A Review of Literature: Modelling the Operability of a Micro-chip E-ID Possibility in Botswana - The Inclusiveness of Big Data and IoT

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Abstract: **The technological and digitization of 4th industrial revolution is wildly pacing and persistent. It cannot be stopped, and this revolution is spurred by the people's desire to lead a better and easy life. The Covid-19 pandemic has hastened the upsurge of automation, digitalization and the inception of the fifth industrial revolution (5IR) resulting in Botswana seeing a prenominal increase of 269% in the uptake of fixed bandwidth services and up to 55% reduction in mobile broadband prices post Covid-19 together with an establishment of data centers to enable cloud storage for businesses. As countries cross over to the digital domain of long set digital transformation visions, methods of asserting our national identity need to transform to support the journey, hence, adding value to sustainable economic development. This paper reviews a list of literature using the theoretical and systematic reviews on the current identity practices and modelling a micro-chip electronic identification (E-ID) implementation with the inclusion of Big Data and internet of things (IoT). This paper offers an insight into the feasibility and technological aspects of this potential identity solution. This review of literature was done in particularly with a search technique of "E-ID implementation", which aims at examining what other existing literatures have embodied the various aspects associated with E-ID implementation alongside the methodologies and frameworks applied in the process. Based on the analysis of scientific narratives, which will, as well map out and model variables to measure and how to expect them to relate to one another will guide and align the current author PhD research process on the topic "Modelling the Operability of a Micro-chip E-ID Possibility in Botswana - The Inclusiveness of Big Data and IoT". The review is established on the systematic database searches and it includes peer reviewed articles, journals and papers published between 2017 and 2022.**

Keywords**:** *Micro-chip, E-ID, Botswana, Big Data, IoT*

I. INTRODUCTION

Botswana, a country with a population of 2.352 million people, does not have a digital identity card (e-ID), instead have an analogue machine-readable laminated card barcoded using biometric (finger, print, and photo). This multifunctional analog-ID card is fundamental, and holders utilize it to access most services offline. Nonetheless, the national identification is linked to a number of government entities for asynchronous identification of person identity, individual data, and service delivery. [1].

This study aims to comprehend or establish the revolutionary potential of digital identity in achieving Botswana's sustainable development objectives in terms of, (1) an analysis to IoT inclusion-Botswana bandwidth algorithmic analysis in terms of quality of service (QoS) and quality of experience (QoE) for all nine districts in Botswana, (2) an analysis of the Big Data-Botswana data centers storage capabilities in anticipation of more than 2.352 million data mining structures, (3) an analysis of ICT skills in Botswana to sustain or support the e-ID implementation, (4) A model for e-ID implementation will be proposed and discussed.

This study is motivated by the current various Government offline services access and distributed systems causing duplication of data and slow public and private services. In all the distributed national services, identity is the primary verification and validation of the offline services. The Botswana's National e-Government Strategy, the Smart Bots action plan and the Government's RESET agenda [2] are also the motivation to undertake this study to examine and analyze beforehand, the different aspects affecting E-ID implementation before any Government digitization implementations in order to apprehend how other nationalities implemented the E-IDs to learn from.

II. RESEARCH HYPOTHESIS

It is therefore hypothesized that, to realize the possibility of implementing smart microchip e-IDs in Botswana as an

dependent variable, the broadband algorithms (IoT) capability, data structures mining extraction (Big Data) capability, relevant ICT skills independent variables should meet the requirements to explore the model of implementation. Below research questions were formed:

RQ1: With the inclusiveness of Internet of Things, does Botswana broadband capability or status and internet usage enough to host "the e-ID things"? (Models and Algorithms to measure internet/broadband feasibility).

RQ2: Does Botswana have the facilities capable of hosting e-ID big data structures securely and optimally? (Possible storage measurements predictions based on population and data structures mined algorithms).

RO3: Does Botswana have the relevant IT personnel capacity available to implement and support the microchip e-ID?

