



Integration of Blockchain Technology into a Land Registration System for Immutable Traceability: A Casestudy of Georgia

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Abstract. Land as an immovable property represents an important asset for which such crucial aspects evolve as ownership rights, security of land records, possible disputes, corruption risks and sundry transparency matters of land registry processes. Critical issues are traceability of records, hazards of document forgery as well as vulnerability to various errors. Delivering accountable land registry systems and particularly increasing validity of land titles is vital for present-day governments in terms of suppressing corruption, eliminating red tape, enhancing transparency, improving speed of the stated public service and eradicating risks of possible disputes. Furthermore, integration of the blockchain technology into land registries leads to achieving a disruptive transformation of public-service provision systems. This Georgia focused casestudy-based research ascertains how blockchain technology resolves the issues above concerning contemporary land registry systems and examines determinants for a successful application of the digital novelty. The findings from semi-structured interviews and document studies we analyze and scrutinize the present blockchain model of the Georgian government. Additionally, we provide recommendations for administering the blockchain-based digital solutions present in the public land registry service-provision system.

Keywords: Blockchain · Land title · Registry · Property · NAPR · The Bitfury Group · Georgia

1 Introduction

Contemporary technologies are constantly evolving and challenging societies [1,2]. Artificial intelligence, blockchain, smart contracts, electronic identities and many other advancements are actively being integrated into day to day government-citizen relationships [3,4]. With the evolution of information- and

communication technologies (ICT), state authorities are challenged to provide more efficient and effective services to citizens, yet guaranteeing a high level of data security, transparency, auditability, and privacy. Acquisition of information, transparent diffusion, secure storage and proper communication have become essential parts of present-day public sectors and ICT in this regard plays an important role in supporting proper functioning of governments [5]. The digital roadmap of the twenty-first century is constantly progressing and ICT advancements heavily influence the performance of present-day governments. ICT spurs innovation and in this sense can play a transformative role as well [6]. In many aspects these digital novelties might determine the course of actions of countries' developments too. The application of contemporary electronic tools to governmental operations and e-service provision systems possess the ability to create platforms for providing fast, transparent, cheap and convenient solutions to citizen related concerns.

Blockchain technology is a disruptive innovation with the potential to revolutionize the way governments and other non-profit, or for-profit organizations handle themselves, as well as how they communicate with collaborating parties. Technology creates a platform for the distributed governance and affects in every aspect the stakeholders' relationships via affecting the full spectrum of document processing, data storage, information exchange, power distribution, transparency and other crucial aspects of business processes [4]. In this regard, blockchain technology creates novel opportunities for governments to succeed in all respects of government-citizen relationships and support the provision of highly advanced services within electronic platforms. Thus, identifying prevalent challenges regarding the application of the technology to state services, possesses vast potential to further contribute to the development of public service provision systems.

1.1 Research Objectives

Based on the extended version of this study [7], our casestudy in this paper focuses on the land title blockchain project of the National Agency of Public Registry¹ (NAPR) of Georgia^{2,3} and examines the grounds of the given public service from various angles with the aim of providing wider insight about the project. Our research focuses on identifying challenges related to the application of blockchain technology to the Georgian state-service routine and discover recommendations. Thus, the main goals of the research are defined as follows:

- Evaluate the land-tiling blockchain project from the point of effectiveness and efficiency.
- Point out the project advantages and disadvantages.
- Propose a framework for the future development of blockchain technology within the same and any other state services.

¹ <https://napr.gov.ge>.

² <https://europa.eu>.

³ <https://www.consilium.europa.eu>.

We deem it relevant to clarify for the reader, even though the state of art of the blockchain technology can be endlessly discussed, this paper does not focus on the thorough analysis of the blockchain technology as it is the subject to a bigger scale research. This work intends to examine the blockchain-based solution deployed by the Georgian government within the land registry system and generate a set of recommendations for the further expansion of the project.

1.2 Motivation

We identify factors for the successful administration of blockchain technology and discuss the world precedent of an early adopter country, Georgia. This research is motivated by ascertaining how blockchain works for the public sector, to what degree the technology benefits the land-title registry process and to find what lessons have been learned so far. Determining the next development steps for improving the system is an additional incentive for our research.

