Internet of Things, Blockchain and Analytics: Technology Convergence in Tax Administration

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Abstract

Technological developments create new capabilities that have the potential to solve existing business problems and exploiting new opportunities. The rate of technology change is faster compared to organizations' adoption of technology. This difference creates a gap that may push organizations to reset. Tax agencies are faced with the problem of traceability and fast changing business environment that challenges traditional tax administration systems. To address these challenges, this paper suggests converge of blockchain, Internet of Things, and analytics technology. Each of these technologies creates new capabilities that tax agencies can leverage to solve existing challenges of traceability of transactions, improve efficiency and align tax agencies operations to digital transformation. The paper proposes change of business model for tax agencies to operate as ecosystems as opposed to the current models. By adopting these changes, tax agencies are expected to grow their taxpayer base, facilitate taxpayer compliance, improve their relationship with taxpayers, and rely on intelligence for tax administration.

Keywords: Tax, Blockchain, Internet of things, analytics, digital transformation

1.0 Introduction

Disruptions to traditional business models and established businesses continue to be witnessed on a daily basis in the corporate arena. As boundaries that distinguished businesses continue to diminish, companies are now faced with new challenges driven by technology, innovation and connectivity. Ultimately businesses have to find new mechanisms to deal with the dynamic operating environment. As technology continues to evolve, new capabilities are created and businesses have to innovatively develop new business models that leverage on the new technologies. The European Commission (2014) explains that digital economy affects how goods and services are produced, how businesses create new value, and how that value is converted to revenue streams. These new business models leverage Information Technology (IT) and hugely rely on intangible assets as opposed to tangible assets that have traditionally been used in trade. By relying on intangible assets, creation and distribution of digital content becomes even faster and alters value creation and thereby introducing new competition.

The value of IT is fast changing from the traditional role of business process enabler to integrating technology solutions and innovation McKinsey (2018). As new technologies continue to evolve

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and mature, convergence of technologies is expected to deliver even better results. Similarly, the convergence of technology is expected to deliver increased disruptions, change of business models, new competition, and innovation. Changes in the operating environment requires businesses to adjust their strategy, innovate, and change their business model. In the digital economy era, all sectors of the economy face different levels of impact from digital transformational forces. One of the driving forces is internet that is empowering customers in creating and sharing ideas, giving rise to new opportunities European Commission (2014). These changes affect how businesses interact with customers, how businesses promote their products, and how businesses generate income. Increased connectivity and growth of ecommerce has led to emergence of new business models which compete with traditional brick-and-mortar business models.

The tax industry is faced with threats from the changing business environment. Taxation of the digital economy requires an understanding of how digital economy operates. A report by OECD (2017) posit that digital transformation is driven by technological advancements, digitization, and increased flow of information. The report continues to suggest that tax administrations have to re-examine their role and position in the tax ecosystem. The European Commission (2014) has characterized digital economy by classifying it into three categories, namely mobility, data as source of value and network effects. In terms of mobility, digital economy relies on intangible assets which makes it possible to perform cross-border trade that is not easily noticeable in the traditional tax systems. Data plays a pivotal role in digital economy. With decreasing cost of data storage and increasing ease of data collection, data is becoming the new source of value. Network effects thrives as a result of multi-sided business models European Commission (2014) where consumers interact through a platform resulting into externalities.

Digital economy affects tax administrations both directly and indirectly European Commission (2014). By changing how businesses interact with customers and reliance on intangibles, digital economy affect how tax due is determined and where tax due is payable. Income taxes are levied to resident companies. In digital economy businesses operate in a borderless environment enabled by the internet and increased connectivity. This aspect challenges the traditional tax systems and complicates tax administration. In the Value Added Tax (VAT) administration, new challenges

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are being created by digital businesses. Transactions that occur cross-border including downloads which give consumers user-rights makes VAT administration complex European Commission (2014). Changes in supply chain as well affect the VAT due and hence government revenues. Kavoya (2018) shows that shortening of the supply chain reduces VAT payable. Accenture (2016) show that value creation has shifted from the traditional linear and one-way models to a two-way and continuous model under a platform model. Traditional value creation model involves production, distribution, marketing and consumption. However, with changes due to digital transformation, value creation revolves around platforms and ecosystems Accenture (2016). By exploiting intangibles, value creation includes generation, transport, knowledge, outputs and new value. At each stage there is new value creation, but how much of this value can be captured for tax purposes? Tax administrators have to deploy systems that go beyond their land borders to ensure a global reach. The growth of ecommerce, digital economy and telecommunication require tax agencies to rethink their operating model to ensure tax compliance and business support is maintained.

