WHY BUSINESS SCHOOLS IN TANZANIA SHOULD TEACH BLOCK CHAIN TECHNOLOGY

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ABSTRACT

A primer showing the interdisciplinarity of block chain technology is provided. A selection of few use cases of the technology are described to show its relevance to business schools. .An argument as to why business schools should teach block chain technology is presented and the future of education on block chain technology in business schools is proposed

Keywords: *block chain education**,** business schools, block chain technology, fourth industrial revolution, use cases*

1.0 INTRODUCTION

1.1 The Context

According to Prof Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, the world has since the turn of this century been going through the Fourth Industrial Revolution (FIR). The FIR is characterized by the advent of cyber-physical systems and the convergence of emerging technologies in the physical, digital, and biological domains (Schwab, 2016).

The emerging FIR technologies of importance to business and management sciences schools are the ones in the digital domain. Digital domain technologies of immediate interest to business and management sciences schools are the ubiquitous broadband Internet, the Internet of Things, block chain technology, Artificial Intelligence/Machine Learning, Big Data Analytics, Cloud Computing, and the converged permutations of these technologies. These technologies are anticipated to be major positive drivers of business growth in the 2018-2022 period (WEF, 2017).

Digital Technologies are ushering in the digital economy in all countries, including Tanzania. In less than ten years from now, these digital technologies are projected to have a radical impact on economies of developed countries as shown in Table 1.

We focus on the short to medium term and extrapolate from the *tipping points* of the World Economic Forum (WEF) (WEF, 2015) to show how digital technologies might influence businesses in Tanzania in that period. The selected tipping points – moments when specific technological shifts get to the mainstream society – are shown in Table 1.

Table 1: Tipping Points Expected To Occur By 2025

90% of people having unlimited and free (advertising supported) storage
1 trillion sensors connected to the Internet
80% of people with a digital presence on the Internet
The first 3D printed car in production
The first government to replace its census with big data sources
5% of consumer products printed in 3D
90% of the population using smartphones
30% of corporate audits performed by Artificial Intelligence

Tax collected by a government for the first time via block chain
Over 50% of Internet traffic to homes for appliances and devices
Globally more trips/journeys via car sharing than in private cars
10% of global GDP stored on block chain technology
The first Artificial Intelligence machine on a corporate board of directors

Source: Adapted from WEF (2015)

In Table 1 sensors connected to the Internet, corporate audits, Internet traffic to the home and rides through car sharing have implications (data security, traceability, audit ability, and immutability) on the use of block chains. Thus, the projected 10 per cent of global GDP being stored on block chains must be taken as a conservative estimate. Given the connectedness of the global economy, it is not a matter of whether, but one of when the tipping points in Table 1 would start showing themselves in African countries. For Tanzania, therefore, the skill sets required of a business and management sciences graduate of the near future are expected to be different from those of today. Business schools would therefore need to think carefully on how they would reform their curricula so that they train professionals of the future and not those of the past.

One of the main characteristics, which distinguish the Fourth Industrial Revolution from the earlier three industrial revolutions, is the *velocity* with which technology is changing and changing the world (Schwab, 2016). This implies that there is no time to waste in the adaptation to and adoption of the technologies of the FIR if a country is to achieve successful and sustainable development in the FIR. One of the technologies of the FIR, which has emerged in East Africa, in terms of the establishment of professional associations and the setting up of start-ups, is block chain technology. It is, therefore, important that business

schools in Tanzania start offering courses in block chain technology in order to prepare Tanzania for the emerging future.

1.2 Why Focus on Business Schools?

Block chain technology is interdisciplinary and multidisciplinary in the sense of discipliniarities as defined by Jensenius (2012). Block chain touches a range of disciplines including mathematics, finance, law, electrical engineering, business, economics, and computer science. The use cases of the technology have so far indicated that the technology could have a major transformational impact in a range of industries such as banking, financial services, insurance, real estate, digital identity, healthcare, public service, renewable energy supply, travel and transportation, retail and e-commerce, media and entertainment, etc (Rai, 2018).

Given the multidisciplinary and interdisciplinary nature of block chain technology, this paper proposes that block chain technology education should be offered in business schools. This is because, first, the widespread experimentation in block chain technology has so far involved the use cases in finance, banking, and insurance (Rai, 2018). The widespread deployment of block chain technology in these industries would, most probably therefore precede its widespread deployment in other sectors of the economy. Finance, banking, and insurance are areas within the prime terms of reference of business schools.