The remainder of the paper is structured as follows. Section 2 presents related work and Sect. 3 describes the execution of casestudy-based research for this study. Next, Sect. 4 presents the case selection, subject selection and results of this study. In Sect. 5, we discuss the results related to its context. Finally, Sect. 7 concludes this paper and gives future work.

2 Related Work

Blockchain technology is deemed as one of the most disruptive and promising technological solutions to today's state operations [8]. Even though the technology itself is still immature [9], as the new layer of prevailing e-governments blockchains provide better accountability, trust, integrity, and improved performance [8]. Citation [9] suggests that blockchain technology improves various state operations even in those cases where there does not exist a developed e-government and "adequate technical-, or institutional infrastructure in place" [9].

Study [9] asserts that "ICT systems based on blockchain technology, implying decentralized management and control, offer more robust and flexible solutions that cannot be corrupted. Still, lessons learned from earlier efforts to introduce new technology underscore the importance of following a realistic, systematic approach". Thus, in [10], it is pointed out that applying blockchain technology to developing countries is essential in terms of defeating corruption and malicious activities. Furthermore, study [10] also emphasizes the potential of blockchain technology in terms of data-security enhancement and to support solutions where blockchain technology reinforces business processes within government [10]. Furthermore, "blockchain has the potential to render government operations more efficient by improving the delivery of public services and increasing trust in public sectors" [10].

The essence of blockchain adoption into state services is motivated by the economic benefit and various data security and validity issues [11] where blockchain

is a benefactor. The economically beneficial side for the state in case of administering blockchain technology for storing government records [12] is a promising secure tool along with offering cost-effective solutions for saving sensitive data. In comparison, administering blockchain technology might be very costly [11] and experimentation of the attractive operational solutions offered by blockchain might be inefficient for sole employment within the individual state agency context.

Blockchain can be applied to every area of the government operations where transaction processes take place [4] and as the one of most decently compelling arguments [4], “the fundamental characteristics of this technology enables an implementation in a wide range of processes for asset registry, inventory, and information exchange, both hard assets such as physical properties, and intangible assets such as votes, patents, ideas, reputation, intention, health data, information, etc.”

The role of blockchain in the land registries is particularly useful [4] for reducing risks of corruption and manipulation of land registry transactions as long as land ownership data is a very sensitive in terms of ownership rights. Blockchain is a useful tool to protect the land transaction parties, provide trust among the owner of land and a seller and yields authenticity of the land title records. Blockchain technology is currently applied [13] to various state services such as energy markets, education, e-businesses, and so on. The application of blockchain technology to land registries [13] is a useful tool for conducting land-related transactions, including “transfer of land or the establishment of a mortgage”. Thus, the capacity of blockchain-based solutions [14] facilitates providing the integrity of land records and data traceability for any audit purposes.

Paper [10] accentuates the empirical essence of blockchain-technology adoption as a government solution and argues that even though from the ICT perspective. The technological compatibility of blockchain to the existing information-technology systems are identified and beneficial aspects also are defined while less is known on the empirical challenges such as the regulatory frameworks of countries, managerial approaches, organizational studies, etc. Based on [10], empirical data shows blockchain-technology application to governmental and identifies the most applicable governmental sectors. The health sector is identified for applying blockchain to the management of patients’ health records, followed by the education sector. Authors [10] similarly to [9] also identify the financial sector be a potential area for blockchain applications while, additionally, public-private relationship areas and supply chain also benefit from the technology. Nevertheless, empirical, or practical evidence about blockchain application to state services [10] is lacking while the majority of approaches are theoretical and lack practical support.

3 Research Methodology

We explain next the methodology applied to the research in Sect. 3.1, discuss data collection methods in Sect. 3.2 as well as draw the readers’ attention to

the sample selection process for the study. This section also cover the design of the questionnaires for the semi-structured interviews and logic behind the semi-structured questionnaire that follows the idea of the study’s research questions for more comprehensive data collection purposes.