Gartner (2017) has identified ten strategic technology trends for 2018. These include Artificial Intelligence foundations, intelligent apps and analytics, intelligent things, blockchain, continuous adaptive risk and trust among others. Each of these digital technologies creates new capabilities that businesses can leverage to address their business needs. The questions this paper seeks to answer are: which digital technologies can tax agencies leverage to solve the challenge of traceability? Can these technologies align tax administration operations to digital transformation and therefore improve efficiency? What are the implications of applying such digital technologies in tax administration?

2.0 Empirical Review

2.1 Martec's law

Martec's laws proposes that technology is changing exponentially while organizations change logarithmically Brinker (2013). Technology is rapidly changing, creating new capabilities and enabling new business models that introduce new competition, innovation and disruptions. Szozda & Swierczek (2008) posit that most contemporary industries have seen their product life cycles shortening. This is attributed to developments in information and communication technological

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(ICT) progress and consumer diversity. Organizations are not keeping pace with technological developments. Organizational culture, skepticism on new technology and resistance to change are some of the possible reasons why organizations are slow in adopting new technologies.
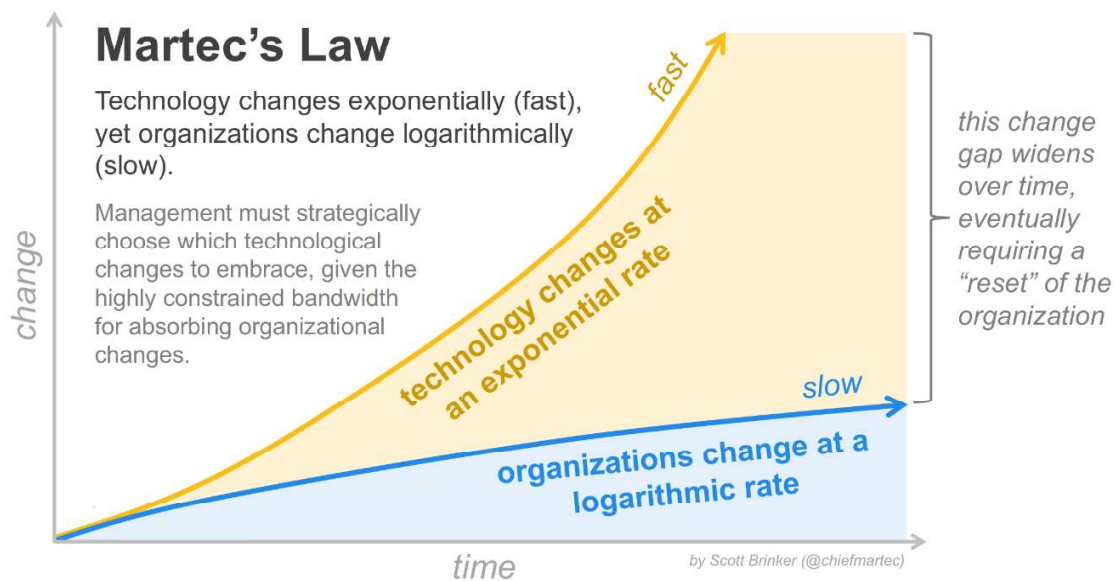
Source: chiefmartec.com

Figure 1: Martec's law

New technologies create new capabilities that organizations can leverage to solve existing business problems or pursue new and emerging opportunities. Due to slower change of organizations, there is a gap that exists between the new capabilities that a new technology creates and how organizations leverage those capabilities. Organizations can choose which capabilities to adopt and not all capabilities that a technology can enable or they may choose to do nothing. This gap grows with time and will eventually force organizations to reset.