Secondly, block chain technology is arguably most suited for widespread use by accountants. The Chartered Institute of Accountants of England and Wales (ICAEW) has characterized block chain technology as a *fundamentally accounting technology* (ICAEW, 2017). In this paradigm, one would expect accountants, out of all other professions, to be at the forefront of

a campaign championing the provision of education on block chain technology in business schools.

Thirdly, there has been a convergence in the business sector of finance, computer science, and computer engineering, which has generated a new discipline of financial technology (FinTech). If education in business schools is to be relevant, this convergence has to be reflected in the business schools of universities. The provision of education courses on block chain technology by business schools could add to the recognition by business schools of the reality of FinTech in today's business environment.

Fourthly, if the education landscape is devoid of education programs on block chain technology then start-ups might move in to fill the gap. A personal communication has indicated that, for Tanzania, Belfrics Tanzania Pvt Ltd, a subsidiary of a Malaysian company, intends to start offering block chain technology education courses. For Kenya, the emphasis by start-ups has been on the training of developers of block chain technology. Thus, the involvement of Kenyan universities in block chain technology must be responsive as to whether Kenyan universities could (David, 2018) : (i) serve as hubs for block chain innovation, (ii) be producers of blocks for emerging block chains, or (iii) start offering block chain development courses. Local institutions must exploit the opportunities of offering of block chain education in East Africa. When local firms are in the market, foreign firms intending to enter the market usually find collaboration with the local firms as the optimal entry strategy. If not collaboration, then Tanzania must come up with another strategy of ensuring that block chain technology education offered by foreign start-ups in Tanzania is demand-driven.

Lastly, we note that block chain technology is but one of the technologies driving the Fourth Industrial Revolution (FIR). The convergence of block chain technology and other physical, digital, and biological domain technologies driving the FIR has disrupted and will continue to disrupt production processes, ushering in, time, capital raising ability and data – the lifeblood of the digital economy - as new factors of production in place of land, labour, and capital. These new factors of production, coupled with the LASIC (**L**ow margin, **A**sset-light, **I**nnovative, **C**ompliance-easy) principles have given rise to new business models which are radically different from legacy business models (Chuen, 2015). LASIC has created the sharing economy which has brought forth new ways of consuming goods and services and has seen the emergence of businesses with high market capitalization being built on relatively low capital expenditure (*capex*). Companies which follow these principles and which did not exist twenty years ago are, for example, Facebook, Alibaba, Uber, Netflix, WeChat, Airbnb and SocietyOne. These companies have attained large market capitalizations in a much shorter time than was the case with companies in the past. Only a tech-savvy business graduate who is literate in the emerging technologies of the FIR would be able to see the potential of harnessing LASIC principles and be able to implement them for development. Business school graduates could use their knowledge of block chain technology as the basis upon which to build capacity in the use of the convergence of block chain technology and other digital technologies in the implementation of LASIC principles in businesses.

2.0 A PRIMER ON BLOCK CHAIN TECHNOLOGY

Before discussing block chains, we define two concepts, *cryptographic hash functions* and *Merkle Trees*, which are basic to the understanding of how block chain technology works.

Cryptographic Hash Functions

Hash functions are functions, which map bit strings of arbitrary length to bit strings of fixed length.

Cryptographic Hash Functions are hash functions, which are imbued with security features known as *preimage resistance, second preimage resistance* and *collision resistance* (Vijayakumaran, 2017).

Merkle Trees

A Merkle Tree is a binary tree whose leaves are cryptographic hash functions of transactions. The cryptographic hash of the root of a Merkle Tree is a compact representation of the transactions, which form the leaves of the tree. A list of transactions is included as part of a data block. However, instead of including all transactions in data blocks, a Merkle root of the transactions could be included in a data block to represent the transactions. The root of a Merkle Tree provides an efficient method of proving the membership of a transaction within a data block without requiring that all details of the transactions be present in the data block. The use of the root of a Merkle Tree to represent transactions thus saves storage disk space (Nakamoto, 2008).

Chain of Blocks

Heber and Stornetta first described a cryptographically secure chain of data blocks in 1991 (Heber, 1991). Nakamoto built on this work to develop a chain of data blocks, which he described in a White Paper in 2008 (Nakamoto, 2008). Nakamoto's chain of data blocks underpinned trading in the Bitcoin cryptocurrency.

Block chain derives its name from the fact that its data structure is a chain of data blocks. Copies of the chain of data blocks are replicated and distributed across a peer-to-peer (P2P), disintermediated, and network of computers. Each computer, referred to as a *node* of the network, maintains a copy of the latest version of the chain of data blocks. This chain of data blocks is thus a distributed digital database.