3.1 Casestudy

We choose casestudy-based research as the main method for attaining the empirical primary data about the study object as the passage [15] asserts that “empirical research implies to one’s experience and observations often without due regard for system and theory”. Such design helps in attaining a brief overview of the property-registry blockchain project of the Georgian government and gives an opportunity to analyze the topic based on this factual example. The unique nature of the casestudy design provides more opportunities for exploring the subject and as scholars [16] note, “case studies offer an approach that does not require a strict boundary between the object of study and its environment”.

As long as the government of Georgia is a pioneer state in the successful application of blockchain technology in public services, casestudy design is a competent method for briefly exploring the implemented project. As research questions, we examine how blockchain technology contributes to the public service-provision process of Georgia in the context of the land-tiling project framework. Furthermore, our research follows the path of the main study question of how blockchain fits into the narrative of contemporary e-service provision systems of the Georgian government? What are the main criteria for evaluating the project? How does blockchain technology affect the public service provision system?

3.2 Data Collection

Our research is qualitative and entails data collection methods both from primary and secondary sources. Study [15] explains the primary sources refer to collecting data for the first time and is mainly deployed for studying of not yet researched topics. The secondary data-collection method, on the other hand, gives opportunities to explore topics that have already been studied once. On that account, the research applied to the primary data collection method via interviews and, in addition, for diversifying the data, we apply document analysis to the research as a secondary data collection method.

Interviews: Semi-structured interviewing style is applied to the paper as the means for the exploratory studies to help gain comprehensive information about the study topic and to understand the respondents’ perspectives to the study object [17]. First-degree, primary data is acquired within the interviews and this feature stands out as a remarkable characteristics of the interview-based data collection method in terms of producing valuable output for the qualitative studies [18]. More enhanced explanations about questionnaire design, sample size determination and data analysis procedures are provided in the next sections.

Document Review: Alongside the interviews, document review as a secondary data collection method is also applied within the given paper in order to expand and diversify data. Such a method applies to different types of documents, in light of evidence from the study [19], and includes both printed and electronic sources. This process of data collection explores information for the study object via the content of the respective documentation. One of the main advantages of employing such a data collection method in parallel with the interviews is that documents related to study questions match with the agenda topics that are not mentioned by the interviewees. As quotation [19] suggests, “document analysis is often used in combination with other qualitative research methods as a means of triangulation with the combination of methodologies in the study of the same phenomenon”. Therefore, more comprehensive results are expected to be attained within a combination of the interview and document review-data collection methods.

Survey-Sample Selection: The sample size for the data collection is eight respondents. Among the interviewees are the stakeholders of the land tilting project, both from NAPR and the Bitfury Group, who either used to work on or are currently implementing the project under investigation and include former head of the National Agency of Public Registry, current lead of the Project Management and Sales Department, present head of the Working Component of the Information and Communication Technology Development and a Software Maintenance and Development Engineer of the agency. Moreover, respondents from third parties such as experts researching blockchain technology and those developing technology in the private sector are interviewed to attain impartial and unprejudiced information. This eventually results in collecting the unbiased and more easily populated data. All the interviews are conducted remotely, between the period of March–April 2019 and for more detailed description we refer the reader to the master paper [7].

Questionnaire: In order to attain comprehensive answers to the study questions, the interview questionnaire is constructed based on the main research and sub research questions, respectively. For the logical flow of the interview process, questions are initially grouped into logical units such as the set of the open-ended questions related to understanding the respondents’ backgrounds and their competency with regards to study object, as well as questions to attain respondents’ evaluations of Georgia’s prevalent public administration system. The set of questions are designed to specifically explore the preliminary researches conducted before launching blockchain into the land registry system. This part is followed by questions about the outcomes of the project and the respective metrics for measuring the results. The questionnaire also addresses the topic of stakeholders and their roles in the project, whilst the final set of questions draw attention to the prospective application of blockchain technology into state services. Furthermore, a semi-structured interview style we deploy for attaining the versatile insights on the study objects.

Finally, interview results are analyzed via elaborating tool-based data analysis method. Therefore, we employ one of the Computer Assisted/Aided Qualitative Data Analysis Software (CAQDAS) tools, such as the open-source R package qualitative data analysis tool - RQDA project⁴.