This paper adopts the views of Martec's law that technology is changing faster compared to organizations' adoption of technology. However, the reset is slightly different. As the gap between technological and organizational change continue to grow, business offerings become irrelevant to the needs of their customers. This means that the products or services a firm is offering will lose demand forcing the firm to reset. Reset would mean a firm closes business and ceases to exist or the business is sold to more agile firms. In the recent past, there are a number of firms that have

been forced to reset, simply because they were too slow to adopt the new capabilities that new technologies created. Some of the well-known companies that have had to reset include Kodak, Myspace, and Nokia. These companies have one thing in common; they were once market leaders but due to their slow adoption of technologies, they lost business.

2.2 Digital technologies for tax administration

2.2.1 Blockchain technology

Almunia & Rodriguez (2015) show that in advanced economies tax compliance remains high even when tax audit frequency is low. This has been attributed to availability of third-party information Kleven, Kreiner, and Saez (2015). Almunia & Rodriguez (2015) show that availability of third party information and possibility of tracing transactions for large corporations encourages firms to be tax compliant. However, for small firms whose transactions are not easy to monitor are lesser compliant. This means that there is a relationship between traceability and tax compliance. Sung, Awasthi, & Lee (2017) give evidence that the most challenging areas in tax administration is the B2C transactions monitoring. B2B transactions can be traced through tax invoices however B2C transactions that involve huge cash sales transactions are more hard to trace. This could be an indicator that small and medium enterprises (SMEs) are more likely to be lesser compliant compared to big firms. The challenges of traceability of tax transactions, management of B2C business and on-going digital transformation require immediate attention by tax administrations to improve compliance and efficiency in tax administration.

Gartner (2018) defines blockchain *"as an expanding list of cryptographically signed, irrevocable transactional records shared by all participants in a network."* Blockchain has various applications in both the public and private sector. Blockchain technology has been integrated in government processes in Britain to minimize fraud and erroneous claims, Center for technology & global affairs (2017). In Sweden, blockchain is being used to support real estate transactions, in Japan the government is planning to deploy a blockchain backed tender processing, China has started using blockchain to issue tax invoices and collect taxes, while the United States (US) intends to integrate blockchain into contract bidding Center for technology & global affairs (2017). In the private sector, blockchain has been used in the banking sector Iansiti & Lakhani (2017),

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insurance, and supply chain IBM Institute for Business Value (2016). How can blockchain be applied to solve the challenges of traceability of transactions?

PWC (2017) published a report summarizing a joint technology and tax experts' views on the potential of blockchain to transform tax administration. Blockchain *"… has the ability to deliver real-time, reliable information to a wide group of people, and create a system where both taxpayers and tax authorities have equal confidence in the veracity of the data collected. It could make it easier for people to pay tax and for governments to narrow the tax gap"* PWC (2017). This statement highlights the potential of blockchain to transform tax administration by improving visibility of data flows, the quality of data transmitted to tax agencies, enhancing transparency in tax administration, lowering cost of tax administration as well as growing tax base. With this enhanced transparency and verifiability of transactions both taxpayers and tax agencies are expected to benefit a lot. Tax agencies are to benefit through reduced cost of tax administration, growth of tax payer base, improved taxpayer compliance, and relationship building with taxpayers. Taxpayers will benefit through reduced tax burden as a result of growing tax base, improved visibility of tax assessment, and better understanding of tax assessments.

2.2.2 IoT and Analytics

Gartner (2018) predicts that by 2020 95% of new electronics designs will incorporate Internet of Things (IoT) technology at a negligible cost. IoT is a technology that enables physical objects to exchange information, sense or have a capability to interact with its internal state or external environment Gartner (2018). Lee &Lee (2015) have categorized IoT applications into three: monitoring and control which collect data on device performance, energy usage or environmental conditions, big data and business analytics which generate data that is transmitted to analytics tools to support decision making, and information sharing and collaboration applications that enable exchange of information.