Each data block consists of a header and a list of transactions. Each data block is identified by the cryptographic hash value of its header. This identifier is called the *block hash.*

Included in the block header are cryptographic hash values of the root of the Merkle Tree representing the transactions in the block and that of the header of the immediately predecessor block in the chain of blocks (block chain) (Nakamoto, 2008).

Once a large number of blocks have been added to the block chain, transactions in old blocks can be discarded in order to save disk space. This could be done without changing the block's hash because the header contains the root of the Merkle Tree representing the transactions and not the transactions themselves. Old blocks are thus compacted by shedding off leaves and branches of the Merkle Tree. The interior hashes of the Merkle Tree, other than the root hash, do not need to be saved. This reduces storage space on disks (Nakamoto, 20078).

The inclusion of the hash value of the header of the previous block in the header of the current block is recursive and hence the block hash of a block's header is made to depend on previous block hash values going all the way back to the genesis block of a block chain.

Changing any transaction would change the root hash of the Merkle Tree to which that transaction belongs, which in turn would lead to a change in the block hash of the block containing the transaction. This would cause a recalculation of all the block hash values of the block containing the transaction, which is being changed, and a recalculation of the block hash values of all blocks subsequent to this one, a process that is computationally hard. This is the basis of the immutability of the contents of a block chain (Nakamoto, 2008; Vijayakumaran, 2017).

The record of encrypted transactions, whose hashes form the root hash of a Merkle Tree, is generated from transactions, which range from the exchange of cryptocurrencies and tokens, to records on digital rights, property ownership, intellectual property rights, digital identity, medical records, sensor data from Internet of Things devices, and the like.

Scripting Languages

Both the Bitcoin and Ethereum block chains (to be described in Section 2.1) are open-source, public, block chain-based distributed computing platforms, and operating systems. The only well-known application supported on the Bitcoin block chain is cryptocurrency exchange whereas the Ethereum block chain can support many more and more complex applications. Different block chain applications start-ups have used different

programming languages for different use cases of block chain technology. We therefore limit this discussion to generalities.

For Bitcoin, a special stack-based programming language, called *Script*, was developed. Script has limited functionality, that is. it is not *Turing complete*. It consists of byte strings of data and operators written in Reverse Polish Notation necessitating that the instructions be executed from the left to the right.

For Ethereum, a special programming language, *Solidity,* similar to C and JavaScript was developed. Solidity is the most supported and maintained language as of January 2018 (Orlick, 2018).

A Digital Identity

Since the block chain network, which underpins trading in Bitcoins, is a decentralized network, with no central authority to serve as a verifier and validator of transactions, Nakamoto used cryptography to verify and validate transactions (Nakamoto, 2008).

The validation of transactions involves the use of public and private keys of a public key cryptographic system, digital addresses, and digital signatures. Because of its relatively small key size, the cryptographic system of choice is the *elliptic curve cryptographic system* (Vijayakumaran, 2017).

2.1 Block chain Technology Platforms

There are two platforms of block chain technology, currency-based platforms such as the Bitcoin block chain and smart contract-based block chain platform, which are essentially programmable block chains.

The first programmable block chain was created by Vitalik Buterin. In 2013, Vitalik Buterin derived a new block chain called *Ethereum* whose aim was to generalize the concept of bitcoin beyond currency. Ethereum took a Bitcoin-oriented block chain and extended it to cater for transactions involving small computer programs called *smart contracts*. Smart contracts could be of unlimited complexity – from simple computer programs to programs of *Turing Complete* complexity. Ethereum's currency was called *ethers*. Ethereum remotely executes software on a distributed computer system called the *Ethereum Virtual Machine*. Ethereum is the block chain platform most open to experimentation (Peck, 2017).

Smart contracts are computer code uploaded on a block chain and the code contains instructions, which are automatically executed once specified requirements have been met. A smart contract (or any other document earmarked for storage on a block chain) could be stored on a block chain only after it had been converted into a *hash*. Hashing is essentially an encryption process. Hashes on a block chain can never be altered and, therefore any hash of a smart contract or document would remain in the form in which it was uploaded on a block chain in perpetuity. The fact that documents on a block chain cannot be easily tampered with or hacked could be used as the basis for secure storage of documents on the Internet (Peck, 2017).