III. SIGNIFICANCE OF STUDY

Through the comprehensive analysis and modelling of this study, the Government of Botswana, other governments and the private sector will benefit a foundational analysis or base of core aspects of its future E-ID digital transformation which are aligned to the Government digitization strategies, plans and agendas. The digital ID systems will also play an essential role in reducing redundancy in terms of the resources and effort required to provide identification across various government agencies or services. This advantage will almost certainly lead to several nations studying, approving, and using the same technology in the near future.

This research study will make some important contributions to the Botswana Communication Regulatory Authority (BOCRA) in terms of IoT analysis and data centers capability analysis, which is a government agency founded under the Communications Regulatory Authority Act, designated to govern Botswana's communications industry, which includes telecoms, the Internet and information and communication technologies (ICTs). The same benefit will as well contribute to Botswana Fiber Networks (BOFINET) which is a wholesale provider of national and international telecommunications telecommunication infrastructure in understanding the requirements for e-ID transformation.

The ICT Skills analysis required for e-ID Implementation will benefit Ministry of Employment, Labor Productivity and Skills Development and Human Resource Development Council (HRDC).

IV. METHODOLOGY

For the current paper, Qualitative method over existing peer reviewed literatures and documents reviews within the five year range was used to identify the existing identity practices in Botswana and globally.

For future work, interview guides and desk/documents reviews at department of Immigration and Civil Registration and some global literatures will further be reviewed throughout the PhD study. To examine the current Botswana broadband and Data Centers capabilities, Qualitative embedded over descriptive qualitative [10], [11] will be used in the study through interview guides, questionnaire survey and documents reviews at Botswana telecommunications bodies and data centers. The possibly e-ID model implementation will use an exploration and modeling approach over document reviews and case studies. The study sampling will be a non-probability-purposive sampling [12] with less than 35 participants per target population. Content and Thematic data analysis will be used further in the study using SAS analysis tool.

V. RELATED WORK

In the amount of electronic identity digitization implementation research literature, there is a scarcity of examples of reviews on smart micro-chip e-ID mapped to IoT and Big Data. This is due to the fact that the micro-chip e-ID implementation is a comparatively new or future development in which digitization is only evolving in several nationalities [3]. As a result, there has been moderately limited consideration from researchers on Micro-chip E-ID exploration with big data and IoT dependencies rather studies looked Radio Frequency Identification (RFID) and Smart e-ID models in countries that implemented the E-IDs. There have been several researches pointing to electronic government (e-Government), electronic records (e-records) management instead. Under the context of Botswana literatures, there were none of the studies covering the E-ID implementation within the 2017-2022 range and beyond, rather the e-Government studies were done.

Nonetheless, several governments realized the gap identified by the traditional identity solutions, whom in turn closed the gap by implementing several models to address gaps caused by the traditional identity practices. [5], [6], [19], discussed and proposed the evolving Smart Card ID with viable technology ID card to do away with carrying multiple cards by an individual. Authors further stated that the technology will assist governments across the globe in better administration with cost effective solution for multiple application single smart ID cards.

The current research further aims at examining Botswana bandwidth capability or quality of service (QoS) and quality of experience (QoE) algorithms together with examining the data centers big data structures capability to realize the gaps drawn by lack of QoS and QoE capability analysis reports. The bandwidth and data center capabilities are independently linked to e-ID implementation variable. The dependencies of E-ID implementation was brought to picture by [19] by stating that management of a large database with processing and scalable

computing to home on desired ID. Data centers handling these big data are contributing in reducing the delay and costs in data processing and improving the quality of service to include certain discrete services using internet based services (IoT). The Scholar in [20] reminded that the world have entered the age of Omnipresent computing. This means that an increasing number of objects "things" incorporate a microprocessor and can connect to the internet hence the need of micro-chip cards.

Despite the scarcity of e-ID implementation in this research context, authors in [4] at Osmania University, Hyderabad, India devised a study in execution effects of E-ID Device in Smart Campus using IoT, in which they investigated the target population of students and staff's health and employment data being closely watched with the help of E-ID device using IoT platform [4]. The researchers implemented an E-ID device for all university employees, including students [4]. The researcher further connects the E-ID to IoT and Big Data by investigating the connectedness of all the records on an IoT environment, in which the campus is referred to as a smart campus. [22], perceptions indicated that data centers are becoming a predominant ICT industry due to the rapid growth of Big Data applications, the Internet of Things (IoT), 5G, autonomous systems, Block chain, and artificial intelligence (AI). In this regard the authors in [4] provided a foundation for this study because they employed all the relevant independent variables of the current research though limited to a campus.