Deloitte show that linking IoT with blockchain will result in a transformative force that enhances efficiency and audit of transactions (traceability). IoT devices play a very important role of bridging the divide between physical and digital by facilitating collection of data from real objects and transmitting it through a network to a predefined place Deloitte. The IoT infrastructure will be required to operationalize this model and includes sensors and things that have a capability to

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create data sets and connectivity capabilities that enable machine-to-machine communication. Connectivity includes networks, gateways, data storage, data exchange protocol and data formats Deloitte. The IoT infrastructure includes both hardware, networks and software. The following diagram summarizes the IoT infrastructure as adopted from Deloitte.
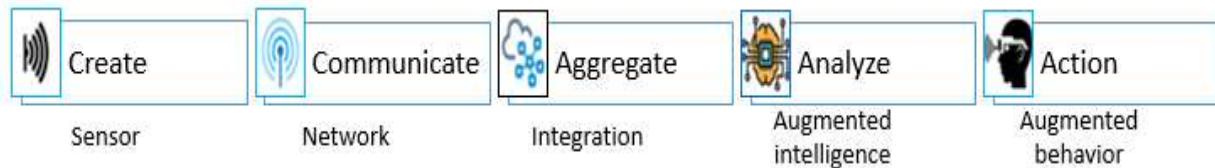
Figure 2: IoT Infrastructure (Source: Adapted from Deloitte)

Sensors are embedded to things and are able to create and transmit data from one machine to another via a network. This machine to machine communication may cause a chain of events to occur and its infrastructure includes both hardware and software. The data created by the sensors is aggregated with other relevant data for analysis to be executed. The aggregated data is analyzed to generate actionable insights that may be executed by another machine or an output for human decision makers Deloitte. This processes can be automated to improve efficiency.

Bhuvaneswari & Porkodi (2014) posit that IoT enables devices to access information that has been aggregated by other things and therefore plays a very critical role in convergence and communication. The application of IoT is varied and cuts across many industries impacting a full spectrum of our daily lives. IoT applications in smart cities creates new capability including monitoring of vehicles, parking spaces, adaptive street lighting, waste management among others Bhuvaneswari & Porkodi (2014). In agriculture, IoT has been be used to monitor moisture, pressure variations in pipes, and presence of pests. In retail and logistics, IoT has been used in tracking products, automatic check-out, and re-stocking of products in the shelves. In health care, IoT has been used for automatic data collection, improved monitoring, remote monitoring and care of patients and better planning Bhuvaneswari & Porkodi (2014). In addition, IoT has created a new capability to capture data about a patient's daily activities enabling hospitals to personalize patient care Lee &Lee (2015). Other IoT applications include security and emergencies, homes, offices, factories, human McKinsey (2015).

Gartner (2018) has define advanced analytics as

".... the autonomous or semi-autonomous examination of data or content using sophisticated techniques and tools, typically beyond those of traditional business intelligence (BI), to discover deeper insights, make predictions, or generate recommendations. Advanced analytic techniques include those such as data/text mining, machine learning, pattern matching, forecasting, visualization, semantic analysis, sentiment analysis, network and cluster analysis, multivariate statistics, graph analysis, simulation, complex event processing, neural networks".

Digital economy makes it easier for companies to generate data or gather it from other platforms including social media. But this data will not create new value to organizations unless it is analyzed to identify deeper insights, trends and patterns. The NVP (2018) survey of approximately 60 leading firms in the United States America show that the importance of analytics is on a steep rise. 84.8% of respondents indicated that they had a data responsibility role with chief data officer accounting for 55.6%. The key role of this position is data initiatives including ensuring quality data is created. Analytics will deliver best results when the quality of data is at its best. The best way to ensure quality data is available is to control how data is created Berkooz (2017).

NVP (2018) report show that executives perceive as a serious threat organizations leveraging data to drive their strategy. This is a clear indicator of the power of analytics to drive new disruptions and innovation. Additionally, the report show that 48.5% of executives see people and change as the key barriers to organizations becoming data-driven while 57.5% of the executives identify organizational culture as a barrier to being data-driven while processes account for 32.4%. The NVP (2018) report show that 97.2% of firms are investing in big data and artificial intelligence initiatives. Respondents said that their top objective in investing in big data was advanced analytics that would support decision making. 84.1% of the firms have already invested in this objective. Analytics creates new value where data is analyzed to identify trends and patterns, make recommendations or support decision making. Availability of data that is not analyzed will not yield much benefit to an organization unless the organization plans to monetize its data.