Ethereum uses the basic architecture of the Bitcoin block chain; therefore, he is saddled with the shortcomings of the Bitcoin block chain: which had low throughput and low potential of scalability. In addition, the block chain could store at most 40 bytes of metadata. Block chains need to be enabled to access and store data about the real world using *oracles* (Peck, 2017).

The first area outside cryptocurrencies to which block chains and especially Ethereum block chains, were applied, was the financial sector. Overcoming the shortcomings of the Ethereum block chain, adding what were perceived to be useful functionalities catering for the specific needs of particular financial institutions and inventing block chains able to provide next-generation financial services, motivated developers to embark on several projects on the improvement of the block chain technology for use in the financial sector (Bitfury Group, 2018).

2.2 Public vs. Private Block chains

The compliance to legal and regulatory requirements placed on banks and other financial institutions made it difficult for them to embrace block chain technology. This is because of the open structure and anonymity of users, which are essential, attributes of the Bitcoin and Ethereum block chains. Experience has shown that these legal and regulatory requirements have forced the banks and other financial institutions to set up private (*permissioned*) block chains either singly or in consortia (Bitfury Group, 2018).

Public block chains, of which the Bitcoin block chain was the first in existence, use open source protocols and algorithms and are accessible by anyone at any time provided they have the requisite computer processing power. The data on these block chain networks are viewable by anybody at anytime (Nakamoto, 2008). The transaction processors on public block chains are anonymous, being represented by alphanumeric public key addresses of a public- key cryptographic algorithm such as the Riverst-Shamir-Adleman (RSA) algorithm (Riverst, 1079) or the Elliptic Curve Cryptography (ECC) algorithms (Vijayakumaran, 2017).

The security of a block chain is a function of the cryptographic algorithm used in hashing transactions. Thus, for example, the security of ECC is based on the fact that the best algorithms for finding a private key from knowledge of the public have running times of $O(2^{128})$for ECCs whose domain parameters are the same as those of the ECC used in the Bitcoin block chain (Vijayakumaran, 2017).

The updating (addition of new blocks) of the original Bitcoin block chain used a computationally intensive process called *proof-of-work.* This process involves the passage of a data block (an amalgamation of transactions, about 2000 transactions per block in August 2017 (Peck, 2017)) multiple times through a hash function to produce a hash. For the Bitcoin block chain the algorithm used for the hashing process belongs to the standard SHA-256 of the U. S. National Institute of Standards and Technology (NIST) where SHA is an acronym for **S**ecure **H**ash **A**lgorithm. About 256 is the length of the output of the hash function in bits (Vijayakumaran, 2017). The hashing protocol in SHA-256 encrypts the blocks imbuing the block chain with immutability and security.

Public block chains using the Bitcoin block chain protocol are also distinguished by the following properties (Peck, 2017):

(i) They facilitate peer-to-peer (P2P) transactions
(ii) They eliminate the need for trusted third party intermediaries in transactions. In monetary transactions, the trusted third party is usually a bank. The place of the third party in transactions is taken over by cryptographic algorithms.
(iii)The immutability of the transactions makes the system highly resistant to censorship.

The low throughput and high electricity energy consumption of the Bitcoin block chain are due to the implementation of acryptographic hashing process for adding blocks to a Bitcoin block chain. In the proof-of-work protocol, the hashing is done iteratively until a hash with the desired characteristics – that is, beginning with a prescribed number of zeros – is obtained. This process is computationally –intensive and consuming large volumes of electricity (Peck, 2017

Developments of new mining protocols (such as proof-of-stake) as well as the production of integrated circuit chips specifically designed for the computation of cryptographic hash functions are aimed at redressing the low throughput and huge energy consumption problem of public block chains (Peck, 2017). These chips are designed to have high hash rates (hashes/sec) and high efficiency (i.e. low energy consumption in Watts/Hash). The special chips for bitcoin mining belong to a class of chips called *application specific integrated circuits* (ASICs).

Private block chains – also referred to as permissioned block chains – form a more controlled and predictable environment than do public (*permissionless*) block chains. The proof-of-work protocol, which is fundamental to the security of the Bitcoin block chain, is redundant for private block chains (Peck, 2017). Not using the proof-of-work protocol leads to higher transaction throughput and a reduction in operating costs, especially the high energy costs associated with the *mining* processes (addition of new blocks to a block chain) inherent in the implementation of the proof-of-work protocol (Peck, 2017). In permissioned block chains, the identity of the transaction processors is known and the data on the block chain are viewable only by permitted users. Entities allowed

to add new blocks to a private block chain are also known (Peck, 2017.