4 Case Selection, Subject Description and Result Presentation

Given the extended version of this paper in [7], Sect. 4.1 provides insights towards the case subject and briefly describes it, whilst in Sect. 4.2 results of the research are presented into two main parts that draw attention to the identified requirements necessary for adoption the blockchain solution into land registry states-service systems. Hereby needs to be mentioned that even though the recommendations are drawn based on the reviewed documents and academic literature, our proposition still has to be tested and validated. Finally, but importantly, the second part of the chapter explains briefly how conventional blockchain solutions operate in realtime state land-title operations.

4.1 Case and Subject Description

The land-registration process in Georgia is fully administered by the NAPR. At the present time, the land-registration process takes from one to four days and is almost a fully digitized service. As the most IT advanced public authority in the country, NAPR constantly strives towards enhancing the services through accepting contemporary digital challenges. One of the main, yet fully unleashed technology is the blockchain and NAPR decided to adopt for the implementation of this digital platform to increase the overall performance of the agency and improve the quality of the e-services and particularly address improvement of the land title service. The agency started exploring the technology in 2015–2016.

Existing threats on data security, such as cyber-attacks and data breaches, are the incentives that play a major role for NAPR in adopting blockchain technology along with enhancing the existing registration model of land titles and eliminating the possible risks of corruption. Red tape and corruption in the state services are the legacy that Georgian public administration system is left with after the collapse of the Soviet Union and blockchain technology provides opportunities for addressing the aforementioned issues as well. Land titles are digitally provided since 2006, thus, a fair base for implementation of blockchain technology already exists. By integrating blockchains into the administration of land titles, NAPR discovers a way to move from a centralized model of data management to a decentralized one. In this regard, all advantages are inherited from the blockchain's essence of a distributed ledger technology, rendering transactions simultaneously available for peers to mine, check, save and validate.

⁴ <http://rqda.r-forge.r-project.org>.

NAPR partners with the Bitfury Group⁵, a worldwide blockchain development company. Specialists from both organizations, the Bitfury Group and NAPR develop the project whilst NAPR is responsible for the content provision and Bitfury for the implementation of the blockchain technology itself. In order to harmonize with the existing system of property registry along with the respective legislation, both organizations agree on the creation of the “add-on” layer over the existing system. Thus, the process of the immutable and traceable property registration remains unchanged, while one more layer of the blockchain is built on top to store land titles on the blockchain. At present, the entire process of land registration lasts up to four working days, while transferring the first-hand land titles from NAPR’s database to the blockchain requires roughly 10 min.

4.2 Result Presentation

Requirements Necessary for Further Blockchain-Technology Adoption: We thoroughly analyze the data from various sources such as interviews and internal documentation as well as provide insights for the cases of Sweden, Dubai and The Netherlands [7]. Thus, general recommendations for adopting blockchains into land-registry systems we summarize as follows:

- Governments must focus on the goals and final outcomes they intend to reach by administering blockchains. Therefore, governments must initially decide the scope of the services where blockchain technology is applied and, based on the needs of the government, must initially determine which blockchain solution is preferably and the most suitable for the country.
- Public-private partnership is conducive for the successful application of blockchain technology. Therefore, agencies that are specifically working either on the development of blockchain technology, or on the development of digital ID systems, as well as agencies working on business-process automation processes, must be involved from the start.
- Legislative frameworks need to be reviewed and necessary amendments implemented to assure the compatibility of blockchains with local- and international regulations.
- Citizen awareness with respect to the technology must be raised before launching blockchain technology to ensure that customers, citizens trust such novel high-tech e-services.
- In order to eliminate present manual processes in land administration services, new operational schemes have to be defined where manual work is no more persistent.
- Governments must continuously investigate blockchain technology to accentuate the research and development side of such projects.

At the same time, major aspects identified within the research that support the adoption of blockchain technology specifically in the Georgian ecosystem, we categorize as follows:

⁵ <https://bitfury.com>.