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2.3 Convergence of technologies in tax administration

2.3.1 New capabilities created

Technological development means new capabilities are created. Businesses have existing problems and challenges that are well known and management will strategically focus on ways to minimize the negative impact of these problems and challenges. Some of the business problems and challenges may occur because there is no available technological capability to solve the problem. As technology continue to be discovered and evolve, new capabilities are created. These new capabilities have the potential to solve some of the existing business problems and probably create new challenges. As an example, let's look at how connectivity enabled by internet has changed how businesses operate and interact with their customers.

Traditionally, businesses required physical facilities where customers would come to buy a good or service. This is what is referred to as brick-and-mortar business models. This changed in 1990's when the first e-commerce company was started, leveraging internet connectivity. Businesses started to sell products without necessarily having a physical store, a new capability enabled by technology. Today, businesses have moved from selling physical products to selling digital products. The sale of music relied on physical compact disks and distribution was relatively slow. Today, sale of music does not require any physical product but only some bytes of data. Distribution has been simplified and even faster, a new capability enabled by connectivity. Customers can review the music, like or dislike music, and share music file with their friends. These new interactions with digital products can encourage new potential customers to buy a product or otherwise. The new capabilities enabled by technological development have created new issues including data security and privacy. However, although new technologies create new capabilities, businesses can choose to adopt the technology and innovate their business models to leverage the technology or they can choose to do nothing.

Blockchain technology creates new capabilities that tax agencies can leverage to solve some of the existing challenges. Traceability of transactions has a great impact in taxpayer compliance. Blockchain ensures transparency and creates improved visibility of transactions between the parties. In tax administration, blockchain will improve data veracity and integrity. It also enables new value creation by facilitating new collaborations between stakeholders involved in tax

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administration. IoT will act as a link between the physical and the digital. Data captured at the taxpayer's point of sale will need to be transmitted to tax agencies secure servers on a real-time basis. IoT will create a new capability by ensuring that the data captured at the point of sale is transmitted to the tax agencies servers in a secure and trusted methods. IoT can have geolocation capability that will be useful in taxpayer registration. By embedding virtual assistance functionality in the IoT device, tax agencies can create new value by developing content that will be useful for taxpayer education. Analytics will be useful to ensure that the new data collected from the taxpayers is aggregated and analyzed for deeper insights, trends and patterns. The knowledge gathered from this analysis will be useful to understand areas where taxpayers need more capacity development, areas where compliance is low, density of taxpayers per region as well as areas where a new support office should be established.

Table 1: New capabilities for tax administration

Technology	New capability for tax administration
Blockchain	Traceability Veracity of data Visibility Collaborations
IoT	Real-time data transmission New scope of data Virtual assistance (taxpayer education) Taxpayer registration Remote monitoring
Analytics	Intelligence Insights Trends and patterns

2.3.2 Tax ecosystem: New business model

Technology creates new capabilities that can solve existing business problems and challenges. However, for the new capabilities to be applied to solve the existing problems and challenges, businesses have to develop new business model or innovate their existing business model. For tax agencies to leverage these new capabilities, their existing business models have to be changed. Dominik, Schattona, Bauernhansl (2016) show that digital transformation brings firms closer and that the level of interactions between these firms ensures they continue to coexist. Tax agencies interact with a number of firms as they seek to assess and collect taxes. Some of the key organizations that tax agencies interact with include the legislative body, partner government agencies, banks, international institutions, police, and a number of local businesses. This means tax agencies operations and interactions with other organizations can be classified as an ecosystem. Moore (2006) defines an ecosystem as a plan clarifying how contributions in the system are modularized and which firms provides what into the ecosystem. This means that organizations in an ecosystem should not think solely of their own value but have a broad view of the ecosystem

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as a whole Dominik, Schattona, Bauernhansl (2016). To clarify why tax agencies should operate as ecosystems, let's focus on how digitization affects the whole business environment.