3.0 BUSINESSES UTILIZING BLOCK CHAIN TECHNOLOGY

Except for its use in cryptocurrencies, block chain technology is still at a young stage and, therefore, the use cases under discussion are at the early stages of pilot study, proof-of-concept, experimentation or early stages of being rolled out. Expectations are that commercial block chain technology solutions at a large scale would begin to appear in 2018 (IBM, 2016).

We focus on use cases of block chain technology in areas other than cryptocurrencies, assuming that the use of block chain technology would not face implementation hurdles from the Government of Tanzania. We highlight only a few businesses that employ business graduates and have built some of their products and services onto block chains.

3.1 Finance, Insurance and Banking

Although Satoshi Nakamoto thought that the invention of the Bitcoin block chain would be a harbinger of the demise of the banks and other financial institutions serving as intermediaries in currency and financial transactions (Nakamoto, 2008), the reality is that the banks and financial institutions have found it useful to embrace block chain technology for their own use.

Earlier we stated that legal and regulatory requirements had forced the banks and other financial institutions to prefer permissioned over permissionless block chain technology. Banks and financial institutions have found a way of also implementing solutions based on the permissionless block chain technology

using *coloured coins*. Coloured coins are a method of associating real-world assets with addresses on a public block chain thus enabling the representation and management of the real-world assets on any permissionless block chain. Several banks, insurance companies and other financial institutions are pioneering experimental projects in this area (Bitfury Group, 2018).

We identify three types of use cases in block chain in finance:

(a) Banks and financial institutions are implementing general smart contract-based actions for various financial services offerings.
(b) Banks and financial institutions holding sensitive customer data are implementing permissioned block chain technology-based solutions using tools provided by *Hyperledger*, an open source project backed by the Linus Foundation and large technology firms building experimental products using smart contracts.
(c) IBM, Amazon Web Services (AWS), and Microsoft are offering Block chain-as-a-Service (BaaS) to any institution interested in implementing enterprise-level permissioned block chain technology for financial and healthcare solutions (Peck, 2017).

More specifically, some of the use cases in finance have been identified (Lorenz, 2016):

- Trade finance
- Commercial insurance
- Regulatory compliance
- Automation of underwriting and claims processing
- Bank to bank contract processing

- Processing of on boarding of new customers known as Know Your Customer(KYC)
- Detection of fraud and prevention of money laundering
- Reduction of administrative costs
- Offering of insurance policies administered and regulated by smart contracts for Internet of Things devices

All the activities and projects mentioned above are being carried out by consortia, individual banks, or financial institutions or start-ups, and are uncoordinated. Lessons from the history of the Internet show that the growth and widespread use of a new technology, such as block chain technology, could be accelerated through coordination or standardization (Peck, 2017).

Finance and banking are the areas that have witnessed the largest application of block chain technology (Peck, 2017). The banking and financial sectors in Tanzania are liberalized. Therefore, it is not a question of whether, but when the banking and financial sectors in Tanzania would start using block chain technology. This use might be hastened by the inclusion of block chain technology in international financial reporting standards. What is the feasibility of using this technology in Tanzania's financial institutions? If it were implemented, what would be the implications and consequences on workforce training? Answers to these questions could spawn a wide variety of research projects for business schools in Tanzania

3.2 Healthcare

The application of block chain technology in the health sector has been motivated by the fact that electronic records placed on a block chain are secure, immutable, and the privacy of the records is assured. Microsoft and IBM are already offering BaaS solutions in the health sector (BaaS, 2017).

The benefits of the application of block chain technology in the health sector are as follows.

(a) It would connect a fragmented record keeping system making it easier to retrieve records and enable the use of data analytics to gain insights on patterns of diseases and their treatment leading to better health outcomes for patients.
(b) It could serve as the basis for a nationwide, secure, and immutable system of electronic medical records with verifiable identity and authentication of all users of the system.
(c) It would enable the lifetime history of a patient's illnesses and treatments to be captured and securely recorded in perpetuity.

3.3 Logistics and Supply Chain Management

Supply chains are usually complex and are generally characterized by:

(a) Coverage of large geographical areas, spanning across multiple taxation authorities and sometimes-crossing international borders,
(b) Lack of trust among parties participating in the supply Chains,
(c) Lack of transparently available end-to-end information or documentation about a supply chain,
(d) Requires intermediaries in many supply chain processes,
(e) Involves some participants who are unethical or corrupt, and
(f) Includes friction costs whose authenticity is difficult to determine (Forbes, 2018).

