFwPmkuL8bVH
Permissions	connect, send, receive, issue, create, mine, admin, activate - change
Label	Student 1 - change_label
Address	1MrwjHwsSuzpFeELwTMnsRPFMYDtBuyf7FdQ1N
Permissions	connect, send, receive, issue, create, mine, admin, activate - change

Figure 5: Blockchain Addressees in Node

Figure 6: Blockchain Asset

3.4 Implementing Blockchain



Figure 7: University Certificate Diploma

In this part will show how Blockchain can be applied to produce UCD. From figure 6 is an example of UCD and there are eight essential fields found,

- Point 1 is paper number, is a unique number that represents sequence paper number.
- Point 2 is alumni number, is a unique number that represents of alumni number after graduated from the university.
- Point 3 is the student name, is a student name who graduated from the university.
- Point 4 is student number, is a unique number that represents of student number, used while studying in the university.
- Point 5 is a student date of birth, is a dateof-birth of the student.
- Point 6 is authorized signature, is a name of the authorized person that will give a signature on the university certificate diploma, for example, is a dean.
- Point 7 is rector signature, is an authorized person that will sign the university certificate diploma.
- Point 8 is ministry higher education certificate number, is a unique number come from the ministry of higher education,

Exhibit in Figure 7, it can be implemented with Blockchain in asset area, can be seen in Figure 6, where the field of the asset can be inputted with the information from UCD. By following this technique, all the information written on the Blockchain will be protected (hash), unchanged, and immutable. Figure 8 can be seen the asset field filled with the value of UCD such as paper number, alumni number, student number, date of birth, authorized signature person name (dean and rector), and the last is registry number from the ministry of higher education.

Figure 8: Blockchain UCD

3.5 Discussion

The benefit of the characteristic of Blockchain to produce UCD

- Immutable, by using blockchain technology the university certificate diploma will be existing forever started the date of the certificate published
- Unchanged, the data on the university certificate diploma will never be changed forever, and cannot be falsified
- Distributed, the one who has the ability to see the university certificate diploma will be able to see the UCD.
- Secure, by using Blockchain, the information is protected (hashing), and the Merkle Tree method applied using multiple hashing technique. Therefore, all transactions written on Blockchain will be secured. The value of each field, such as paper number, alumni number, student name (see figure 7), will be protected and cannot be changed and immutable or exist forever. No duplication UCD can happen.

Implementation of Blockchain in producing UCD makes the consistency of information, and the reliability of UCD can be ensured, protect the brand image of the university.

On the other hand, the limitation of the implementation of Blockchain for UCD has been detected as well, even though the project is running recently. The challenge found such as

- Duplication of data, where the data exist in the contemporary system and at Blockchain.
- Double posting, the data should post twice to ordinary database and Blockchain database.

3.6 Simulation Testing Result Validation

Validation is one of the critical parts of the simulation test to ensure the result meets with the requirement. The validation of testing result has been done by a university-related party such as vice-rector, rector of office that directly involved in this part.

3.7 Simulation Testing Exclusion or Challenge

The simulation testing will not cover system scalability; no customization has been made (use "asis" system). The several challenges found during the simulation test such as the recent business process need to adjust, cause the business process might not be possible to operate as Blockchain system characteristic such as no update or changes of data is allowed (except creating another transaction), integration between Blockchain system application and contemporary system used require plan, for example, the primary key and Blockchain address need to match. However, during the double-entry simulation, the strategy is applied or manual entry due to time constraint. Therefore, business process reengineering will be involved in the university operation in case Blockchain will be used in the future.

The lack of knowledge about Blockchain Technology as one of the challenges found during the simulation test, the many times explanation of Blockchain Technology had been done during the discussion, the recent system and application development method cannot apply directly into the Blockchain system and application, and database concept, such as distributed Blockchain characteristic it should be implemented carefully because of data secrecy referred for university certificate diploma (no duplication of certification number, student number, alumni number). Blockchain system application challenge, the standard Blockchain system application used in the simulation testing, not the enterprise Blockchain, the lower security mode used. Therefore, there will be a gap in the security process transaction (hashing calculation process) in the future.

4 CONCLUSIONS

This study of Blockchain for UCD is in the right stage. The next phase will be discussed for university student transcripts connecting to Blockchain with other industry that produces certification such as IBM, Microsoft, Oracle, etc. Besides that, the most important part is the connection to the Ministry of Higher Education as the center of certification registration in Indonesia. In this research, McRhys university model or framework is applied especially for university certificate diploma process. It can be used and adapted with Blockchain Technology, especially with Multichain Blockchain system and application. The simulation test represents the objective of the research yet not comprehensive in some aspects.

The distributed monitoring and one-time diploma certificate issuance are focused on Blockchain Technology. It functionates to minimize the falsification and fraudulence of university diploma certificate. At the same level, the department can mitigate the issue. Because of the inevitable changes of information in university, diploma certificate will be recorded in the Blockchain system and application; Any attempts to modify the field of the database will be protected by Blockchain mechanism. It implements hashing 256 and Merkle tree method that operated multiple hashing on each level of data in the database.

The scalability and time constrain of Blockchain Technology system need to be tested due to the vast publish of certificate diploma. The scalability might be changed in the future due to the Blockchain is in developing phases for an enterprise system to accelerate the process. The problem related to a fake certificate is possible to solve by Blockchain technology. The future research is required to improve the scalability of the system, infrastructure design, integration process between the new system, and Blockchain system application at the end.

Future study required to continue this research by putting some dummy data (for example, 25% to 50% of total in real graduated certificate diploma) that should publish in the same date and calculate the processing time consume by Blockchain.

ACKNOWLEDGEMENTS

This study is supported by the Directorate General of Strengthening for Research and Development, Ministry of Research, Technology, and Higher Education, Republic of Indonesia as a part of Penelitian Terapan Unggulan Perguruan Tinggi Research Grant to Binus University entitled “Implementasi Blockchain Platform Untuk Menciptakan “Good Governance” pada Perguruan Tinggi” or “The Implementation of Blockchain Platform to Create “Good Governance” in Higher Education” with contract number: 12/AKM/PNT/2019 and contract date: 27 March 2019.

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