- Having a developed e-government is one of the biggest benefits to face the challenge of blockchain adoption. This element is also identified as a major support factor for the successful implementation of the Georgian land-titling project. Based on international rankings, Georgia shows significant results in the advancement of e-government development as also previously also discussed in the extended version [7] of this paper.
- Public-private partnership is a crucial aspect for blockchain-technology adoption. In case of Georgia, the Bitfury group develops the blockchain solution for the government and since then keeps providing the service. The same applies to other adopter countries as well where occasionally even several private-sector companies provide the solutions for integrating blockchain technology into existing land-registry systems.
- The legislative framework is a crucial aspect for the successful integration of blockchain technology. In case of Georgia, the project success is greatly determined by the flexibility of the respective regulations that do not hinder NAPR from saving the citizens' data on the blockchain. In cases of other countries such as Sweden or The Netherlands, for administering blockchain technology into the public service, major regulatory changes are required.
- Research and development activities are equally an important element for blockchain-technology adoption. Having previously determined what obstacles stakeholders face within and after blockchain adoption, helps to provide more effective and efficient solutions. In the case of the Georgian government, one of the respondents admits that after the completion of the pilot project of the land titling “blockchainisation”, NAPR sees the need for conducting research about the legislative framework of Georgia for supporting the further development of this blockchain project.

AS-IS Model of the Land Title Blockchain System: Based on the data collected from the public agency's records, documents and the interviews combined, to better understand the existing administration system of the land-titling of Georgia, we develop a corresponding business-process model. This blockchain-induced process comprises the following steps:

- Initially, seller and buyer physically pay a visit to the NAPR's local office for allowing the NAPR agent to visually verify the identities of both parties and submit a joint application for the registration of transfer.
- A PDF (land title doc) extract is generated at the registrar's desktop client application.
- This PDF is sent to the NAPR's database where the servers are maintained by the agency itself for signing the document digitally so that the offline PDF document is secured from data tampering.
- A digital signature-integration service via software for digitally signing PDF documents and placing a time stamp on them, requires new PDF documents from databases. Consequently, a file is ready for signing: In case there are specific factors restraining either seller, or buyer to execute a purchase then the document is ejected from further processing and at this point, the land

tilting process is over. Therefore, no document is sent to the blockchain. In case the transaction is bona fide then the processing continues.

- The digital signature-integration service sends the document for signing to the digital-signature Service.
- Via the digital-signature service, it is possible to sign the document. This task requires several sub processes to be complete such as:
 - The hash of a PDF file signature is generated.
 - The signature is added to the PDF file that is signed digitally with the private key held by NAPR only.
 - Third-party timestamp is applied to the document.
- The signed PDF file is sent to a Blob storage and saved permanently. Blob is a server owned by NAPR and files preserved at this storage are immutable, i.e., they can not be deleted or edited.
- Upon entering the document into the Blob-storage blockchain, a gateway executes a transaction to the bitcoin blockchain where a transaction is hashed and validated by bitcoin blockchain miners. This phase consists of several sub processes such as:
 - The gateway reads the newly signed files from the Blob storage and generates hash code of every single file.
 - The gateway creates a Merkle's Tree of hashes.
 - A new bitcoin-transaction object is created that contains the Merkle's Tree root hash.
 - The transaction is sent to the bitcoin network for validation.
 - Bitcoin miners verify the transaction, which involves producing a hash-based (SHA-256) Proof-of-Work (PoW).
- Once the transaction is validated, it is equally published on NAPR's publicly available webpage⁶.

Figure 1 below is a graphical representation of the current land-title blockchain system of Georgia. The full version of the AS-IS model is represented in Appendix 6 of the original research paper [7] that we can not include here due to page limitations:

Figures 2 and 3 represent the sub processes of the following phases: “Digital signature service signs the document” and “Blockchain gateway makes transaction to Bitcoin blockchain”, respectively.

Having the business process graphically displayed is important to analyze the possible drawbacks of the existing system. The given blockchain solution is applied to the land-titling existing system in a shallow sociotechnical way, i.e., the business model of the system is not modified, but the existing digital solution is improved by adding the additional blockchain layer to the land-titling process. This contradicts the extensively discussed [7] state of the art for blockchain technology in terms of decentralization, distribution and disintermediation. Thus, in Georgia the goal remains to centrally control the citizens' data under the authority's sub-ordinance and consequently, the blockchain gateway undertakes

⁶ <http://www.napr.gov.ge>.