Block chain technology could be applied to address all the vices mentioned above. In fact, studies, pilots, and experiments

applying block chain technology to the supply chains have shown that the following improvements could be obtained in supply chains

(a) Reduction of the number of intermediaries
(b) Reduction of administrative costs by eliminating vast volumes of paper documents crossing international borders.
(c) Enabling the use in the supply chains of verifiable authenticity and immutability of block chain technology-based digital documents
(d) Allows fast, secure and authenticated access to end-to-end supply chain information
(e) Improvement of the performance of supply chains in a sharing economy (Schwab, 2016). A sharing economy involves peer-to-peer interactions and is, therefore suited to the application of block chain technology. More is said about this later.
(f) Allows the use of smart contracts to automate some of the processes in a supply chain thus automating the processes and hence mitigating some of the difficulties encountered in the complexity of the chains
(g) Increases trust and security and assists in addressing unethical practices and corruption
(h) Enables supply chains to be easily adaptable for use in the Fourth Industrial Revolution (White, 2018):.

The efficiency of operations in the complex logistics and supply chain industry in Tanzania could be improved by using smart contracts to automate some of its processes. The determination of the feasibility of using smart contracts in the logistics and supply chain industry in Tanzania could spawn many research projects for business schools in Tanzania.

Digital Free Trade Area (DFTA)

The Common Market for Eastern and Southern Africa (COMESA) is going to start using block chain technology for import and export processes (COMESA, 2017). To achieve this, it is going to establish the first DFTA in Africa. The parties to the transaction would be linked through a set of decentralized ledgers with the ability of creating digital certificates of origin, which could be verified through national information systems. The transacting parties, be large firms or small and medium enterprises (SMEs), would be able to carry out all transactions using their smartphones or tablets. The system would replace the current manual system, which is based on presentation of paper documents to tax authorities and other government authorities and relying on commercial banks as intermediaries in some of its processes. By implementing the DFTA, COMESA anticipates to reduce costs to the tune of USD 450 million per year.

The DFTA is expected to pilot in 2018. Fifteen (15) out of 19 member countries of COMESA would be involved in the pilot. Unfortunately, Tanzania is the only member of the EAC, which would not be participating in the pilot of the DFTA!

3.4 The Sharing Economy

The sharing economy is being built on global digital platforms (Schwab, 2016) leveraging Web 2.0 technologies. These digital platforms provide pseudo-P2P services, as they require an intermediary such as Uber for ride sharing. The sharing economy raises the fundamental question as to what is important to own –

the platform or the underlying asset. According to Goodwin, the media strategist,

> *The world's largest taxi firm, Uber, owns no cars. The world's most popular media company, Facebook, creates no content. The world's most valuable retailer, Alibaba, carries no stock. And the world's largest accommodation provider, Airbnb, owns no property* (Goodwin, 2015):.

Goodwin could also have added (Selamat, 2017), Skype and WeChat = the world's largest telephone companies have no telecommunications infrastructure, SocietyOne - the world's largest growing bank does not use actual money, and Netflix - the world's largest movie house owns no cinemas.

Uber is already operating in Tanzania. However, it is now facing competition from another pseudo-P2P service launched by a Tanzanian MBA degree holder resident in the U.S., Mr Godwin Gabriel (*The Guardian*, 2018). Mr Gabriel's service is known as *Movin.* The services operate in seven cities in the U.S. and three cities in Africa including Dares Salaam. Movin has differentiated itself from the titans of the ride sharing business by,

- Allowing a rider to pre-schedule trips up to a month in advance
- Allowing a rider to select vehicle options depending on available local modes of transport – car, motorcycle or tricycle
- Giving services of moving products from marketplaces to the consumer

The next evolution of the sharing economy would be the introduction of block chain technology so as to disintermediate some of the global digital platforms which offer pseudo-P2P

services such as those offered by Uber (for ride sharing) and AirBnB (for short-term accommodation). The disintermediation would yield true P2P services and, by leveraging the decentralized nature of block chains, this model could be extended to the automation of many online transactions in industries such as finance, healthcare, logistics, real estate, Internet of Things devices, and the like.

In the disintermediation of ride-sharing services, for example, Arcade City has piloted schemes offering decentralized P2P ride sharing services (David, 2016). Implementation has involved Arcade City providing an App for web, *android* and *iOS*, which enabled developers and entrepreneurs to create service offerings in ride-sharing services. This service is a decentralized version of Uber's service. It creates an owner-controlled, self-governing ride-sharing network, which is responsible for setting its own performance standards for service delivery. The elimination of intermediaries has enabled some of the participants to double their earnings from the service.