Digital transformation leverages networks effects which enhances value creation when organizations work together collaboratively. This mode of operation affects firm's strategy and due to openness in the ecosystem, operational advantages begin to shrink Dominik, Schattona, Bauernhansl (2016). The power of digital transformation is experienced both at the business model, strategy and in the business collaborations (ecosystem). Digitalization creates new tools and technologies that alter how value is created and thus affecting the business model. It also creates new competencies, and products and therefore affecting organization's strategy. Finally, digitalization creates network effects and collaborations that works well in an ecosystem.
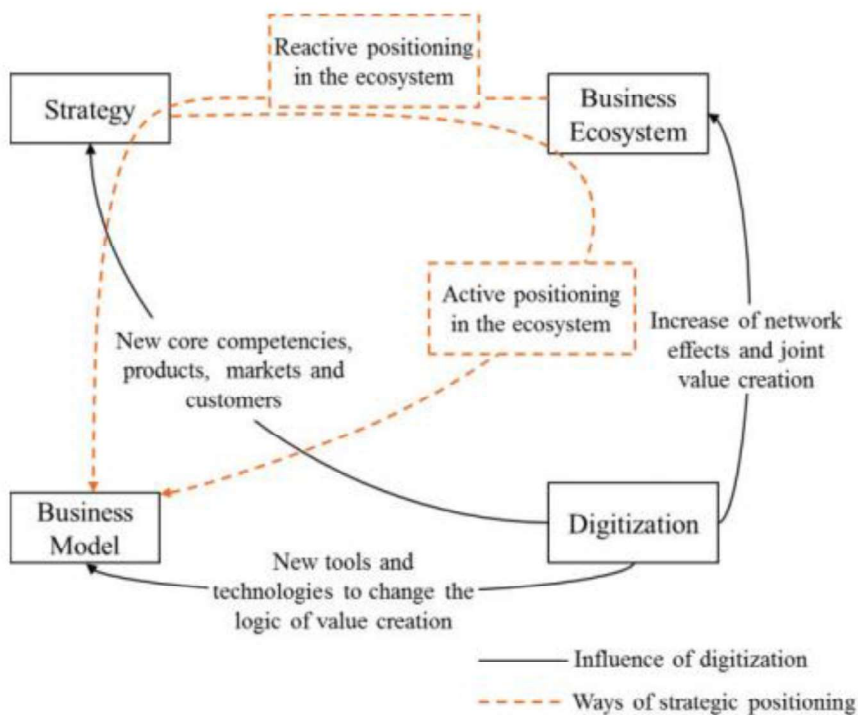

Figure 3: Digitization effects on business

Source: Dominik, Schattona, Bauernhansl (2016).

The role played by tax agencies requires a closer interaction with all parties in the ecosystem. Taxes collected by the tax agencies is used to fund the public expenditure. The government uses

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taxes to build infrastructure, provide security, ensure public health centers have facilities and medicine and this is for the benefit of both the businesses and citizens. Tax agency and the taxpayers interact often. The health of these interactions ensure the survival of firms in an ecosystem. Marco & Levien (2004) identify four types of strategies in an ecosystem; keystone which acts as a hub, niche which specializes in unique content to the ecosystem, commodity, and physical dominator. If tax agencies changed their style to operate as an ecosystem, the best model will require a platform that would facilitate faster and efficient interactions. The result will be new value creation, reduced cost of tax administration, veracity of data, transparency, taxpayer visibility, and increased relationship building within the ecosystem. Blockchain will create new value by ensuring transactions are immutable and traceability issue will be solved.

Data captured at the business premises will be transmitted to the tax agency's servers. This will require an IoT enabled tax register (Smart Tax Register [STR]) that can automatically record and transmit data in a secure method to the tax agency server. To achieve taxpayer base expansion, each building will be required to submit an approved building plan clearly indicating the available spaces in that building. Issuance of STR will be mapped to a specific building space. This will ensure that tax agency can remotely monitor which office spaces have no STR issued and possibly conduct periodic compliance checks to ensure there is no business operating without STR. The STR will be linked to the point of sale system to ensure every transaction is transmitted to the tax agency servers ensuring every transaction is traceable. New business starting in every facility becomes an active taxpayer at issuance of the STR. The data transmitted by the STR will be wide enough to ensure that business expenses including rent or lease, as well as third-party data is captured and transmitted alongside sales and purchase data. The data transmitted from the STR will be pushed into a permissioned blockchain ensuring that transactions are aggregated and tracked.