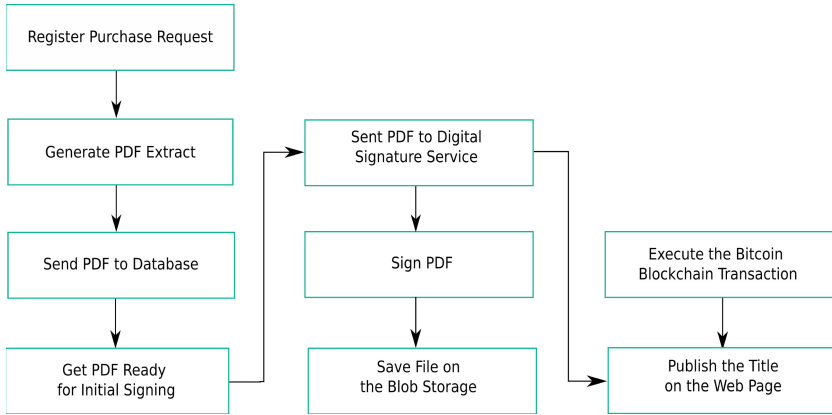


Fig. 1. Land-title business process.

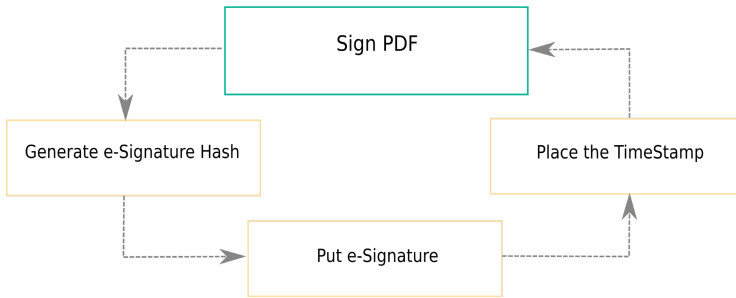


Fig. 2. Sub-processes of the phase “Digital signature service signs the document”.

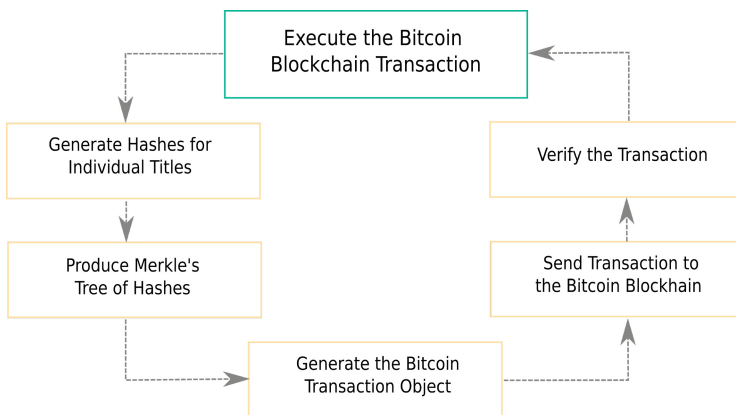


Fig. 3. Sub-processes of the phase “Blockchain gateway makes transaction to Bitcoin blockchain”.

the transaction on the blockchain merely technically while other security risks of data tampering remain.

We stress based on the currently existing AS-IS model that the blockchain solution is applied to the existing business process merely as a shallow applied “add-on” service. Thus, it is difficult to estimate how this blockchain solution benefits the cost-effectiveness of the existing land-title registry process. On the other hand, as long as the transactions on the bitcoin blockchain have their fee determined by the value of the cryptocurrency, the land-title registry process as an e-service, is an even more expensive process. It would be the best option for the government to re-engineer the business process instead of applying a new digital solution to the already digitized services. Currently, the cost- and time-saving aspects of sociotechnical blockchain adoption are ignored.

5 Discussions

Based on the analysis of the data attained from the respondents, we postulate the following assumptions. Even though all the respondents in unison agree that the project is successful and praise Georgian government for supporting this project, there are drawbacks of the existing project. This project carries high risks of failure and it is unclear what outcomes to expect. Thus, the success of the project heavily relies on the blockchain expertise of the Bitfury Group and the expertise of NAPR in administering the electronic public services.