Business schools could determine the feasibility of the formation of cooperatives running disintermediated peer-to-peer digital platforms – like the one for ride sharing in Arcade City – which would allow all profits to be owned and be shared by members of the cooperatives rather than having a large chunk of the profits being siphoned off by foreign capitalists.

A sharing economy is a decentralized business model, perfectly matched to the attributes of block chain technology. What are the prospects of using block chain technology to offer true P2P sharing economy models in Tanzania? Who owns the data in sharing economy models under implementation in Tanzania? How are those who capture value from consumer data expected

to share that value with consumers? Does Tanzania need standards for use and protection of consumer data? Should these standards be national or should Tanzania work with other East African Community member states to evolve regional standards? Are there lessons for Tanzania from the General Data Protection Regulation (GDPR), which started being implemented in the European Union on May 25, 2018 (GDPC, 2018)? These and similar questions are potential researchable areas for Business Schools in Tanzania.

3.5 A Synthesis on Use Cases

The use cases, which have been presented, were meant to be illustrative, not exhaustive. They have highlighted a small representation of work that is currently going on and which would be of interest to business school graduates.

The local media in Tanzania carries articles from time to time on activities being carried out in Tanzania by foreign start-ups in cryptocurrencies and block chain technology. Despite this interest by the local media and foreign start-ups, there is dearth of activity in the same areas in Tanzanian business schools.

4.0 BLOCK CHAIN TECHNOLOGY EDUCATION

Business schools in Tanzania have so far shied away from getting involved in scholarly work on cryptocurrencies and block chains. The lack of activity in cryptocurrencies might be understandable, but not the lack of activity on block chains. This would seem to indicate that the biggest challenge to the adoption of block chain

technology in Tanzania would be the mindset of academics in Tanzania's business schools.

Students and academic staff in business schools in Tanzania are witnessing the dawn of the technology-driven digital economy. This gives business schools a unique opportunity of modernizing their curricula so as to produce graduates who are literate in emerging technologies, including Financial Technology (FinTech). These graduates would be more competitive in the job market and would be uniquely empowered to fit into and thrive in the digital economy of the Fourth Industrial Revolution.

A primary reason for business schools shying away from getting involved in block chain technology education might be the perceived complexity of the subject. As highlighted in Section 2, the subject is an interdisciplinary and multidisciplinary combination of subjects such as public-key cryptography, game theory, mathematics, monetary theory, and computer science. However, there is no basis for this perception, since only basic general knowledge of these subjects is required in order to be able to visualize how they all work together in a block chain, or how Satoshi Nalamoto (Nakamoto, 2008) used them to engender trust in a trust less environment. As that goes beyond most curricula of business schools in Tanzania, a discussion unblock chain technology has been absent in Tanzania's business schools, and in the local media.

However, as highlighted in Section 3, the use of block chain technology will disrupt many industries and its arrival into Tanzania's business environment is imminent. In recognition of this, business schools need to ensure that the skills and competencies they impart to their students are relevant to the new environment.

In light of the proposed transitions, the university leadership in general, and that of business schools in particular, ought to ensure that university graduates are technically literate and are capable of understanding the working principles and concepts of emerging digital technologies, such as block chains. Without this understanding, business school graduates might find it difficult to compete in the job market or adapt to the digital economy and, therefore, open themselves to metaphorically suffering of the fate of the dinosaurs. For n survival on the face of change, Charles Darwin's statement is paraphrased as follows

It is not the strongest of the species that survive, or the most intelligent, but the ones most responsive to change (O'Toole, 2013):

4.1 Block chain Technology Education in Executive Master of Business Administration (EMBA)

Business schools should realize that the Fourth Industrial Revolution (FIR) in which the world finds itself today would require creative and adaptable business leaders and managers (Schwab, 2016). In order for the Executive MBA (EMBA) program to produce such leaders, it must undergo several changes. First, its output must be made to consist of visionary, tech savvy graduates who are able to appreciate the potential of the emerging digital technologies in transforming businesses and be able to think of creative ways of using the emerging technologies in creating appropriate business solutions. They should take over from engineers and technologists and become drivers of the application of technology in business.

Secondly, the curricula of the EMBA need to focus on the provision of an innovative, career-supportive executive education relevant for the digital economy. The curricula should focus on

enhancing the technology-based, business-transformative potential of its graduates.