Data transmitted to the tax agency servers will be analyzed for deep insights, trends and patterns. Compliance checks can be automated to verify who has paid correct taxes and who needs to pay additional taxes. The analysis results should generate actionable results that will enable tax agencies to rely on intelligence in tax administration. The analysis would incorporate both transactional data (purchases and sales), customs data (import and export) and third-party

information. With this increased traceability of transactions, compliance levels are expected to improve, revenue growth will be realized, and taxpayer visibility will be achieved. The STR model is summarized below.
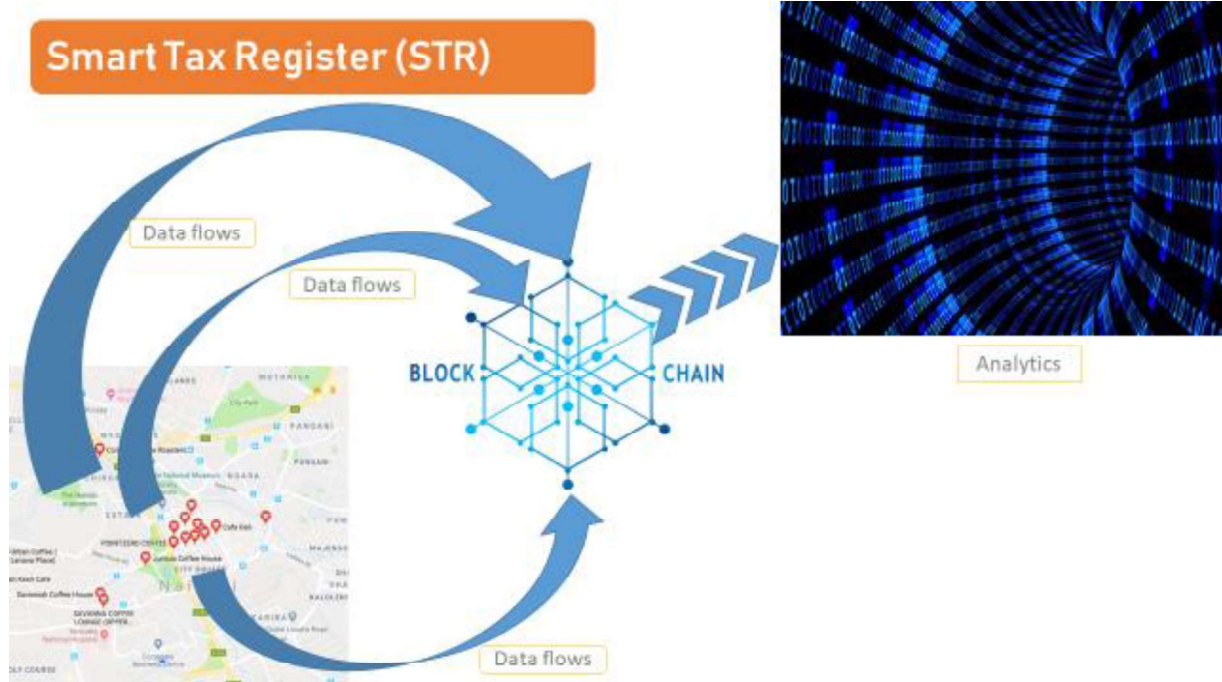

Figure 4: Smart Tax Register model

3.0 Conclusion

This paper provides a highlight of how convergence of blockchain, IoT, and analytics could lead to digital transformation of tax administration. Each of these three technologies provides new capabilities that tax agencies can leverage to improve efficiency, achieve better traceability of transactions, and facilitate taxpayer compliance. To leverage new technology capabilities, tax agencies have to innovate their business models and align then to digital transformation. Digital transformation will require a complete change of tax administration processes, people and organizational culture. To achieve this transformation, tax agencies have to invest in change management, process reengineering, change of legislation, form new collaborations, and possibly re-organization to address organizations culture. Although organizations can choose not to adopt

technology, tax agencies may find themselves unable to collect expected government revenue or the cost of tax administration will be too high for them.

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