Upon reviewing the documentation and conducting the interviews, we do not detect specific metrics for evaluating the project results. As pinpointed within this research, the main achievement of the project is an increased safety and security of citizens’ data, as well as increased transparency and data traceability. As to the quantitative metrics, or cost-effectiveness analysis, this aspect remains vague, as per the respondents’ feedback. Thus, the blockchain solution does not yield tangible results in terms of cost efficiency. On the contrary, supporting this “add-on” service requires more funds than the land title service incurred before adding a blockchain layer.

Another project drawback is that the given blockchain solution is not integrated into the land-titling service itself and merely an “add-on” service on the existing land title registry process. Thus, the land titles are still registered as before integrating blockchain technology. Therefore, the current blockchain solution is merely an advanced “archive” platform for data storage while advantages of a deep sociotechnical blockchain adoption remain ignored.

After reviewing the current model of the land title, a weak point to stress is that the existing blockchain adoption still leaves room for possible data tampering with social engineering attacks⁷. As one of the respondents also stated, theoretically, citizens’ data can be amended before a title is transferred to the immutable blockchain storage.

⁷ <https://resources.infosecinstitute.com/common-social-engineering-attacks/gref>.

6 Limitations

Limitations also apply to the research, based on the state of art of casestudy designs, as such deployed methodology is useful for the casual and explanatory inquiries [20]. Generalizability capacity of case studies are limited and can also be a drawback as due to a highly context-specific nature they might be limited to only the study-object context. Intensive use of the empirical pieces of evidence attained within the casestudy research may also lead to overly complex theory [21]. Casestudies are limited to generating the hypotheses and in light of evidence from the study [22], underline they struggle “to summarize and develop general propositions and theories based on specific case studies” [22]. With respect to the limitations of casestudy research methodologies, most relevant to the current research are the following:

- Due to the limited scope of the research topic findings of the single casestudy might not be applicable to the other state services neither within Georgia nor in other countries.
- Opinions of the respondents employed at the NAPR as well as at the Bitfury Group could be biased and therefore, might not reflect the objective reality. Therefore, there exists a possibility that some aspects around the study object are unleashed, or vague as a limitation of the paper.
- Sparse data about other blockchain adopters can be deemed as a minor limitation as well. Even though paper provides an overview of several countries besides Georgia that are also integrating blockchain-based land registries, more nourished comparisons to the study object could be drawn with more thorough examination of the other adopters.

7 Conclusion

This research examines a land-title project of Georgia by analyzing primary and secondary data sources such as semi-structured interviews with stakeholders of the aforementioned project and the project-related documentations respectively. For this blockchain-supported land-title process that we also graphically represent, the main benefits and drawbacks of the status quo are determined. Additionally, cases of other early blockchain adopter countries are reviewed for specifying final conclusions that facilitate the adoption of blockchain technology in the public sector.

Assuming the application of blockchain technology increases the overall government efficiency and improves the quality of service-delivery processes, it is important to determine additional incentives for government to adopt blockchains in public administration processes. Besides the aspiration for Georgia to portray a high e-governance development standard, reducing project risk for the government by initiating public-private cooperation is identified as a major incentive. Additionally, in the Georgian case, costs of the project along with the technology maintenance expenditures are covered by the private blockchain service-provider company.

In the course of this research, specific quantitative metrics for evaluating the efficiency of the project we can not identify while main metrics for characterizing the technology application within the land registry state service are the increased security for possessing sensitive data of citizens and boosted transparency of government activities. Blockchain technology has the potential of reducing data tampering risks, increasing security and safety of the state records, along with providing decentralized governance that Georgia intends to exploit in the future of the land-title project. Currently, the land-title service does not transform the business-process models and is merely added as an additional service layer.

We identify as future work the need for guiding the land-title project towards a deep adoption of blockchain technology that triggers sociotechnical changes such as a considerable optimization of the currently existing business processes. In an optimum case, such deep adoption results in a complete automation of land-titling for taking maximum advantage of the cost-cutting and time-saving potential of blockchain technology. We understand the implications as the consequence of full automation is a near complete redundancy of the current employees coupled with the need of stakeholders to employ state-of-the-art paperless technology for land-title management.

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