Thirdly, the curricula of the EMBA need to be responsive to the question, In the era in which rapid technology-driven changes are causing skills to be outdated sooner rather than later, what should it mean to be a *Master* of a subject (as in *Master* of Business Administration)?

Turning specifically to block chain technology, we first note that the EMBA programs are targeted at the needs for up skilling of employees who are mid-career managers and who are holders of undergraduate degree qualifications. Whatever these individuals learn, they are able to implement almost immediately. Given the imminent deployment of block chain technology in various businesses and industries in Tanzania, the offering of education courses in block chain technology as part of the EMBA programs would provide a unique opportunity for the upscaling of mid-career managers in a new technology. Executive MBA programs in business schools in Tanzania could be modernized so that they play a facilitating role in the adoption of block chain technology, making these managers better prepared for the arrival in their businesses or industries of this new technology. For, it should be expected that managers knowledgeable in block chain technology would be able to provide a leadership role in either facilitating the introduction of block chain technology into their businesses or playing a leadership role by arguing proactively for the introduction of the technology in their businesses. This is especially because the profile of holders of EMBA degrees in Tanzania shows that they are occupying senior decision-making positions in their organizations.

To achieve the intended impact of facilitating the introduction of block chain technology into Tanzania, students in Executive MBA programs do not have to learn to become experts in block chain code development (which is best left to computer science departments). Similarly, students do not have to learn advanced block chain technology topics such as how to prove, using projective geometry, and the associativity rule of point addition for elliptic curve. All that students in EMBA programs need to learn is general knowledge about block chain technology. They need to know what block chain technology is, how different types of block chains work and what their characteristics are. others include, what use cases of the technology are relevant to Tanzania and to one's business, and how to identify when and whether block chain technology is – or is not – applicable to a particular business case or problem. Other matters include, who are the main players in Block chain-as-a-Service (BaaS) solutions and how does one decide on whether to deploy BaaS and how to carry out a cost/benefit analysis for the application of a block chain technology.

The mode of imparting knowledge to EMBA students has to evolve and become more relevant to the FIR. To achieve this, the EMBA programs should aim at becoming more customized and personalized, empowering their students with abilities of lifelong and life wide education as encapsulated in *higher education 4.0* (Jhingen, 2017). The adoption of Education 4.0 principles coupled with the production of tech savvy graduates from business schools would be evidence that the capacity of business schools to be transformational had been built into their planning and operations.

4.2 The Future of Block chain Technology Education in Business Schools

The convergence of block chain technology with Big Data Analytics, Arial Intelligence (AI)/Machine Learning and the Internet of Things (IoT) will further disrupt legacy business models, ushering in new models with major impact on the skill sets required of business school graduates. For example, IoT networks are decentralized networks. To exploit their decentralization would require a shift of the intelligence to nodes (devices) of the network rather than leave it to be resident in a central server. This implies the use of block chain-based smart devices in IoT networks. Such devices would not only have communication capabilities but would also have also computation capabilities. If the nodes are empowered with artificial intelligence then decentralized decision-making could be taken at the nodes. When fully exploited, this would lead to a decentralized Internet of Things, which would be the ultimate platform for a sharing economy in the near future. A good example is the application of AI in creating new business models from Product-as-a-Service models described in (Spacey, 2016).

New business models could also be created so that the integration of block chain and 3D printing technologies. Data security, traceability, validation, and auditability could be guaranteed by block chains thus facilitating 3D printing processes and opening up of innovative business models arising from global block chain-based netwoof 3D printers (Karath, 2018).

The possibilities of defining new business models enabled by this integration of block chain technology and Artificial Intelligence/Machine Learning, the Internet of Things and Big Data opens up unlimited opportunities for cutting-edge research in the development of new and innovative business models for business schools in Tanzania.

5.0 CONCLUSION

The digital technologies driving the Fourth Industrial Revolution are disrupting legacy business models and ushering in new ones, which share little in common with the legacy models. Data are the lifeblood of the digital economy. The secure storage and exchange of data in the digital economy are guaranteed by block chain technology. This could be exploited by business schools to define innovative cutting-edge research programs. In response to the emergence of digital economy, business schools should, aim at producing tech savvy graduates who would be able to identify the transformative potential of the emerging digital technologies in improving the efficiency of current business operations or in the creation of new business models altogether. Leaving the space of the application to businesses of digital technologies to engineers and technologists is not optimal. The space needs to be occupied by graduates of business schools. The introduction of education on block chain technology in business schools would be the first step, which business schools could take in producing tech savvy business school graduates who are required by the digital economy of the emerging Fourth Industrial Revolution.

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