An E-ID design and analytical model can be built using an IPv6 model on Indonesian Kartu Tanda Penduduk **(**e-KTP) registering and use of one IPv6 model on e-KTP registration using IPv6 IP address as discussed by researchers in [5] through an exploration and modeling study. The researchers depicted the most prevalent identification and authentication methods, such as using ID cards to interact with any public service, online buying, and other transactions [5]. However, the research is limited to the IPv6 model exploration and does to explore further any Big Data structures aspect as explored by researchers in [4]. [23], argued that the major digital identity management models that are in use today are the Silo Model, User-Centric Identity Management Model, Centralized Identity Management Model, and Federated Identity Management Model.

A researcher in [6] in India conducted a study that investigated the Global Smart Card ID Using RFID by realizing rapidly increasing global mobility for universal validation, which is a phenomenon of just using radio-frequency identification (RFID) as well as technique is applied for identity information in e-passports and other applications. According to the researcher in [5,] in order to account for the spanning the globe Identities, an IPv6-based addressing mechanism for identification registration as well as access to data of every people throughout the globe must be utilized. The researcher in [6] discussed the state of the art technologies being Internet of Things and Big Data. The research covers a global perspective as compared to this research which aims to a lower level of a national case study.

The final objective of this research is to create a model that can be offered for an E-ID design and implementation under Botswana context. The authors in [9] created a digital identification concept for electronic financial services in Zambia. The digital identity at both the national level and banking level can however be related despite the levels. The authors of [9] employed the mathematical modeling that was reviewed and assisted the authors in developing an identity model based on Shannon's Cognitive science and Euclidean measure centered on Euclidean Distance Geometry used mostly for quantifying, applying, and evaluating retrieved identity features. The authors investigated identity credential token extraction using data mining techniques to extract identification credential attributes, which are undoubtedly the most appropriate data structures extractions to explore further in the current study. The banking smart cards makes the obvious place to start when building a national e-ID system. The current study aims to apply approaches that have been tried and proven in countries that have already established and implemented the E-ID in order for them to be valuable to Botswana's advancements in the advancement of the digital society and e-government. However, the study intends to use the E-ID system used in Indonesia, where microprocessor chip technology requires every candidate to always have their fingerprint scanned, authenticated, and recorded in a central storage facility. Furthermore, the fingerprint data will be recorded with in microprocessor chip smart card. Because this is highly sensitive data, various security procedures must be established.

The authors of [14] stated that in order for the smart e-ID card to be effective, a mutual authentication procedure among smart e - ID card readers/terminals and advanced technological identification card is required before any transaction can take place. Using cryptographic techniques, algorithms, and keys, the procedure authenticates both parties and demonstrates that they are allowed. Due to the growing population of Botswana, the IPv6 model in [5] will be utilized to register electronic identities. According to [15],[16], IPv4 Internet addressing techniques only can address 4,294,967,296 hosts globally or 232 with an overall length of 32 bits, but with the introduction of IPv6 addressing progressively increases network address with a total length of 128 bits or 2128 or 340,282,366,920,938,463,374,607,431,768.. This will benefit Botswana for scalability of population growth identity registrations and merging with the global E-ID implementations without issues. The IPv6 model made an interest to take a study which will model the IPv6 addresses in electronic identity card numbers.

This research will create one of the models on the premise of the IPv6 model already studied and will however be combined with the model explored by authors in [9] which is the Euclidean Distance Geometry used to measure, quantify, implement, and validate retrieved identification features in data mining structures over various distances from Botswana locations to data center storage to realize QoS and efficiency of E-ID. For capacity management prediction for hosting millions

of e-ID big data. The researcher intends to look into the Predictive Modeling utilized in hyper scale data centers for data center optimization, as stated by [22]. Adoption of predictive modeling in data center capacity management is the key to freeing stuck capacity and identifying methods for increased efficiency and reliability [22].

The microprocessor-based smart card architecture was selected to be explored further in the study as the fundamental architectural model in this study because it protects identity credentials and is regarded as the most secure authentication method, allowing for the prevention of identity fraud and the effective protection of citizens' data. [21]

VI. RESEARCH FINDINGS MATRIX

Author	Study	Methodology Used	Summary of Findings	Limitations/Gap
[5] Pardede (2018) Research Journal Indonesia	IPv6 Modeling in E-ID Cards as Efficiency Efforts in the Population Registration Process	**Approach:** Exploration and modeling **Target Population:** Government, Citizens	Brought to light that an E-ID design and analytical model may be constructed using an IPv6 modeling on Indonesian Kartu Tanda Penduduk (e-KTP) registration and the implementation of one IPv6 model on e-KTP registration using IPv6 IP address.	The study was constricted only to the e-ID networking and did not explore the big data structures mined over networked e-ID devices.
[6] Singh et al (2019) Conference Paper India	Global Smart Card ID Using RFID: Realization of Worldwide Human Mobility for Universal Validation	**Approach:** Exploration and modeling study **Target Population:** Governments	The use of radio-frequency identification (RFID) and biometric technologies for identity information in e-passports and other applications was examined. An IPv6-based addressing system has been proposed for global identification registration and data access for all humans.	Despite the global realization of a smart card id by authors, an analysis of countries implementation possibility to an approach was not done hence limiting the study.
[7] Ibrahim et al (2021) Research Journal Indonesia	The Effectiveness of E-ID Card Services in Sub district City North Ternate	**Approach:** Descriptive Qualitative study **Target Population:** Sub district	Analyzed and described the effectiveness of e-ID services in enhancing e-ID service handling.	The study was limited to a descriptive qualitative study and its main focus is on description, rather than examining relationships or associations of E-ID Card
[9] Wakinji et al (2018)	Digital Identity Modelling For Digital Financial Services In Zambia	**Approach:** Exploration and modeling **Target Population:** Bankers	The study develops a beneficial digital identification model based on Shannon's Information Theory and Euclidean metric-based Euclidean Distance Geometry for measuring identity extractions.	Had restricted the scope to banking sector in Zambia only, limiting the identified valuable modelling of credential attributes to the national digital identity scope.
[22] Islam et al (2019) Research Article Sweden	Capacity Management of Hyperscale Data Centers Using Predictive Modelling	**Approach:** Mathematical model **Target Population:** Data center located in Lulea, Sweden	As a predictive model, this study developed a Belief Rule-Based Expert System (BRBES)-based predictive model to estimate the Power Usage Effectiveness (PUE) of a data center.	The article was limited to real world data collected from Facebook at one data center only. The predictive model could not depict the overall capability of a data center rather its power usage only.
[23] Mburu et al (2019) Research Journal	Review of Digital Identity Management System Models	**Approach:** Qualitative	The paper brought different insights of other digital identity models to be explored	A hybrid digital Identity Management System model can be the future of the paper

Kenya		**Target Population:** Governments		

Table II: Research Findings Matrix (Sampled only 8 findings in Matrix)

VII. CONCLUSION

While the review highlighted the possibilities of digital identity technology, it is critical to state that E-ID implementation was done in some of the countries like Germany, Italy, Estonia, Spain, Croatia, Indonesia and Luxembourg just to name a few and some literatures were studied in particularly some of the stated countries. Nevertheless, there still remain knowledge gaps concerning contemporary micro-chip e-ID technology, its connection to the state of the art technologies, big data and IoT, which are the main components or variables forming the digital identity. The e-ID phenomenon is not relatively a new novelty, however, its dependency to IoT and Big Data algorithms measurement before implementation still surpluses. There were limitations to none literatures relating to Botswana context and any other developing African country, of which this research will make an original contribution to the current subject area in Botswana and any other developing country. Therefore, this research will create a literal impact for this scope of research. The review of literature discussed only eighteen closer literatures due to the nature of the paper, which was a limitation to holistically review more literatures. In future, more literatures will be discussed.

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